Some Complications of Chronic Suppuration in the Middle Ear

by

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I hereby certify that the accompanying thesis entitled "Some complications of chronic suppuration in the Middle Ear" has been entirely composed by myself.

J. Curtis Wayte
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Some Complications of Chronic Suppuration in the Middle Ear.

Introductory remarks.

It is not proposed to deal in this paper with every complication which may arise in the course of chronic suppuration of the middle ear --- with such complications as polypi and granulations, cholesteroloma and facial paralysis. The scope of the paper will be limited to the consideration of mastoid suppuration, meningitis, infective sinus thrombosis, and cerebral and cerebellar abscess. The intention is to set forth the present state of knowledge regarding these maladies; to collate the opinions of the chief authorities thereon. The importance of the subject has long been recognised, though from the Middle Ages down almost to the present day, the importance of the most skilful
surgeon to deal with intra-cranial complications of ear-disease was accepted as an indisputable fact. Thirty or forty years ago the treatment had not advanced beyond the application of leeches and fomentations, and the administering of purgatives. Of late, however, the treatment has shared in the recent wonderful development of surgical knowledge and skill, and one result of the introduction of antiseptics has been the inclusion of operations on the cranial cavity among the recognised procedures of surgery.

For centuries it was held that no operations were permissible in cases of intra-cranial disease. Then in recent years the treatment passed into a second stage, and the surgeon, it was agreed, was justified in operating when the localising symptoms
gave a guide to the seat of the lesion. A third stage in the treatment is foreshadowed by Professor Annandale in a paper on intra-cranial surgery in The Edinburgh Medical Journal for April 1894. "The cavity of the cranium," he remarks, "has not as yet been so freely treated upon this principle (i.e. the principle of exploratory operations) as other cavities, but I believe that in the future surgeons will explore this cavity more frequently." He goes on to say: "It has usually been a recognised principle that the cranial cavity should not be opened into by the surgeon unless the history or special symptoms of the case pointed to some condition which experience has shown may be remediable by such procedure, but I am of opinion that in certain cases the surgeon is justified in
departing from this principle and operating when such guides do not exist."

While the treatment has thus made a remarkable advance during recent years, middle ear disease is still in many quarters apt to be regarded too lightly. Of its gravity, when long continued, there can be no question. In treating of the disease Professor Maclean ("Pepro-
genic Diseases of the Brain and Spinal Cord") declares that a person with chronic suppuration in the mastoid antrum and cells might as well have these filled with a charge of dynamite, as there is no knowing when circumstances may arise to disseminate the infective matter over the entire cerebro-spinal system.

It has been estimated (Dr. F. Williams, Brit. Med. Journ., Nov., 1888)
that 50 per cent. of the cases of cerebral abscess are due to outstanding ear disease. And the late Dr. Hilton Fagge (Principles and Practice of Medicine) gave it as his opinion that otitis media is prolonged, involved such risk of extension of mischief through the bone to the internal surface of the skull, that a person affected with it should never be taken for life assurance at ordinary rates.

Before surveying the existing theories and methods of practice in connection with the subject, it will be well to consider the anatomy of the parts involved. It will not, however, be necessary to enter minutely into the aural anatomy, as in the following pages the middle ear will be considered not as a part of the organ of hearing, but simply as
a cavity in which certain pathological processes may occur and lead to disease in neighbouring structures. This being the case there will only be described briefly, the position and relations of the tympanum and the various parts in connection with, or in relationship to it.

An accurate knowledge of the anatomy of these is of the utmost importance, for it not only renders clear how pathological processes extend from the tympanum to the neighbouring parts, but is simply indispensable to the surgeon in carrying out safely and efficiently the various operations which are practised in this region.

**Anatomy**

The Tympanum: This is a small, irregularly-shaped cavity, situated in the petrous portion of the
temporal bone. It is compressed from side to side its anteroposterior and vertical diameters being greater than its transverse. Its long axis is anteroposterior and measures about 13 mm. Its width transversely is greater above than below, in the former position measuring about 4 mm, whereas the floor, as it is called, (formed by the junction of the outer and inner walls) is very narrow. Thus in transverse section the tympanic cavity would appear wedge-shaped.

The cavity is usually described as possessing six walls, (though these are not as clearly defined) viz.: (1) an upper wall or roof; (2) a lower wall or floor; (3) an outer wall; (4) an inner wall; (5) an anterior wall; and (6) a posterior wall. Politzer (Text Book of the Diseases of the Ear) points out that these names are not in
Keeping with the actual positions of the walls, as the direction of the tympanic cavity from above downwards is not perpendicular, but extends in an oblique direction downwards and inwards towards the middle line. Thus the so-called outer wall is really exterior-inferior, the interior wall, interior-superior, and so on with the others. 3. The roof or tegmen tympani as it is also called, is an exceedingly thin plate of bone separating the tympanic cavity from the middle cerebral fossa of the skull. Defect in the bone sometimes occur in this wall, occupied by a membrane which is thus the only structure separating the chorda mala from the cavity of the middle ear. These defects are probably due to arrested development, and the process has been called by the term spontaneous dehiscence.
In shape the upper wall is roughly triangular, and besides covering the tympanum it extends backwards and forms a roof to the mastoid antrum (the tegmen antri). On the outer side the roof is bounded by the petro-squamous suture, which is usually obliterated by the end of the first year of life, (Symeington. Topographical Anatomy of the Child.) But may remain unossified for a longer period, so that soft parts only are interposed between the brain and tympanic cavity. A ready channel is thus formed for the passage of infective processes to the brain and meninges. Even in after life this may occur, as the course of the fissure in the adult is still marked by minute foramina for the passage of veins.

(2) The floor, which is very nar-
now, as before mentioned, by the meeting of the outer and inner walls. As it lies below the level of both the membranous tympanum and the Eustachian tube, it may become a receptacle for pus for which there is no outlet. The floor separates the cavity of the tympanum from the internal carotid artery in front and from the internal jugular vein behind.

(3) The outer wall is partly formed by bone, but consists chiefly of the membranous tympanum. In the osseous part which forms the lower portion of this wall are seen the apertures of entrance and exit of the chorda tympani nerve, which thus passing through the tympanic cavity may readily be implicated in middle ear disease.

(4) The inner wall, which lies nearest to the internal ear
presents on its surface the following features:—(a). The fenestra ovalis leading to the vestibule and occupied by a membrane and the base of the stapes. (b). The fenestra rotunda situated below the fenestra ovalis and also filled by a membrane and communicating with the scala tympani of the Cochlea. (c). The pyramid situated between the fenestra rotunda and the fenestra ovalis. At the apex of the pyramid is a tunnel opening for the passage of the tendon of the stapedius muscle and the small nerve for the same from the facial. (d). The promontory, formed by the first turn of the Cochlea, is situated between, and a little in front of, the two fenestral. (e). Above and slightly behind the fenestra ovalis, occupying a position between the latter and the roof of the tympanum, is a
slightly rounded concavine, forming part of the Fallopian canal in which the facial nerve is lodged.

(5). The anterior wall is formed by an oblique irregular plate of bone, lying in close relation to the carotid canal. Two openings are seen in this wall, the larger and lower being the tympanic end of the Eustachian tube, the smaller and upper the canal for the tensor tympani muscle. These are separated from each other by the processus cochleariformis.

(6). The posterior wall rises abruptly from the floor of the tympanum. At its upper part there is an irregular triangular aperture leading to the mastoid antrum; each side of which aperture measures about 4 mm. The posterior and upper part of the tympanum
into which this opens is called the tympanic attic. In some cases the posterior wall is perforated by a number of smaller openings which lead directly to the mastoid cells.

**Vascular supply of the Tympanum**

**Arteries.** The following are the principal arteries entering the tympanic cavity: (2). The tympanic branch of the internal maxillary which enters by the Glaserian fissure and is distributed to the anterior part of the tympanum. (2). The stylo-mastoid branch of the posterior auricular, which passes through the Aqueductus Facialis and besides supplying the posterior part of the tympanum sends off twigs to the mastoid cells. (3). One or more auricular branches from the internal carotid as it lies in the carotid canal. (4). The petrosal and tympanic
branches of the middle meningeal which enter by the hiatus Fallopii, and petro-squamosal fissure respectively. (5). The minute tympanic branch of the ascending pharyngeal which supplies the inner wall of the tympanum.

Veins. These may be arranged in three principal groups:-
(1). Those opening into the lateral sinus. (2). Those running through the mastoid foramen and communicating with the occipital and other veins of the scalp. (3). A set passing through the petro-squamosal suture and joining the veins of the dura mater.

Through any of these veins inflammatory or septic processes in the tympanum may extend to (1). the lateral sinus in which they cause thrombosis; (2). to the scalp producing periduritis; and (3). to the dura mater giving
rise to meningitis or cerebral abscess.

Nerves of the Tympanum.

It is not necessary in this paper to give a description of the various nerves in connection with the tympanic cavity, as such would have no practical bearing on the subject under consideration. An exception, however, must be made in the case of that part of the facial nerve which is contained in the Aqueductus Fallopii, not because it is intended to discuss the subject of facial paralysis due to middle-ear disease, but because the position of this part of its course renders it extremely liable to injury during operations on the middle or mastoid antrum. An accurate knowledge of this nerve's position is thus of importance as enabling the
surgeon to avoid it when operating in these regions.

The **Auditory Fallopian** begins

in the nictitans auditory 

meatus above the cribriform 

plate where the auditory nerve 

enters the labyrinth. It then 

passes outwards in the substance 

of the petrous bone above the 

vestibule, and reaching the 

inner wall of the tympanic 

takes a knee-like bend, and 

runs in an oblique direction 

downwards and outwards 

along the inner wall of the 

tympanic cavity, passing 

between the foramen ovale and 

the tympanic roof, in which 

last position it may be seen 

as a slight projection. In this 

part of its course it crosses the 

passage connecting the tympanum 

and mastoid antrum, where it 

may occasionally be seen as 

a distinct ridge of bone on the floor.
of this passage. After having described this irregular course the canal takes another bend and runs in a fairly straight line downwards to the stylo-mastoid foramen where it ends. The bone forming the walls of the facial canal is harder and denser than the surrounding osseous tissue. This increased density not only protects the nerve but serves as a guide to the position of the canal. In some cases where the surrounding bone is destroyed, this denser bone may escape the pathological process, and so protect the facial nerve. Where, however, as the result of disease, the entire bone is more or less sclerosed, no such difference in structure as the above can be detected.

In that portion of the wall of the canal which runs between the foramen ovale and the tympano-
unic roof, the bone, in the newly born infant, is very thin or even entirely wanting, thus rendering the spread of disease to the nerve very easy. A similar condition, due to arrested development, is occasionally met with in the adult and may lead to similar results.

The mastoid antrum is situated posteriorly to the facial canal, the descending part of which runs down in a line with the inner wall of the antrum-tympanic passage. Therefore in operating, the surgeon must keep to the outer wall of this passage, and in exposing the mastoid antrum the higher and closer to the posterior zygomatic ridge he makes the opening, the less risk he will run of injuring the facial nerve. Besides its connection with the tympanum the Aqueductus facialis communicates by means
of the internal auditory meatus with the posterior cranial fossa. It also communicates with the middle cranial fossa by means of the hiatus Fallopii and a smaller hiatus in front of this, these respectively transmitting the greater and lesser superficial nerves. Along any of these paths infective processes may pass from the tympanum to the membranes and brain, and hence set up meningitis, or abscess.

Mastoid process, auricles and cells. The mastoid process as we are familiar with it in the adult, has no existence in foetal and infant life. About the second year, however, it becomes recognisable, and from this time steadily increases in size.

Dr. Cunningham has pointed out (Topog. Anat. of Child) that in young children the mastoid
contains no air cells such as one met with in the adult. It, however, always contains a cavity, the mastoid antrum — lined by mucous membrane continuous with that of the tympanic cavity.

The antrum communicates by means of a passage with the attic of the tympanum. Until puberty, the mastoid process consists of finely cancellous bone, but after that period the air cells proper become developed by a process of absorption. In some cases the air cells are imperfectly developed and may even be entirely absent, the bone being dense and containing only a few canaliculi. This denseness and absence of air cells is often quite normal and not necessarily the result of chronic inflammation.

(From Aethmoid Sinus. Archives of Otolaryngology, April 1892.)
In all cases, however, the feature which never varies is the mastoid antrum which is constantly present in both the child and the adult. According to Politzer (Text Book of the Diseases of the Ear) there are three types of the mastoid process: (1) the pneumatic; (2) the diploëtic; and (3) a combination of the two or mixed form. 03. The pneumatic form is composed of a large number of irregular cellular spaces penetrating the temporal bone in all directions. They extend backwards as far as the occipital bone in which there are occasionally cellular spaces communicating with those of the mastoid. They surround the lateral sinus and extend downwards to the apex of the mastoid process and forwards as far as the root of the zygoma and encircle the auditory meatus. (2). The diploëtic
from consisting of small-celled diploë and osteous tissue, and only occasionally possessing well-marked air cells, which when present are seen chiefly in the vicinity of the mastoid antrum. (3). The united form which is partially pneumatic and partially diploëtic, the commonest variety being that in which the lower portion is diploëtic and the upper part pneumatic in texture. The Mastoid Cells. Some of these cells communicate directly with the posterior part of the tympanum, but the majority open into the mastoid antrum. They are lined by prolongations of the mucous membrane of the antrum and tympanic cavity. The posterior cells are only separated by a thin layer of bone from the sigmoïd sinuses, and this layer at times exhibits gaps filled in by membrane. This osteous partition is
perforated by minute foramina which transmit vessels from the antrum to the squamous sinus.

The mastoid antrum. H. A. Lane (Archives of Otolaryngology, April 1892) has demonstrated that this cavity known as the mastoid antrum is really situated in the petrous bone, and is anatomically a part of the middle ear, having therefore no relationship with the mastoid process further than the fact that some of the small cells of the latter open into it. In size the antrum varies from that of a small pea to that of a bean. It lies behind the tympanum and communicates by a passage with the tympanic attic. The antral floor usually lies below the level of this passage. Through drainage into the middle ear is thereby prevented, and fluid lodging in the antrum is apt to
pass into the mastoid cells. The roof of the cavity or tegmen anteri -- an exceedingly thin plate of bone, often deficient in places -- is formed by a prolongation backwards of the tegmen tympani. The cavity is only separated by a thin and at times incomplete wall of bone from the inner part of the external osseous auditory meatus. Its outer wall is composed of the descending vertical plate of the squamous. The junction between this plate and the mastoid proper is known as the masto-squamous suture. In the child this is still unossified and may remain so till puberty. In a few cases even in adult life, it may still persist, and in the cases where it has ossified, its course is still marked by numerous foramina for the passage of veins.
The inner wall of the anterior sinus lies at a variable distance from the surface of the skull, the average depth being about three quarters of an inch. The actual depth of the cavity from the surface of the skull varies at different ages and depends on the thickness of the outer wall. According to Spenrington (Fig. 1, Dissect. of the Child) in the newborn child the outer wall is from 1.52 mm thick. At five years it has increased to about 6 mm, and at nine or ten years it has reached a thickness of about 1 cm. In the adult it averages about 1.2 cm. Externally the level of the root of the maxillary antrum is indicated by the lower border of the posterior root of the zygoma. The level of the central floor corresponds in adults to a point about a quarter of an inch above
the roof of the eustachian auditory meatus; and in children to a
point from \( \frac{7}{66} \) to \( \frac{1}{6} \) of an inch
above the roof of the eustachian auditory meatus

Point at which to open the mastoid
antrum. The most suitable spot
at which to open the mastoid
antrum is towards the base of a
triangle having the following
boundaries: It is bounded above
by: (1) the posterior root of the
hypoglossal running almost horiz-
ontally; (2) below, by the upper and
posterior segment of the otic bone;
(3) by an
imaginable line joining these
two and running from the most
posterior part of the eustachian
osteon to the root of the
hypoglossal. This triangle was first
described by Professor Wallace
(Lancet, August 12th, 1893) and
(Prorogonic Diseases of the Brain
and Spinal Cord) and has been
named by him the "Supra-
meatal triangle". It can be
observed in the great majority
of skulls, and its floor is usually
marked by a depression although
occasionally it may show a
slight prominence instead. If
it cannot be recognised, then
a useful guide to the position
of the antrum may be obtained
by horizontally bisecting the
orifice of the external auditory
meatus. The opening may be
safely made in the bone im-
mediately behind the upper
half of the meatus which is
on a level with the mastoid
antrum.

The Lateral Sinuses. There are
two of these generally differing in
size, the larger one receiving the
brunt of the blood from the super-
longitudinal sinuses, the other the
chief part of the blood from the
straight sinuses (Quain's Anatomy)
The right lateral sinus is usually the larger. Each sinus passes outwards from the internal occipital protuberance, along the corresponding lateral groove in the occipital bone, to the posterior-superior angle of the parietal bone, thus forming an arch with the convexity upwards (Professor A. S. Birmingham, Dublin Journal of Medical Science, February 1891).

Having reached the parietal bone, it curves downwards in the sigmoid groove of the mastoid portion of the temporal bone, and finally turns forwards over the jugular process of the occipital bone to the jugular foramen through which it leaves the skull, and is continued on as the internal jugular vein.

That portion of the lateral sinus which is lodged in the groove on the inner surface of the mastoid is sometimes specially distinguished.
red as the sigmoid sinus. This
nomenclature will be followed
here, so that by the lateral sinus
is meant that part of the vessel
extending from the internal ac-
cipital protuberance to the posterior
superior angle of the parietal
bone, while the remainder of
the vessel from this spot to
jugular foramen is called the
sigmoid sinus.

Relations of the Lateral and Sig-
moid Sinuses to the outer surface of
the skull. The course of the lateral
sinus is indicated on the surface
of the skull by a line extending
from the external acipital pro-
tuberance to the posterior border
of the mastoid. This line is
not horizontal but forms an
arch with the convexity upwards,
the highest point of the arch being
situated about 1 1/2 inches behind
and nearly 3/4 inch above
the centre of the lower teeth.
At the posterior border of the mastoid the dura takes a bend and the remainder of it, or sigmoid dura as it is termed, runs down in front of the posterior border of the mastoid process, about half an inch behind the transverse; it then turns into the sigmoid foramen at a point about a quarter of an inch below the level of the floor of the meatus [Proc. Birmingham. Brit. Med. Soc. September 20th 1890].

The right sigmoid groove is wider and deeper than the left, and is at a rule placed more anteriorly; it thus encroaches more upon the posterior mastoid cells, and so is more apt than the left to be affected by pathological processes spreading from these.

The anterior portion of the sigmoid groove is perforated by numerous foramina for the passage of several veins from the tympanum
and mastoid cells to the sinus.

The mastoid vein and occasionally the posterior condylar vein open into the sigmoid sinus, as does also the superior petrosal sinus. The mastoid vein leaves the skull through the mastoid foramen, joins a scalp vein from the occipital region and ends in the deep cervical vein. Occasionally it joins the posterior auricular vein which ends in the external jugular.

The mastoid vein is very important as an aid to diagnosis of thrombosis of the sigmoid sinus, a point specially insisted on by Dr. W.H. Bennett (Lancet, September 9th and October 21st, 1893). He regards tenderness over the posterior part of the mastoid as pathognomonic of this condition and accounts for the tenderness on the ground that the thrombus in the sinus has extended along
the mastoid vein. He says, that in uncomplicated mastoid disease the bone may be tender, but in such cases the painful spot is situated over the central part of the mastoid and not in the region of the mastoid foramen which is much further back. The same authority holds that the fact of the vein being absent in about from 10 to 15 per cent. of persons does not lessen the diagnostic importance of this depression, as in these cases the vein is always represented by two or more smaller vessels which reach the surface in the same region, and by their thrombosis give rise to this "post-mastoid" tenderness.

This concludes the description of the anatomy, and there will now be described the various complications of chronic suppuration.
in the middle ear with which it is intended to deal in this paper. The first to be considered is suppuration in the mastoid antrum and cells.

**Mastoid Disease.**

Pathological changes in the mastoid process are among the most frequent complications of chronic suppuration in the middle ear. They may result occasionally from cold or injury which, by causing an exacerbation of the middle ear disease, may lead to complication of the mastoid, but the most frequent cause of mastoid complications is undoubtedly deficient drainage. Should this occur in the course of chronic suppuration in the middle ear, it will lead, through the increased tension to the passage backwards of pus into the antrum and cells.
This discharging of discharge may be due to a number of causes, the most frequent being a very small perforation in the membrana tympani, or a narrowing of the external meatus by the presence of polypi or granulations. The pneumatic form of mastoid process is more frequently affected by disease than either the diploëtic or compact.

**Symptoms.** In some cases symptoms pointing to mastoid disease may be entirely absent, and yet on examination the process may prove to be seriously affected. On the other hand, in the course of chronic middle ear suppuration mastoid symptoms may develop suddenly and be very intense.

The most prominent symptoms are:—Severe pain in the mastoid region of a throbbing nature, and often extending down
the neck; well marked tenderness over the upper and middle portions of the mastoid immediately behind the pinna, (Cf. "post-mastoid" tenderness occurring in sinus thrombosis); considerable rise of pulse and temperature; diffuse headache; photophobia; tinnitus; and less frequently dizziness and vomiting. The appearance of the superficial structures in the mastoid region varies. If the disease is deeply seated or the bone dense, they may be perfectly normal; but when the more superficial layers of bone are affected these structures become red and swollen, and this swelling, by spreading to the soft parts behind the cartilaginous mastoid, causes the auricle to project from the head, a symptom which is often well marked. When the above symptoms are found in a case of long standing suppuration in the
the middle ear therefore occurs simultaneously, a marked diminution in the discharge from the ear. This fact at one time led to the mistaken idea that it was harmful to stop a purulent discharge from the ear, a belief which is still prevalent among the public. This belief is due to a confusion of cause and effect, the stoppage of the discharge being due to deficient drainage, which leads to the extension of the disease backwards to the mastoid. The occurrence of this cannot be urged, however, as an argument against treatment of suppuration in the tympanum; any more blame can the occurrence of epididymitis simultaneously with the spontaneous cessation of urethral discharge be urged against the treatment of gonorrhea.

On examining the ear close
obstruction to the free flow of pus may be discovered, such as polypi or granulations, and occasionally the upper and posterior part of the maxilla is found to be swollen and tender. If the disease is left untreated, the process may extend to the surface of the bone and lead to the formation of a subperiosteal abscess in the mastoid region, or less frequently in the posterior wall of the ethmoid sinuses. The former is due to an abscess perforation of the bone, but in children the pus may find an exit in this region by the still unossified squamo-mastoid sutures. More rarely the mastoid abscess bores its way through the inner wall of the process in the region of the digastric fossa. Bezold first pointed out the serious results which might ensue from perforation of this region. When this occurs the pus
tumours either under the muscles attached to the mastoid or along the sheaths of the great vessels of the neck. In one case (George Zeitschrift für Ohrenheilkunde April 1892) the pus passed downwards behind the pharynx and formed a retro-pharyngeal abscess; and in very rare cases it has opened into the pleura and caused a pyothorax.

The diagnosis of this condition, which is known as Bezoard's disease, may be made when symptoms pointing to mastoid suppuration suddenly cease, and are followed by the development in the cervical region of a tender swelling.

At times the mastoid disease may extend upwards and open into the cranial cavity, or backwards to the sigmoid groove, producing in the first instance meningitis or sub-
dural abscess, and in the second thrombosis of the lateral sinuses. These conditions will be subsequently dealt with.

**Prognosis.** As the subjective and objective symptoms only rarely coincide with any approach to accuracy, the extent of the disease in the inflammatory process, the prognosis is very often indefinite, but in the majority of cases it must be regarded as grave. Dr. E. Budge (Diseases of the Throat, Nose and Ear) says that the danger to life is inversely proportionate to the external evidences of inflammation, as the danger from the lead affections is roughly in proportion to the amount of inward tension of the inflammatory products. Thus when external signs of sub-periosteal abscess appear, it may be assumed that the greatest pressure
is outwardly, and the risk of intra-cranial mischief is minimised. Should the inner surface of the mastoid give way the prognosis is invariably grave. When the disease spreads to the lateral sinus or cranial cavity the outlook is serious, but these conditions will be more fully discussed in subsequent sections. In adults the chief risk arises from haemorrhage. In very young children death is frequently caused by marasmus due to long continued sequestration from extensive necrosis of the bone. Naturally, the prognosis is always more favourable in healthy persons than in cachectic or tuberculous individuals.

**Treatment.** The treatment to be adopted in a case of mastoid disease will depend to a large extent upon the severity of the symptoms present.
Should there not be of a grave nature. attempt should be made to relieve them by establishing free drainage: - by 
removing polypi or granulations; by enlarging a small perforation in 
the membrana tympani and wash 
ing out the cavity of the middle ear 
by means of the mastoidian cath 
eter. Local measures may also be 
applied to the mastoid process itself, 
such as, blood letting by means of 
leeches, counter irritation with 
iodine, and the application of 
cold by means of ice-bags or 
Leiter's coil. Should these fail 
to relieve the symptoms (and 
these palliatives are of much less 
value in mastoid disease occur 
rning along chronic middle ear 
suppuration than they are in that 
from resulting acute otitis media). - 
or should a subperiosteal abscess 
form a free incision, extending 
down to the bone, must be made 
over the mastoid process. This is
known as Wilde's operation, having been first advocated by the author of that name. It consists in mak-
ing an incision extending from the base almost to the tip of the mastoid. Wilde advised that this incision should be made about half an inch behind the auricular attachment, but the Bride (Dis-
eases of the Throat, Nose & Ear) recommends it to be made only a quar-
ter of an inch behind, as in this position the wound can be more easily utilised for the opening of the mastoid antrum should this be required, and is nevertheless sufficiently far back to avoid the posterior auricular artery. Then the bone is thus exposed it should be carefully examined by means of a probe, for any fistulous opening. Should such an opening be found, and seem too narrow to admit of free drainage, it must be enlarged and the mastoid antrum and air
cells opened in a manner to be afterwards described. Wille's incision relieves pain by diminishing the tension on the outer surface of the bone, and will evacuate any subperiosteal abscess which may be present. It may also aid in the drainage of the tympanum should a fistula exist between that cavity and the surface of the bone. Politzer (Text-book of Diseases of the Ear) recommends the making of this incision only in mastoid periostitis, and those cases of mastoid trouble arising in the course of acute otitis media. He regards it of little or no use in mastoid disease due to chronic suppuration in the middle ear.

However, in all cases where the symptoms point to deep-seated abscess in the mastoid, or in those in which head symptoms interfere, some of the foregoing methods of treatment must be persevered
with; but the mastoid antrum and cells must be laid open without delay.

Indications for opening the mastoid antrum and cells.

It is due to Schwartzze that definite rules have been laid down for guidance as to the cases in which to open the mastoid antrum and cells. These rules are variously modified by other authorities, but all agree in accepting the principles broadly laid down by Schwartzze. According to that authority the following are the chief indications for operating:—(1) Recurring inflammation of the mastoid antrum and air cells, accompanied by signs of inflammation over the mastoid surface. The indication is even stronger should the pus tend to burrow down the neck, or should a fistula exist in the bone discharging pus.

2. Acute inflammation of the
mastoid autotomy and cells (even when the surface of the process appears healthy) should then appear to be obstruction to the free flow of inflammatory products from the tympanic cavity.

(3). Cases of chronic purulent discharge from the ear in which symptoms pointing to intracranial mischief occur.

(4). Long standing cases of purulent otitis media which have resisted all other treatment. In such operation may be carried out even when no evidence of retention of secretions exists, nor any signs of inflammation over the mastoid are present.

(5). Cases of intense mastoid neuralgia due to sclerosis of the bone and obliteration of the air cells. In such cases it is unnecessary to open the autotomy as a rule, the removal of a large portion from the surface being sufficient.
Methods of Operating.

In all operations on the mastoid, the object of which is free drainage, the point to be aimed at is the antrum and not merely the mastoid cells. These, as has been shown by Dr. Arbuthnot Lane (Brit. Med. Jour., March 29th, 1890) may be perfectly free from disease while the antral cavity is filled with pus in its foulest condition. Although the various methods of operating have the same object in view — viz. laying open the antrum and air cells and to establishing free drainage — they nevertheless differ in details in the hands of various surgeons both in the character and extent of the operation and in the instruments used in carrying it out. As regards the choice of instruments, Wacewan (Op. Cit.) recommends the rotary bur driven by a surgical engine.
he object to the chisel and mallet on the grounds that the chisel cannot be guided with exactness, and in consequence important structures, such as the bony sinus or facial nerve may be unintentionally injured. He holds that the vibration due to the repeated blows of the hammer may cause a fracture of the tegmen tympani and so allow pus to invade the cranial cavity; he likewise believes that the vibration may lead to a cerebral abscess rupturing into the lateral ventricles. He maintains that while the chisel produces a rough aperture, that made by the bur is smooth, and so facilitates dressing of the wound. Mr. Bride (Op. Cit.) on the other hand, advocates the use of the chisel or gouge and mallet, on the ground that the objections to them are entirely theoretical. Mr. A. Lane (Archives of Otology. April 1892) also approves of
these instruments, which are also recommended by Politzer (Op. Cit.)—
and speaks of the sphenine, which
Jackson (Operations of Surgery)
advocates, as "a clumsy and
unsuitable instrument." Dr.
Black (Lancet, May 20th 1892)
uses an ordinary pinilet until
he has reached the auricular, after
which he enlarges the opening
by means of a cone-shaped
bur. From the above it would
appear to be a matter of custom
which form of instrument is ad-
opted, each giving good results
in the hands of those accustomed
to use it.

The usual method of operating
is that advocated by Schwartzs
and generally known by his
name. This method is carried
out as follows:— Through different
surgeons make alterations as re-
gards details. The scalp for some
distance around the area of op-
eration should be shaved, and
having been thoroughly cleansed by
means of soap and water, turpen-
tine and methylated spirit,
should be covered for several hours
before the operation with a wet
dressing of lint soaked in carbolic
lotion (1:500). The patient having
been anaesthetised, an incision
is made about a quarter of an
inch behind the posterior border
of the external meatus, extending
from the posterior root of the tyg-
oma above, to within about a third
of an inch of the tip of the mastoid
below. This incision should div-
ide the soft parts down to the bone.
Then, including the periosteum,
should then be raised by means
of an elevator, and the whole of
the post-auricular attachments
pushed forward, so as to lay
bare the posterior aspect of the
external auditory meatus.
All bleeding is now stopped
by means of forceps or ligature and the surface of the mastoid carfully examined. If a fistula is found, then a probe may be introduced into it as a guide to its direction, and the fistula carfully enlarged and followed inwards till the mastoid ant
trum is opened. Should no such fistula exist, then different authorities give different guides as to where the opening into the ant trium should be made.

Macnaghten Jones (Lancer, March 5th, 1892) gives as the point to open the mastoid ant rnum at a spot ½ or 1 inch above, and the same distance behind the superior margin of the external osseous canalis. Probably the best guide is that given by Ulceman (Op. Cit). According to him when the bone is exposed as above described, the following points are to be noted:

The boundaries of the "supra-" mental
triangle” (see section on Anatomy) formed by the posterior tympanic root above, the posterior segment of the external acoustic meatus below, and an imaginary line running from the most posterior part of the tympanic root to the most posterior part of the meatus. "Within this triangle and touching its base the opening into the mastoid antrum may be made with safety." The triangle being defined (and in nearly all skulls it is marked by a depression) the operator proceeds to open the mastoid antrum, the perforation being directed inwards, and at the same time forwards and slightly downwards. By so doing the risk of injuring the sigmoid sinus is reduced to a minimum. After proceeding in this direction for a variable distance the antrum as a rule is opened, being situated in
admits at a depth of from \( \frac{3}{14} \) to \( \frac{5}{12} \) of an inch. In children as a rule the Lies fairly near the surface. In old standing cases of mixed disease in adults the bone may be much thickened owing to hypertrophic sclerosis which likewise encroaches on the aural cavity, rendering it small and deeply placed and in some cases even obliterating it entirely. Should the surgeon not reach the aural cavity after having penetrated to the depth of half an inch, great care must be exercised to avoid injuring the facial nerve or labyrinth. This may best be effected by keeping close to the posterio-superior angle of the infratemporal triangle. Macewan further advises, so as to lessen this risk, that an assistant be placed to watch for any twitchings of the facial muscles, such
twitchings, indicating that the operator is working in close proximity to the nerve. Another guide to the facial canal is the fact already mentioned, that the bone forming its walls is very dense compared to the surrounding tissue; but this does not hold good in the cases in which sclerotics is present.

When once the antrum is opened, H. A. Lane (Brit. Med. Jour. June 28, 1870) advises a probe to be passed through the opening between it and the middle ear, and holds that any portion of bone lying external to the probe can be removed without danger to the nerve. When the antral cavity has been opened, a sharp spoon may be employed to remove granulations, cholesteatomatous masses, or carious debris, and any pus gently surged out with an antiseptic solution. After this has been done, the antral
roof must be carefully examined for any erosions through which the cranial cavity might have become affected, and which might necessitate further operative interference in this direction.

Laying open the Antonius may complete the operation, but in some cases this is not enough, and both the mastoid cells and tympanic attic may require to be exposed.

Should the mastoid cells be diseased they are best opened by working downwards and backwards from the Antonius, keeping in mind the close proximity of the masto-posterior cells to the sigmoid sinus. When the condition of the middle ear warrants the opening of the tympanic attic, this can be best accomplished by working through the junction of the outer wall and roof of the antro-tympanal passage, as the encroachment either upon its inner wall or
floor the facial nerve is endangered.

Should the malleus and incus then be found to be diseased, they should be removed along with all pus and granulation tissue; but wherever it is possible the stapes should be left, as otherwise hearing will be much impaired, whereas when the stapes is left in situ hearing remains fairly good. Lane advises the patient, after the operation, to wear one of Franz Coussin's artificial membranes, not only to improve the hearing power but to prevent the entrance of cold air. In removing the malleus and incus the chorda tympani nerve is almost necessarily destroyed, which is followed by loss of taste in the anterior two thirds of the tongue on the same side. When the operation has been thus completed, the wound should be gently sprinkled out with some antisepctic solution,
which should escape from the external ear and bring with it any pus and debris which may remain. The dressing should always be done from the wound and not from the ear, as in the latter case putrid material might be carried from the ear to the surface of the wound and infect it. After this stage has been reached authorities differ as to the form of dressing to be applied. Some (Politzer) stuff the wound tightly with iodoform gauze and introduce a rubber drain. Macleod also fills the external canal with gauze together with boric acid and iodoform powder so as to bring the displaced earlobe back to position and retain it there. McBride and Jacobsen introduce a rubber drain into the wound, the latter also placing one in the canal. The wound must be dressed as often as the amount of discharge renders this
necessary, and should there be any tendency for the discharge to re-accumulate, syringing will be required. To prevent the too rapid closure of the gap in the aurum and to ensure that this leads from below and becomes filled by fibrous tissue, Lane recommends the introduction of a silver tube, and Schwartz a lead plug, which latter Politzer, however, condemns as leading to bad results. But whatever means are adopted for the purpose, there is no doubt that the wound must be kept open until all factor and discharge from the middle can have disappeared.

Schwartz's operation as described above proves sufficient for the cure of the great majority of cases of myocardid disease. In some cases, however, the method has proved ineffective.

In those it has been found that benefit is derived from the removal of the posterior superior wall of the
ossesous meatus, and the consequent opening up of the mastoid antrum and tympanic cavity. The conditions requiring such treatment are:—(1) Caries in the posterior wall of the meatus or the presence of a fistula in the same position; (2) Caries in which Schwartz's operation has hitherto been abandoned on account of an abnormal position of the sigmoid sinus; or (3) those in which after Schwartz's operation the middle ear suppuration continues for a long period despite careful after-treatment.

The removal of the posterior superior wall of the osseous meatus was first suggested by Carl Roelf (Berlin. Klein. Arch. 1877). It was never practised to any extent, and for a time fell into disuse; but in 1889 it was revived and modified by Hüster (Deut. med. Arch. 1889), and in the same year Berghoffmann
introduced an operation on the same lines as Küster's though differing from it in details. Küster's method is as follows:

the auricle is loosen from its attachment by an almost semi-circular incision about 2 cm behind its insertion, and extending from the anterior point of insertion of the helix to close upon the tip of the meatal process. By means of this incision the tissues are divided down to the bone, and are then pushed backwards and forwards by means of an elevator until the posterior border of the ossicular chain is exposed. The perimembranous chain is then gradually separated from the bony chain, and along with the auricle is displaced downwards and forwards, thus exposing the posterior and superior walls of the ossicular chain. All haemorrhage having
been checked, the posterior wall of
the meatus is carefully examined
for fistulous openings if there have
not already been seen. Should
such fistulae exist, they are en-
larged until the antrum is
reached. If no such fistulae
are present, the posterior superior
meatal wall must be attacked
by means of the gouge and cut
away until the central cavity
is laid open. When this has been
accomplished the further proce-
dure will depend upon the ex-
tent of the disease. Should the
tympanic cavity be filled with
granulations or Cholesteatoma,
this cavity must also be opened by
removing its outer wall, and all
such masses cleared away to-
gether with the walls and ves-
ces, painis must be taken to pre-
sure the stapes however.

In cases in which the mastoid
cells are also diseased the bone must
the removed in a backward direction.
and the cells freely exposed, until
the mastoid process, middle
ear, and external meatus are
thrown into a single cavity.
The wound is now syringed
out with an antiseptic solution
and the auricle and mem-
branous meatus replaced and
kept in apposition to the bone by
means of a large sized rubber
drainage tube placed in the
meatus. Should the gap in the
bone be small, the wound in the
superficial structures over the
mastoid may be sutured and
the tympanic cavity stuffed
with cocaine on gauze through
the meatus. In cases, however,
where a large amount of bone
has been removed, it is best to leave
the soft parts unsewn over the
defect in the bone and to plug
the cavity with gauze through
the wound. Küster advises that
in after-treatment the dressings should not be changed frequently, and that suppuring should be avoided as much as possible.

Bergevin's method of operating is much the same as Küster's, but he removes more of the superior wall of the cavity in the first instance, and only in three cases in which the necrotic cases are to be opened does he remove the posterior wall. Stacke's method. Another method of operating which has been widely adopted was that brought forward by Stacke at the International Medical Congress at Berlin in 1890 (Monatsschrift für Öhrkrankh. November 1891).

The auricle is displaced forwards and the posterior wall of the outer ees is cut away until the centrum is reached. The realing and varied are then removed, and bone is cut away until the attic,
lower part of the tympanum, and antrum are converted into a single cavity. In order to form a permanent opening lined by skin between the external meatus and antrum, a four-cornered flap of skin and periosteum from the membranous meatus must be preserved, and kept in apposition to the wall of the antrum, and gap in the bone by plugging the meatus, until the flap becomes adherent. "Mr. Bride (Edinburgh Medical Journal. April 1894) remarks that Stack's method fulfills surgical principles to an extent not previously attained. He adds that the success which has attended this method of operating has led him to reflect "whether in most cases of intra-craniad mischief due to ear disease it would not be well to carry out Stack's operation or some modification of it."
recommends an operation which he has named Antrectomy in many ways as closely resembling Stacke's operation, as not to require detailed description here.

As regards the utility of these more recent methods of treatment (Küster's, Benjamin's & Stacke's) Politzer (Op. Cit.) says that no final judgment is yet possible, the number of trustworthy observations being too few to afford a foundation for sound conclusions. He, however, considers them as valuable additions to the surgical treatment of some cases of otherwise irreducible middle ear suppuration.

For the treatment of those cases of mastoid disease where the pus bursts through the inner wall of the process and moves down the neck, Beyold at one time advised the more or less complete removal of the lower part of the
mastoid. This is now generally considered unnecessary, and the treatment most usually adopted is to open the mastoid antrum, and at the same time open the abscess in the neck and introduce a drainage tube. This

--- enables the abscess cavity to be syringed out from the upper opening till healing occurs and the drain is removed.

Septic Thrombosis of the Cerebral Venous Sinuses. Thrombosis of the lateral, sigmoid, superior petrosal, and cavernous sinuses is amongst the more serious complications of chronic suppuration in the middle ear. Of these sinuses the lateral, and more especially the portion of it called the sigmoid sinus, is by far the most frequently affected, and are the only ones which will be here described.

The condition occurs most fre-
frequently in early adult life, less frequently in children, rarely in infants and persons of advanced years. Its rarity in infancy is due to the anatomical peculiarities of the temporal bone at this period of life. In infants, although the mastoid antrum is present, the air cells have not yet developed, and the sigmoid groove is very shallow, so that a greater thickness of bone exists between the sigmoid groove and the rest of the disease in the middle ear than is present in the adult. In young children moreover, the squamoso-mastoid suture is unossified, and this, added to the superficial position of the antro-cavum, renders the escape of purulent matter to the surface of the bone easy, and so prevents tension occurring which might lead to an inward extension of the pus and implication of the sigmoid sinus. There are two ways in which
infective processes may extend
from the middle ear and the cas-
ities in connection with it to the
sigmoid sinus:—(1). By direct ex-
tension of the disease from the
antrum, tympanum, or mastoid
ecess to the bone adjoining the
sinus; (2). By the occurrence of
septic thrombosis in the minute
veins passing from the middle
ear to the sigmoid sinus. In the
former case the middle ear dis-
ease may continue for years, dur-
ing which time the bone is slow-
ly becoming eroded, until at
least a mere film of bone exists
between the sigmoid groove and
the mastoid antrum or air
cells. This thin plate at last
becoming perforated, the dis-
ease invades the sigmoid sin-
us. In the case in which the
infective material reaches the
sinus through the emissary veins
there may be little or no disinteg-
nation of the bone.

The changes occurring in the wall of the sinus vary. As a rule it is thickened, discoloured, and separated from the bone by purulent matter, at times ulcerated and even perforated. The endothelial lining is swollen or unrecognisable, and the vessel is lined by layers of coagulated lymph, which prevents haemorrhage occurring even when the wall is perforated. The lumen of the sinus contains a thrombus which more or less completely fills it. This is at first fairly solid, but as a rule soon becomes discoloured and gradually disintegrates into a purulent semi-solid mass abounding in pyogenic organisms. The above process may extend from the diploë of the sinus to the various vessels in connection with it e.g. to the lateral sinus, even invading the
superior longitudinal or the lateral sinus of the opposite side --- to the superior petrosal sinus --- to the lateral angular vein --- and to the mastoid and posterior con- clavular veins.

**Symptoms.** Mr. Charles Ballance (Lancet, May 17th & 24th 1891 and Clinical Journal, Vol. 2. 1893) notes has given much attention to this subject, consider the "type symptoms" of thrombosis of the lateral sinuses to be as follows: --

1. A long-continued discharge from the ear or the history of such. It is important not to be misled by the absence of the discharge, as this may often cease on the intervention of the second symptom symptoms. Ballance also keep stresses on the fact that the discharge need not necessarily be foetid, and states that experiments have proved that in- odorous fluid from the ear may
cause fatal pyaemia, when injected into the veins of animals, whereas foetid pus may under the same conditions not do so. He therefore urges that an inodorous discharge is not to be regarded as a thing of little moment, as it may contain pyaemic organisms, and may therefore be more serious than an offensive discharge. Macewen (Op. Cit.) concurs with this view. "The virulence of a discharge" he says, "cannot be measured by its odour. Nearly odourless otorrhoea may contain pathogenic micrococci, and some of the most serious intracranial inflammatory lesions ensue in the presence of an odourless otitis media". On the other hand Mc Bride in a recent paper (Edinburgh Medical Journal. April 1894) says: "In estimating the probability or the reverse of the extension
of inflammation from the ear to the ends - examination, I attach
much importance to the presence or absence of factor. He goes on to
say that if no offensive odour
be met with, he is "strongly
inclined to think that the ear
should only be looked upon as
the focus of origin (of the lead
trouble) if no other possible cause
can be discovered."

(2). The sudden onset of the disease
with headache, rigors, vomiting and
pain in the ear of the affected side.

(3). Oscillating temperature reaching
103° to 106° and then falling
suddenly to 100° or even to normal,
one or two such oscillations occur-
ing every twenty four hours.

(4). Vomiting repeated day after
day.

(5). A second, third or more rigors.

(6). Local oedema and tenderness
over the mastoid and internal
jugular veins. In some cases oc-
curving after long continued ear
disease the mastoid process is so
hard and sclerosed that this edema
is absent.

77. Deep seated tenderness in the course
of the sinuses and at the posterior
border of the mastoid and beneath
the external occipital protuberance.

8. Stiffness of the posterior cervical
muscles.

9. Optic neuritis. The exact value
of this symptom as an aid to
diagnosis is as yet uncertain, as
authorities differ as to what con-
dition, thrombosis, meningitis, or
cerebral abscess, it is chiefly due.

Lawford and Edmunds (Ophthal.
Soc. Trans. Vols. 3, 4, 5 & 7) are of
opinion that optic neuritis oc-
curring in intra-cranial dis-
 ease is invariably due to the spread
of the inflammation from the pia
matter to the sheath of the optic nerve;
they therefore consider optic neur-
itis to indicate the presence of basal
mенингитис. Dr. Pitt (Gulstonian Lectures, 1890) on the other hand, believes that optic neuritis is more frequently observed in sinus thrombosis than in meningo-itis or abscesses, and indeed he states that in the last named condition it seldom occurs. Ballance (Lancet, 1890) considers that optic neuritis indicates that the dura mater has thinned, or has become inflamed to such an extent as to set up a slight basal meningo-itis extending forwards to the optic nerves. Jacobson (Operations of Surgery) states that while optic neuritis undoubtedly occurs in some cases of meningo-itis, thrombosis and abscesses, it does not invariably do so; while, on the other hand, it may be seen in cases of extradural inflammations in which there are no signs of any intra-cranial complications. Barker (Hunterian
Lectures 1889) also states that optic neuritis may occur in the course of suppuration in the tympanic cavity and yet no indication of any intra-cranial affection may exist. He accounts for this on the assumption that the optic neuritis is due to a vasomotor disturbance in the optic nerve and sheath, caused by "damage to the carotid plexus of the sympathetic."

Wallacean (Op. Cit.) is doubtful as to the correctness of this theory, and points out that such cases may really be due to a slight degree of meningitis.

It will thus be seen that there is considerable divergence of opinion as to the diagnostic value of optic neuritis, and Jacobson (Op. Cit.) is probably right in maintaining that in the present state of knowledge it would be rash to found any definite diagnosis on the presence or absence of the symptom.
A symptom which Dr. W. Bennett (Lancet, Sep 9th and Oct. 21st 1893) considers pathognomonic of blocking of the lateral sinuses is what he terms "post-mastoid" tenderness. He holds that in all cases of lateral sinus thrombosis the mastoid vein is also blocked and so gives rise to a tender spot where it leaves the skull. This spot is not situated over the central part of the mastoid but at its extreme posterior part or even over the posterior superior angle of the parietal. This view has not been generally accepted by other authorities, and MacEwan states that owing to sclerosis of the bone the mastoid foramen may be entirely obliterated in which case this symptom would be absent.

**General Symptoms.** Should the disease remain untreated, the general system becomes infected from the passage of septic material
into the circulation. When this occurs the pulse is rapid, small, and thready; the tongue is dry and coated; and the breath has a heavy fetid odour. There is complete anorexia. There is usually diarrhoea, but the bowels may be constipated. Although the rigours are followed by profuse perspiration, yet when the illness has lasted some time the skin becomes dry and of a jaundiced colour. In most cases which are left to themselves, the lungs, owing to the introduction of the infective matter, become variously affected. Pulmonary infarcts due to infective emboli may form, leading to abscess or gangrene; at the same time infective pneumonia as a rule supervenes, with the characteristic bronchi juice expectoration. Less frequently secondary seats of pyaemic mischief form in the liver, kidney,
subcutaneous tissue and joints. In cases of thrombosis uncomplicated with cerebral abscess or meningitis the cerebral functions remain unimpaired to the end, death usually ensuing from exhaustion although coma may supervene at the last.

Macewan classifies cases of infective sinus thrombosis under three heads: - (1) The pulmonary, in which the lungs are chiefly affected by the infective process. (2) The typhoid or abdominal, where the disease presents typhoid symptoms. and (3) The meningeal, where the lead symptoms are the most prominent. These types can seldom be definitely distinguished, as most cases present symptoms of a mixed kind e.g. both pulmonary and abdominal.

Diagnosis: In uncomplicated cases this is fairly easy, and thrombosis of the lateral sinuses may be
diagnosed with probability when in a case of chronic empyema concretion a rigor occurs and is followed by a highly hectic temperature with remissions approaching or even falling below normal. The diagnosis is only absolutely certain, however, when evidence of the thrombosis of the internal jugular vein is found.

Uncomplicated cases are distinguished from meningitis and cerebral abscess by the fact that in these conditions there are neither such severe rigors nor such a high temperature as in thrombosis. In meningitis and cerebral abscess the head symptoms are more marked, the patient soon becoming drowsy and finally comatose, while in uncomplicated cases of thrombosis the consciousness remains clear up till the end.

It must be remembered, however, that all three of the above conditions
may be present in the same case thus rendering the diagnosis obscure. Then the three conditions are present in the same case it is as a rule the abscess and meningitis which are not recognised, as the symptoms of the infective thrombosis are generally the worst from annoyed, and so tend to obscure those of the two associated conditions.

Again the diagnosis may be difficult in those cases where there is no abdominal, and therefore it is important in all doubtful cases to enquire if such has ever existed. In such cases, especially with general symptoms of the abdominal or typhoid type, the diagnosis of enteric fever has been made. This is not remarkable as the condition of the patient closely resembles that seen in typhoid fever. The same mistake may also occur in cases where there
is otorrhoea, which is a well known complication of enteric fever. Thus Dr. Murchison (A Treatise on the Contagious Fevers) says: "Otorrhoea may supervene in the earliest stages of typhoid," and he also makes this important remark: "In patients who have otorrhoea enteric fever may commence with rigors." From these statements it is clear that cases may present themselves in which there is great difficulty in arriving at a correct diagnosis.

As Baclwines (Clin. Jour. Vol 2) has pointed out, cases of lateral seismic peracedia may occur in which there is no otorrhoea or pain in the ear; again typhoid fever may be complicated in its early stages by otorrhoea, or lastly a patient with a chronic discharge from the middle ear may develop typhoid, which in such a case may commence with
migrans. The diagnosis may, however, be made even under all these circumstances, as the sudden onset, oscillating temperature, and repeated vomiting would all point to pyaemia.

As regards temperature Mur
dchison (op. cit.) says, 'In time
fever would be excluded from
the diagnosis by a temperature
approaching to normal on any
evening during the first week,
and on the other hand by a
Temperature approaching too

close an area of 104° on the
first day or second morning
of illness.' This is an important
guideline, as a temperature of 104°
at the beginning of a case of
lateral sinus pyaemia would be quite common. The migrans
are not diagnostic of either
disease -- though pointing to
pyaemia) -- for Murchison
again says: 'I have observed
decided rigor, and indeed all
the phenomena of ague, during
the first few days. When the
characteristic rose-coloured
typhoid spot appears, the diag-
nosis is at once cleared up.
Again if optic neuritis is found
when the patient is first seen,
typhoid fever is excluded; but
as it is not by any means
constantly present in urinary
thrombosis, its absence does
not preclude the presence of
that condition.

Prognosis. This must always be
regarded as grave. The great ma-
jority of cases allowed to run their
course without treatment, end
fatally. At post-mortem exami-
nations, however, there are occa-
sionally found instances of
long-standing obliteration of the
internal jugular and sigmoid
diverticulum, in connection with infect-
tive carried and extensive disinte-
...
nation in the temporal bone. Cases have also been reported which exhibited all the symptoms of infective thrombosis, and which nevertheless recovered. A classical example of this is the case reported by Prescott Hewett (Lancet. 1861) which not only presented all the type symptoms of thrombosis but in which pyaemic changes also occurred in the lungs and joints. More recently a case has been reported by Dr. James E. Bloomfield (Lancet. 1893) having all the symptoms of pyaemia from infective sinus thrombosis and which yet recovered without any operation upon the sinus. Such cases of recovery without operation are exceedingly rare. Maclean accounts for them on the supposition that "the pyogenic organisms inducing the inflammation have been so attenuated as to permit a formative process
to occur in the thrombus; or that "the extension of the inflammation has been so gradual, and has been accompanied by the formation of granulation tissue which slowly invaded the soft tissues and by-and-by formed an obliterating connective tissue barrier within the sinus."

Cases treated early, by thorough removal of the source of contamination from the sinus and its vicinity, offer a reasonable prospect of recovery. If the treatment be delayed until systemic infection has occurred and infarctions have formed in the lining, and elsewhere treatment will then offer but a very distant hope." Still the general opinion now held by most surgeons is that such cases ought to be operated upon, as if they are not they inevitably and fatally, and in several such cases which
exhibited all the symptoms of general infection recovery took place after operation. 

Treatment. Until comparatively recently infective sinus phthisis was regarded as a condition beyond the sphere of surgical interference, and was treated by nourishing diet, stimulants, and large doses of Quinine. Although these means of treatment must still be employed, it is now admitted by all surgeons that operation is the only form of treatment which offers the patient a reasonable chance of recovery.

This advance has been chiefly due in this country to the efforts of Arbuthnot Lane and Ballance, who have ably advocated radical surgical treatment in this condition. As might be expected, surgeons differ as to the form and extent of the operation they adopt; but whatever difference
may exist as to detail, the same broad principles underlie all the surgical procedures. The treatment will be twofold: (1) The primary centre giving rise to the condition must be destroyed; and (2) the dissemination of the infective material from that source throughout the system must be prevented by blocking the stream along which such infective matter is travelling to enter the general circulation.

As regards choice of instruments, the same difference of opinion exists as in the case of mastoid operations, some surgeons using the gouge chisel and mallet, some the trephine, others the rotary saw.

Operations. The first step in the operation consists in keeping freely open the mastoid antrum and antrum, in the manner already described under the section on
mastoid disease. When this is done, all canines bone, pus, and granulation tissue must be cleared away. While this is being done the wound should be freely irrigated with an antiseptic fluid, so as to prevent the septic matter lodging on the surface of the freshly cut bone and so infecting it. Besides the above, some surgeons remove the posterior wall of the external ostium, so that the antrum, tympanum, and external meatus are thrown into a single cavity. The posterior wall of the antrum being thus exposed, an opening is made in the bone behind that point for half an inch horizontally. This opening will in most cases lay bare the greater part of the diameter of the sinus. This having been done, it will be necessary to enlarge the opening and expose the sinus for a considerable distance by cutting away its osteous covering upwards.
and backwards and downwards and forwards. It is very important to have free access to the sinus in case of haemorrhage occurring, and also to allow of thorough antisepctic operation of the seat of disease.

On opening the aqueous groove, pus frequently escapes from it, and occasionally the wall of the sinus nearest to the bursa is ulcerated, thus exposing its interior and contents to view. Should no such escape exist in the sinus it may be difficult to decide whether or not thrombosis has occurred. Under these circumstances authorities differ as to the proper treatment to adopt.

Some advise that the operation should end here, i.e., on passing a grooved needle into the sinus, fluid blood escapes, on the assumption that no clot is present.

Ballewance (Ohio Jour. Vol. 2) deprecates this proceeding, and points out that owing to the core-
fraction of the clot, blood may still be flowing along the sinus and so carrying septic matter into the general circulation. He therefore recommends that in all cases in which there have been well-marked pyænic symptoms, the treatment should be the same whether or not a clot can be detected in the sinus. He advises the sinus to be laid open freely, and all clot if present thoroughly removed, and the cavity plugged with antiseptic gauze. MacEwan in reference to the same subject follows a similar course, and after the removal of all clot inserts the cut edges of the sinus so as to occlude its lumen, and retains them in this position by packing carefully with iodiform and boracic powder on the top of which he places iodiform gauze.

Rudolph Parker (Liverpool Medics - Clinicourgical Journal. Jan'y. 1892)
in a case operated on by him, after opening the sinuses and removing all clot, employed antiseptic
way for the purpose of occluding the sinuses. Occasionally on the
removal of the clot from the sinuses
subsequent haemorrhage occurs. This
is as a rule easily dealt with
if the opening in the bone has been
made large enough to admit of
the necessary manipulations.

The bleeding is easily controlled
by plugging the vessel with a
strip of gauze, or, if this is not
at hand, it may be arrested
temporarily by tying the sinuses
with Spencer Wells’ forceps.

Balanced considers it bad practi-
cise to place a ligature on the sinuses
as try so doing the intra-dural
space is opened, and may be infected.

Macewen also considers lig-
atures to be attended with danger
and difficulty, and adds that the pro-
ceeding is generally futile.
Ligation of the Internal Iguinal Vein.

This procedure in cases of septic thrombosis of the lateral sinus was first suggested by Professor Victor Horsley (Clin. Soc. Trans. Vol 19), but the first surgeon to actually carry it into practice was Mr. Ballance of St. Thomas's Hospital, who was speedily followed by Mr. R.A. Lane. Both of these surgeons recommended it as a part of the routine treatment in all cases of pyaemia arising from lateral or sigmoid sinus thrombosis, and Ballance even advocates its adoption in cases where the bicuspid of constitutional infection are not clear. Ballance proceeds as follows:—The vein being exposed by an incision along the anterior margin of the sternocleidomastoid, and commencing at the lower border of the parotid gland, and the surgeon having assured himself that the vein is here free...
from clot ... (in the event of clot being present he must go further down the neck) ... Two ligatures are placed around the vessel and this divided between them. Then this has been done the lower end of the upper part of the vein is stitched to the upper angle of the skin incision. Into this end of the vein on the completion of the operation on the mastoid and sinuses, the trocar of a syringe may be inserted and antiseptic fluid gently forced through, so as to remove all remnants of septic clot from the isolated part of the vein and sinuses, the fluid escaping from the opening in the sinuses above. Maclean (op. cit.) says that in the majority of instances the obliteration of the upper two thirds of the sigmoid sinuses is all that is necessary to prevent systemic infection, and recommends ligature of the internal jugular
only in certain cases, as, for example, where the infective thrombus in the sinus has undergone such extensive disintegration as is unlikely to be reached by obliteration of the upper two thirds of the sigmoid sinus. He also advises that in cases where from the outset it is clear that the sinus must be tied, this should be done before the sigmoid sinus is interfered with, as more freedom can then be left in operating on the sinus.

In this connection it is well to bear in mind that the internal jugular, although the chief is not the only channel by means of which septic matter may pass from the sigmoid sinus to the general circulation. Such matter may enter the circulation after ligation of the jugular by the anterior and posterior condylar veins and the occipital sinus, the blood from which passes into
the deep veins of the neck, and ultimately reaches the subclavian vein. From this it follows that ligation of the external jugular, although it is to a large extent prevents the entrance of septic material into the general circulation does not of necessity entirely exclude such matter.

** Infective Meningitis.**

Meningitis due to chronic suppuration in the middle ear arises in various ways, the infective matter from the middle ear may reach the membranes either through a perforation in the tegmen tympani or tegmen anteri. And again when the aqueductus Fallopii is exposed in the middle ear, the pathogenic organisms may reach the membrane by spreading along the facial nerve sheath and as reaching the posterior cerebral fossa through the internal auditory meatus, or by passing along
the great superficial petrosal nerve may extend to the middle cranial fossa. The infective matter may also extend to the membranes by the minute veins which pass from the tympanic cavity to the dura mater. In whatever manner the condition arises it is usually of the nature of a purulent leptomenigitis.

**Symptoms.** The disease as a rule begins with headache, at first localised but afterwards radiating over the whole head. This pain may at first be intermittent, but as time goes on it becomes constant and gradually increases in severity. Along with the headache cerebral vomiting very often occurs, while photophobia and general hyperaesthesia are also often present in the early stages of the disease. At the same time the patient is sleepless, excited, and may suffer
from loss of memory. As the disease progresses, delirium, spasm of the limbs and facial muscles passing on to general convulsions occur. The pupils as a rule are contracted, and react very slightly to light. The temperature and pulse vary; the former is as a rule high, the latter is rapid in the early stages but becomes markedly slower as the disease advances and compression of the brain supervenes. In the latest stages hemiplegia may come on; the pupils become dilated, paralysis of the bladder and sphincter occur, and the patient going from bad to worse dies in a comatose condition.

**Diagnosis.** This has been already referred to under Septic thrombosis of the lateral sinus and will be more fully discussed in the section on cerebral abscess.
Prospective. This in cases which are left to themselves is very unfavourable, as such and almost invariably in death. Should, however, a case be seen before signs of compression have become marked, the prognosis is more favourable, as such a case under operative treatment has a chance of recovery.

Treatment. This consists in freely opening the antrum and tympanic cavity and cleaning them of their septic contents. Should a perforation exist in the tegmen tympani or tegmen anteri it must be carefully enlarged, the membranes freely opened, and any purulent material lodging between the skull and the dura mater or between the dura and the brain, should be carefully washed out. Cases thus treated have resulted in complete recovery.
Cerebral and Cerebellar Abscesses.

Abscesses of the brain occurring in the course of chronic purulent otitis media are most frequently met with in the temporal-sphenoidal lobes of the cerebrum or the lateral lobe of the cerebellum on the side corresponding to the ear disease; more rarely they are found in the opposite hemisphere, and in a few cases are situated in thepons or cerebellum.

Both cerebral and cerebellar abscesses are most frequently met with on the right side. This is not caused by the right ear being more frequently infected than the left, but is due to the greater size of the right lateral sinus, which consequently en-

traverses more superficially the antrum, and is thus separated from it by a thinner layer of bone than is the left, and is therefore more easily invaded by infectious processes.
which now thereafter extend to the cranial cavity and produce abscess. As regards the relative frequency of cerebral and cerebellar abscesses most authorities hold that abscess in the temporo-sphenoidal cave is about twice as frequent as cerebellar abscess.

Balsevance (Clin. Jour. Vol 2. 1893) denies this, and says, "Cerebellar abscess, I believe, is quite as frequent, if not more frequent, and more frequent certainly in children — than temporo-sphenoidal abscess." Taquin believes that he had proved that suppuration confined to the tympanum was followed by abscess of the cerebellum, while abscess of the cerebellum or phlebitis of the lateral sinuses followed suppuration affecting the sphenoidal antra and air cells.

This has not been entirely borne out by subsequent experience but Politzer (Op.Cit.) says that it is the
whole, abscesses in the cerebrum are chiefly developed in ulceration of the tegmen tympani and upper surface of the pyramid, abscess in the cerebellum on the other hand, mostly in cavities on the posterior surface of the pyramid, more rarely in affections of the mastoid process.

The abscess may be caused by direct extension of the disease from the middle ear to the surface of the brain, the pus escaping through a perforation in the tegmen tympani. In such cases the dura mater often adheres to the surface of the brain, thereby preventing the suppuration from spreading to the base of the brain, whilst the pus from the perforation in the bone spreads directly to the cerebral substance. In other cases no such direct connection exists between the seat of disease in the tympanum and the abscess in the brain. Indeed in some
cases there is no perforation in the bone, and in a few exceptional instances a considerable thickness of normal cerebral tissue separates the diseased tympanum from the abscess. In such cases the infective matter spreads to the brain along the blood and lymphatic vessels which pass from the middle ear to the cranial cavity.

The abscesses vary in size from that of a pea to that of a goose's egg, as a rule they are single but occasionally more than one are present simultaneously.

In cases where there has been extensive destruction of the tegmen tympani and where the membranes have become adherent to the bone around the perforation, the abscess by increasing in size gradually causes absorption of the intervening membrane, and so finds its way into the middle ear from which it finally escapes.
through the external auditory meatus.
This occurrence has been termed "cerebral abscess": it is rare.
A cerebral abscess due to ear disease is generally ill-defined, it
waxes thready, and surrounded
by softened cerebral substance;
occasionally, however, it is enclosed
in a thick capsule. The pus varies
considerably in consistence and
appearance. When mixed with
extravasated blood it is of a dark
brown colour, but as a rule it is
greenish yellow; it is commonly
thick, but varies, especially when
postcid the quite thin, and at times
contains shreds of disintegrating
brain tissue.

**Symptoms.** There may be most
conveniently arranged in two groups:
1) the general due to suppuration in
any part of the brain, and irrespec-
tive of the position of the abscess; and
2) the special or localising symp-
toms which give a more exact guile
to the situation of the ear.

General Symptoms. The general symptoms occurring in the course of an abscess of the brain fall naturally into three groups. These although gradually passing into one another during the course of the disease, nevertheless present features which serve to distinguish one stage from another. In the first stage there is in nearly every case the history of a long continued discharge from the ear. The absence of such, however, must not be allowed to mislead, as the discharge is in many cases so slight as to escape the notice of the patient. Under such circumstances a careful anoscopic examination will as a rule disclose the presence of disease of the ear, although cases of serious intra-cranial mischief have been reported, resulting from chronic middle ear suppuration in which there was no destruction
of the membrana tympani.

In connection with the discharge it is well known that in the course of chronic suppuration in the middle ear the flow of pus as a rule becomes remarkably diminished, or ceases altogether on the suppression of symptoms indicating intracranial complications.

During this early stage the patient complains of pain which is at first localized in the ear, but which is soon experienced all over the head. It varies in character, severity, and duration. As a rule it is described as a "shooting pain"; it is generally aching and may be either continuous or intermittent.

Other symptoms present are vomiting and rigors. The vomiting is of the kind known as "cerebral vomiting", there being generally no nausea, and the act being quite independent...
of the taking of food.

The rigors which are almost invariably present in this early stage, differ greatly in severity and duration. Sometimes there is only a passing feeling of chilliness, while at other times they take the form of severe shivering lasting for half an hour or even longer. In uncomplicated cases of cerebral abscess the rigors are not as a rule repeated, being usually confined to the earliest stage of the disease. Any recurrence of them ought to be regarded as strong evidence of the presence of infective sinus thrombosis and consequent pyaemia.

During the early stage the patient is weak and prostrated, his tongue furled, his pulse rapid and his temperature slightly raised.

The length of time during which all the above symptoms may
continue is subject to great vari-
ation. In some cases they may
last for nearly a week whereas
in others they may only be present
for about twelve hours, at the end
of which time the symptoms
characterising the second stage
may have developed.

When this stage is reached the
symptoms exhibited are due to
the presence of the fully formed
abscess. When the disease has
advanced to this point it is
noticeable that the patient's sensi-


ibility is more or less dulled,
and although he still retains
his mental faculties he is in-
capable of exercising them for
any length of time. He answers
questions correctly but slowly,
and as it were unwillingly,
and in a dreamy manner—
this condition at this stage hav-
ing been described as one of
"sluggish but perfect cereb-

nation" (A. E. Barker, Lancet 1887). He shows a marked tendency to fall asleep from which condition, however, he is easily roused. The sleep is restless and unrefreshing. Along with this listlessness there goes a decreasing loss of strength. This apparent weakness is not due to loss of muscular power, but to inability on the part of the patient to apply his strength, owing to a loss of will power. The pain in the head which was formerly so distressing now becomes much less severe, and may not be complained of unless the patient is specially questioned regarding it, or the physician percussed over the mastoid region on the affected side.

The pulse is slow, full, and full, sinking in some cases to thirty per minute.
The respirations are also much diminished in frequency, but usually continue regular. In some cases, however, the Cheyne-Stokes type has been observed.

The temperature is seldom high in uncomplicated cases, and is often subnormal, thus differing remarkably from that met with in most cases of meningitis and serious thrombosis.

There is usually obstinate constipation; retention of urine may occur and may necessitate the use of the catheter, and at times albumen is present in the urine. The vomiting and rigors which are well marked symptoms in the early stage of the disease seldom occur when this point has been reached.

Along with the above there is a marked loss of appetite; the tongue is thickly furrowed, and
the teeth covered with sordes, at the same time the breath has an offensive odour and the patient complains of a disagreeable taste in the mouth.

Towards the end of this stage, the patient becomes distinctly emaciated.

Authorities differ as to the frequency of convulsions in cerebral abscess, some holding that they are met with in about half of all the cases, others considering them to be of rare occurrence.

Optic neuritis frequently occurs towards the end of the second stage; when present it is not so intense as that met with in cerebral tumours and rarely results in atrophy of the disc, but may persist for a considerable period after the abscess has been evacuated. It is seen both in abscess of the cerebrum and
cerebellum, and is not necessarily more marked in the eye on the same side as the abscess. Its diagnostic importance has been already dealt with in the section on infective thrombosis.

Swelling and redness over the mastoid, although they may occur, are not symptoms necessarily indicating abscess of the brain.

If no surgical measures are taken to arrest it, the disease passes into a third stage, and has invariably a fatal issue. (Politzer, Op. Cit.). Death may result from the abscess opening into the lateral ventricles from the pus escaping on to the surface of the brain... or from coma brought on by the increased intracranial pressure due to the engorgement of the abscess.

Should rupture of the abscess into the lateral ventricles occur a marked change takes place in the
symptoms. The pulse, formerly slow, becomes rapid, reaching at times 120 per minute. The temperature from being normal or even subnormal rapidly rises, and may touch 104° or 105°. Along with these the respiration is markedly accelerated, and may become stertorous. The face appears livid, and the pupils are greatly dilated. Convulsive scenes may occur, and at times there is well marked opisthotonus. The coma deepens and death as a rule follows the first symptoms of rupture in from six to twelve hours.

In those cases in which the pus finds its way one to the surface of the brain, the symptoms which follow are less sudden and severe than are those resulting from rupture into the lateral ventricle. When the abscess does escape one to the surface the patient
becomes restless, the pulse and respiration rapid, and the temperature high. The face is flushed, squinting may occur, and clonic spasms followed by rigidity of the limbs may take place. Convulsion and death ensue.

The above are the most important general symptoms which may be met with in a case of cerebral abscess allowed to run an uninterrupted course. It is however pointed out by Professor Anniandale (Bain. Med. Journ. April 1894) that abscesses of the brain "as sometimes exist for a considerable time without giving rise to marked symptoms, and yet serous symptoms may occur suddenly by the rapid extension, or by investing cause death" Politzer (Op. Cit.) mentions similar cases, and states that on post mortem
examination they have shown an old abscess surrounded by a connective tissue capsule which had given way on the accession of fresh suppuration and as led to the fatal issue.

**Localising Symptoms.**

Besides the foregoing general symptoms which occur in all cases of brain abscess, there are in some cases certain other symptoms which as giving a more exact guide to the seat of the lesion are known as "localising symptoms." These symptoms are of very great value. They are not, however, very frequently met with in abscess the result of ear disease. When of most importance they are due to interference with the motor areas of the brain. But as abscesses caused by chronic middle ear suppuration are most frequently situated in the temporo-sphenoidal lobe and
Cerebellum, which are not in close relationship with the motor areas, it follows that in the majority of cases, there are no localising symptoms present to indicate the position of the lesion.

Small abscesses in the temporo-sphenoidal lobe give rise to no localising symptoms. When they are large, however, they may be interfering with neighbouring parts of the brain produce distinctive symptoms, among the most important of which are hemiplegia on the side opposite to the abscess, paralysis of the third nerve, deafness, hemianopsia, and when the abscess is situated in the left temporo-sphenoidal lobe aphasia has been observed.

In reference to abscesses of the brain due to middle ear disease Prof. Annandale (Ed. Med. Jour. Apr. 94) says that "localised brain symptoms are not usually present,"
as that the diagnosis must depend upon the history of the case and general train and other symptoms.

Cerebellar Abscess.

Symptoms. The general symptoms already mentioned may all occur in the case of an abscess situated in the cerebellum. Special symptoms which would help to localise the position of the abscess in this part of the brain may also be present if the abscess is large. Maclean (Op. Cit.) considers slowing of the pulse and respiration, low temperature, yawning, clenching of the teeth, slow syllabic speech and retraction of the lead, as indicative of cerebellar abscess. Ballance says abscesses the following symptoms which he regards as pointing strongly towards cerebellar abscess: constant vomiting, severe vertigo,
and mydriasis, and in some cases he has been able to detect
definite tenderness on deep
pressure behind the lower part
of the posterior border of the
Jour. 1887 p. 996) believes that cer-
ebellar abscesses occur more
commonly than cerebral from
extension of the middle ear sup-
puration to the labyrinth, and sub-
sequent escape of the pus one to the
posterior surface of the petrous bone.
He therefore holds that if nerve deaf-
ness, as tested by the tuning fork,
is present, (this form of deafness
being due to labyrinthine disease)
it is probable that the abscess will
be found in the cerebellum.
Körner, (Sajous. Annual of the
Universal Medical Sciences Vol.2
1893) however, holds that laby-
brinthine disease does not cer-
tainly indicate cerebellar
abscess.
Dr. Edgeworth (Bristol Medico-Chirurgical Journal, June 1890) believes that reeling gait and vertigo together with tenderness on percussion over the cerebellum are symptoms which indicate an uncomplicated abscess of the cerebellum, which is gradually increasing in size and causing pressure on the middle cerebellar lobe.

**Diagnosis of Abscess of the Brain.**

This is frequently surrounded with great difficulty, as abscess of the brain is often complicated by the co-existence of meningitis and sinus thrombosis, the symptoms of which more or less mask those due to the abscess, and so render the clinical picture presented by the case a highly complex and confusing one. Abscess is distinguished from infective sinus thrombosis by the absence of the characteristic symptoms of...
The latter, viz. the rapid weak pulse, the oscillating temperature, the repeated rigors, the profuse perspiration, the tenderness in the course of the internal jugular, and in the later stages the signs of systemic infection. Should both conditions exist the symptoms due to the thrombosis as a rule predominate, and obscure those of the abscess.

In diffuse meningitis the patient is irritable whereas in abscess his senses are dulled; in meningitis the temperature is high, though not oscillating, while in abscess it is normal or subnormal; in abscess except in its final stage, the pulse is slow while in meningitis it is rapid.

Even in those cases in which the diagnosis of an abscess of the brain has been made, it has yet to be decided whether the focus is situated in the temporal-ephemoidal lobe or cerebellum.
A decision is arrived at from the localising symptoms, but in many cases these are so indefinite that it is impossible for the surgeon to decide whether the abscess is situated in the temporo-spheno-oidal lobe or cerebellum. Under these circumstances showed an operation be decided upon, it will be best to search for the abscess, in the first instance at least, in the temporo-spheno-oidal lobe, and should it not be found there, to next explore the cerebellum.

Prognosis. Until recently the prognosis in all cases of abscess of the brain was exceedingly hopeless. Since the introduction of operative procedure, however, it has greatly improved, and in a case which is early recognised and promptly treated the prognosis is fairly hopeful. Nevertheless an abscess of the brain must
still be considered an exceedingly grave condition which is always liable to end fatally, even although it is treated surgically in the most skilful manner.

Treatment.

When once the surgeon has decided that an abscess of the brain exists, or even in some cases where an absolute diagnosis cannot be arrived at, it is his duty to open the skull as soon as possible and evacuate the pus. In all cases the opening in the skull should be made as near as possible over the site of the pus. Point at which to trephine for a temporo-ethmoidal abscess.

Authorities differ as to the exact position in which to make the opening to evacuate an abscess in this region. Maclean (op.cit) places the point of the trephine at a point in a line with the posterior border of the external osseous
meaties and three quarters of an inch above the posterior root of the zygoma. Mr. Barker (Brit. Med. Jour. Dec. 11th. 1886) believes that the great majority of abscesses in the temporo-sphenoidal lobe are found within a circle having a radius of three quarters of an inch, the centre of which is situated one and a quarter inches above and the same distance behind the centre of the external osseous meatie. He would therefore place the pin of the trephine on the centre of this circle.

Prof. Brinicombe (Dublin Jour. of Medical Science. Feb. 1891) in Brit. Med. Jour. Sep. 20th. 1890) who has given great attention to cranial topography, points out as a result of his experiments that "in about 15-per cent. of cases, if a three quarter inch trephine were applied at the point in-
created by Mr. Barker for trephining in temporoparietal abscess, the lateral sinuses would either be exposed in the opening or would run along its margin. It therefore advises that a point half an inch higher than that recommended by Barker should be selected.

Mr. Jacobson (op. cit.) adopts Mr. Barker's directions, but advises that in children the point of the trephine should be placed no further than one inch above and the same distance behind the incisions, as otherwise there is a risk of wounding the lateral sinuses.

Mr. Macraughton Jones (Lancet, March 5th, 1892) recommends a spot two inches above and one and a quarter inches behind the centre of the bony protrusion.

Petiger (op. cit.) advises the opening to be made at a spot
two and a half to three centimetres above the opening of the external osseous meatus, and placed between two lines, one in front of and one behind the auricle. These lines running at right angles to a line extending from the angle of the orbit to the top of the auricle.

Mr. Bride (op. cit.) advises the selection of a spot just above and in front of the osseous meatus, but admits that an objection to this site would be that it necessitates the direction downwards of the auricle, which on being replaced might hinder dressing and free drainage.

Dr. Pitt (Gullstonian Lectures 1870) "believes that the area under which temporal splenoidal abscesses may almost universally be found may be said to be bounded anteriorly and
posteriorly by curved lines drawn through the temporo-mandibular joint and the middle of the mastoid, running at right angles to the sagittal suture, and lying from half an inch to two inches above the earights. He therefore advises the skull to be opened in the lower part of this area.

Point at which to trephine for a cerebellar abscess.

Mr. Ballance (Clin. Jour. Vol. 2) recommends the trephine to be placed with its anterior border just behind the posterior border of the mastoid, and with its upper border just below Reid's base line (a line drawn from the lower border of the orbit backwards through the centre of the mastoid). In this position the trephine is below the horizontal part, and behind the vertical portion of the lateral sinus.
Mr. Barker selects a point one and a half inches behind the centre of the external meatus and one inch below Reid's base line.

Prof. Birmingham (Brit. Med. Jour. Sep. 20th, 1890) says that although this spot will not encroach upon the lateral sinus, it may, nevertheless, injure the occipital artery.

He therefore advises the opening to be made 2 inches behind the centre of the meatus and 1 inch below Reid's base line.

Whichever of the above sites be chosen, the steps of the operation will be the same, whether the case be one of cerebral or cerebellar abscess. The scalp is shaved, thoroughly washed and rendered aseptic in the manner described in the section on mastoid operations. An incision (suitable to expose the site selected for trepanning) is then made down to the bone,
the flap thus formed reflected and all haemorrhage checked.

The bone being thus exposed, the pin of the trephine is adjusted and the instrument worked until a crown of bone is removed. (If it is intended to replace this crown of bone on the completion of the operation, it should be placed in a sponge soaked in some warm antiseptic lotion). Very great care must be exercised in working the trephine on account of the thinness of the bone in both the temporal and occipital regions. The crown of bone being removed the opening in the skull is carefully examined for any meningeal vessel.

Should such be in the way it should be ligatured in two places and divided.

Any fur which may now appear on the surface of the dura mater should be gently removed,
and that membrane carefully divided and the surface of the brain exposed. When this stage of the operation has been reached, the substance of the brain must be explored for pus. This may be done by means of a fine scalpel and cannula, a hollow needle, or Horsey's pus-seeker. Whichever instrument is used is inserted gently into the cerebral tissue. In the case of a temporoparietal abscess the instrument is directed downwards, inwards, and slightly forwards towards the tegmen tympani. When the abscess is reached pus should escape along the needle, and the opening must then be enlarged by means of strong forceps to allow of complete evacuation of the abscess. When all pus has thus escaped, the abscess cavity must then be washed out with some
antiseptic lotion. This should be done very gently, as otherwise the abscess wall might be ruptured and serious consequences ensue.

The introduction of a drainage tube into the abscess cavity is not as a rule necessary in acute abscesses, as the brain tissue is in such cases soft, and so tends speedily to obliterate the cavity. In old standing cases, on the other hand, in which the abscess walls are more or less thick, the cavity does not become as rapidly obliterated. In such therefore it is as well, in order to prevent reaccumulation, to introduce a drain, care being taken in doing so that the inner end of the tube only just enters the abscess cavity and as does not exercise any injurious pressure on the brain tissue. The other end
of the drainage tube should be stitched to the edges of the dural incision so as to keep the tube in position.

The dural mater is now replaced over the brain, the soft part adjusted and an antiseptic dressing applied.

As regards after dressing the surgeon must be guided as in other operations by the amount of discharge and by the temperature and general condition of the patient. The after treatment will be the same as that adopted in all serious surgical operations.

**Conclusion.** From the foregoing survey it will be seen that the chief authorities are at one as to the main principles regulating the diagnostic and subsequent surgical procedure in the case of these complications.
of chronic suppuration in the middle ear.

The writers suffer almost solely in regard to matters of detail, viz. the choice of instruments; the question whether the foetid or inodorous discharges are of a virulent or innocuous nature, the exact spot at which to incise in cases of abscess of the brain, and the expediency of ligaturing the internal jugular vein in the treatment of lateral sinus pyaemia.

The progress of surgical knowledge and dexterity is brilliantly exemplified by the results of recent operations for mastoid disease, infective thrombosis of the lateral sinus, and abscess of the brain. The history of these maladies has until very lately been a black record of hopeless suffering and death. Needless to say, many such
cases still end fatally. But the surgeon, by pioneering courage and skill, is year by year gaining more and more brilliant victories in this field from which he was so long debarred. It must, however, be borne in mind that cases repeatedly occur in which the need for operating would have been averted had due attention been given to the ear disease in its earliest stages. No subsequent exertions, no success however shining can atone for such previous neglect. It is no doubt a great thing for the surgeon to carry a delicate and dangerous operation to a triumphant issue. But it is better for the patient when timely attention renders such an operation needless. "Prevention is better than Cure."
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