

(fused on the end of a slender probe)—are applied through the external canal. In using them it is of great importance to the patient's comfort that *only* the desired spot be touched, and that too only after thorough cleansing and drying. Under this heading may be mentioned a special form of local treatment, that of aural suppositories or bougies, of medicated gelatin, as suggested by Gruber; these are introduced into the ear by means of forceps, and then afterward the canal is closed with cotton.

(3) In case of an intact membrana tympani fluids and vapors may be introduced into the tympanic cavity through the Eustachian tube. Only small quantities (from eight to ten drops) should be used at a time, and only after being warmed. After the catheter is in position, introduce into it with a syringe or pipette the requisite amount of the fluid to be used, and then with the air bag blow it with some force into the tympanic cavity, always using the diagnostic tube for information as to the successful carrying out of the manœuvre. The entry of the fluid into the tympanum may be facilitated by having the patient swallow at the moment of emptying the air bag, by having the head well inclined toward the side to be medicated, and by using a catheter which enters well into the mouth of the tube. Steam, plain or medicated, formerly much used in the treatment of middle-ear catarrhs, has now largely given place to volatile medicaments (chloroform, chloride of ethyl, menthol, etc.), or to some of the vaporized or nebulized oils containing various substances in solution. By using some one of the well-equipped nebulizing apparatuses the fine vapors can be thrown, warm, into the tympanic cavity through the catheter, with rapid interruptions, so as to obtain a three-fold effect, viz., that of the medicated oils, that of the heat, and that of the pneumatic massage acting upon the inner surface of the membrane and the ossicles. While the injection of fluids into the tympanum is certainly less in vogue than formerly, still with caution, especially as to the fluids used, it sometimes accomplishes beneficial results, mostly for tinnitus, when other means fail.

9. *Electricity.*—The general aural therapeutics of electricity furnishes a good illustration of how great an absence of unanimity there may be in the profession relative to a given subject. While as regards the value of electricity in diagnosis and prognosis there seem to be a few who think alike, when it comes to the question of therapeutics there exists the most astonishing divergence of opinion. It is true that there are competent observers who claim good results from the treatment of the ear by galvanism, faradism, static electricity, and cataphoresis. It is also true that equally good observers have utterly failed by the same methods to obtain similar results. In a general way, as the result of a moderate amount of experimenting, I am compelled to cast in my lot with the latter class. At the same time the effort to bring order out of what is at present a state of semi-chaos, is a fascinating one. I believe that much good thought and considerable time are being given to the subject, and that the time is not far distant when those who are prosecuting these studies will be able to give to the medical world some greater uniformity of thought in regard to this matter than now exists.

It does seem in some measure settled that there are cases of tinnitus which are benefited, and even cured, by both the constant and the interrupted current. This appears to be especially true of those cases in which a morbid state (either torpidity or hyperæsthesia) of the auditory nerve exists. It is also easy to believe, what seems to be pretty well proven, that electrolysis is useful in the treatment of strictures of the Eustachian tube, as well as in connective-tissue strictures of the external auditory canal. The use of the galvano-cautery in the external and middle ears, although it has been highly recommended, seems to me to present no advantages over other methods, and to be fraught with greater possibilities for harm.

In the present uncertainty as to the value of electricity in aural therapeutics, it seems to me better to refer any one wishing to investigate the subject, to treatises and

articles in which the general and special methods of application can be more exhaustively handled than would be possible in the present article.

III. GENERAL REMEDIES.—It is self-evident that general conditions are often of the utmost significance in local disease; that ear diseases may both cause, and arise from, constitutional disturbances, and that the cure of the former may be greatly hindered unless our therapeutic efforts take into account not only the local disease, but the general bodily health as well. Suppose, for example, a disease of the ear has for its underlying cause tuberculosis, anæmia, disturbances of nutrition, etc.; the best results can be obtained only by using all the therapeutic procedures, medicinal, hygienic, dietetic, etc., which medical science offers for the cure of these conditions. The following should receive careful attention: the climatic conditions; the condition of the dwelling-place; the choice of bedrooms; the proper ventilation of the house; and the suitability of the clothing. A general tendency to take colds must be combated; the condition of the general circulation is an important factor; outdoor exercise may have to be urged; the school life of children often needs regulation; tobacco and alcohol will need to be limited or stopped; and, finally, the evil effects of late suppers, venereal excesses, masturbation, etc., must all be done away with. Changes of climate from cold to warm, and vice versa, or from the seashore to the mountains, often accomplish, especially among children, what local treatment utterly fails to effect. Patients who show a tendency to frequently recurring stubborn middle-ear catarrhs, as well as those who are subject to the milder transient catarrhal attacks, need a stimulation of the superficial circulation. Such patients may often be benefited by baths, saline, hot and cold, Russian, Turkish, etc.

Treatment of ear diseases by internal medication, formerly almost the exclusive treatment, still has its uses. For example, purgation in acute ear processes, especially in those of full habit, after blood-letting, is of practical use, as it is also in chronic passive hyperemic conditions of the ear. Pilocarpine, which is so effective in inducing sweating, may also afford material aid to local treatment, in cases of acute and chronic middle-ear catarrh, by favoring the absorption of exudates or as yet unorganized inflammatory products in the internal ear. A kind of specific action has been ascribed to the use of quinine, in the manner recommended by Charcot, in Ménière's group of symptoms. Although in general I do not approve of the use of narcotics, antineuralgics, and antipyretics, in affections of the ear, there are times when it seems necessary to prescribe them.

Suggestion and hypnosis have been recommended for the cure of hysterical deafness, and Urbantschitsch claims to have achieved success with it in the relief of tinnitus as well as deafness. Other writers also have published good results from its use. Nevertheless, great caution must be urged upon those who contemplate dealing with remedies such as these.

J. E. Sheppard.

EAR DISEASES: INTRACRANIAL COMPLICATIONS OF ACUTE AND CHRONIC INFLAMMATIONS OF THE MIDDLE EAR.—The intracranial complications of suppurative otitis are due to infection of the brain and its membranes by the same microbes which are infecting the ear, the infection reaching the brain either through caries of the bone in direct relation with the brain, through some of the natural passages which lead from the aural cavities to the brain, or through some of the connective-tissue fibrils and minute blood-vessels which pass through the bone. The intracranial disease originates, in most cases, at the point where the infection has penetrated the cranium; consequently, when the extension is through the roof of the tympanum or mastoid it is in the cerebrum, and where the extension is through the medial wall of the mastoid or through the labyrinth it is in the cerebellum. The intracranial infections of otitic origin manifest themselves as pachymeningitis, leptomeningitis, brain abscess, and sinus-phlebitis.

PACHYMEMINGITIS is an infective suppuration of the external surface of the dura mater. It may be limited in extent about the spot where the infective material entered the skull, and by adhesion of the dura to the bone the pus may be confined to a small area—the so-called extradural abscess; or it may be diffusely spread out over a large surface of the dura. When the dural inflammation forms about the lateral sinus it is called perisinous pachymeningitis; when over the tympanic roof, epitympanic pachymeningitis. When an extradural abscess has formed, it may be large enough to produce brain pressure; but when the pachymeningitis is diffuse, the pus is usually in such a thin layer that marked brain pressure is wanting.

Pachymeningitis is the most frequent of the intracranial complications. Jansen asserts that it is four times as common as sinus-phlebitis, and twenty times as common as brain abscess. Perisinous pachymeningitis is its most common form. Pachymeningitis is very often associated with one or more of the other intracranial diseases; the most common being phlebitis of the lateral sinus in connection with perisinous abscess.

Symptoms.—In the majority of the cases the development of the disease is insidious, and marked by no symptoms whatever that can be distinguished from those of the ear affection, the pachymeningitis being discovered on removal of the carious inner wall of the mastoid or of the carious tympanic or mastoid roof. In exceptional cases, and particularly in children, there may be in the beginning a chill with fever. Other symptoms, when present, are due to pressure on the brain: headache, general or localized on the affected side; slowed pulse rarely; and somnolence. Fever is the exception rather than the rule, except in the last few hours of life.

LEPTOMENINGITIS (an infective suppuration of the arachnoid and pia) is often the closing scene in cases of brain abscess, sinus-phlebitis, and pachymeningitis, but in more than half the cases it exists alone and is due either to a general sepsis or to infection of the arachnoid and pia through the minute blood-vessels. There are two distinct varieties of the disease: the rapid, almost apoplectic variety, usually fatal in from a few hours to two or three days; and the protracted variety, of from two to three weeks' duration.

Symptoms.—Fever and headache are the two prominent symptoms. In the rapid variety the fever is high (104° to 106° F.), with a very variable curve and continuous; in the protracted variety it is alternately high and normal or subnormal. In both varieties headache is usually present in the earlier stages, in most cases of a very intense character and referred to any part or the whole head. It is, however, often remittent; exceptionally the headache is only slight. As the disease progresses symptoms of irritation of the brain appear: restlessness, excitement, sensitiveness to noises and light, nausea, delirium. From irritation and pressure on the gray substance of the convexity of the cerebrum we may have convulsions of the extremities, with monoplegic or hemiplegic paralyses; from exudation in the fossa Sylvii, occasionally motor aphasia. From involvement of the base of the brain there may be symptoms of irritation and pressure on the cranial nerves of the base, showing themselves, in the ocular muscles, as strabismus and ptosis, or as dilatation or contraction of the pupil without reaction to light; in the facial as facial paralysis; in the vagus as disturbances of respiration. Constipation is almost always present.

Diagnosis is easy in the rapid variety, for the high fever, the excruciating headache, and the brain irritation followed by paralytic symptoms, monoplegic or hemiplegic, in the extremities when the disease is in the convexity of the cerebrum, or in the cranial nerves (third, fourth, fifth, sixth) when the disease is at the base of the cerebrum, or in the seventh, eighth, and tenth when it is at the base of the cerebellum,—leave no doubt when the disease of the ear and of the bone has been already recognized. In the protracted variety the diagnosis is very difficult in the earlier stages, for the moderate headache and remittent

fever are found also with sinus-phlebitis, and, only when the serious disturbances of the sensorium set in, can the diagnosis be absolute.

Lumbar puncture (Quinke) and examination of the cerebro-spinal fluid which is withdrawn are in some cases of undoubted value in proving the diagnosis, but in what



FIG. 1784.—Caries of the Sigmoid Groove. Leptomeningitis of cerebellum.

proportion of the cases cannot yet be said to be determined. The presence of the pyogenic organisms, the Streptococcus and Diplococcus pneumoniae, is confirmatory of the existence of leptomeningitis, as is also probably that of the Staphylococcus aureus and albus, but the absence of the organisms cannot be said to exclude the disease. For a detailed description of the method of procedure see Vol. II., p. 248.

Treatment.—Ice to the head, best by a Leiter's coil, and leeches behind the ear and to the temporal region, with morphine subcutaneously, often afford a certain measure of relief. By exposure and incision of the brain membranes, in cases in which the disease was circumscribed, Macewen has effected a cure in several instances.

Prognosis.—Only within the last few years has the prognosis of otitic leptomeningitis been considered other than absolutely unfavorable; coma sets in, sometimes with convulsions, and death ensues. The opinion now seems to be gaining ground that patients occasionally recover, although anatomical proof of this is very difficult. The otitic intracranial diseases present usually such a confused mass of symptoms that when a recovery from apparent leptomeningitis takes place one is apt to consider that an error in diagnosis has been made, but I myself—judging from my own clinical experience and from that of others—believe that recovery does sometimes occur. The only anatomical proof I can offer is that of a case of otitic brain disease which presented all of the characteristics of leptomeningitis, and yet recovery was perfect; but, death having occurred six months later, from another disease, the autopsy showed old adhesions with slight thickenings of the dura, arachnoid, and pia over the convexity of the cerebrum on the side of the ear affection. These were considered by the pathological experts to be the result of leptomeningitis, but, unfortunately, the value of the specimen was not appreciated, and no thorough examination and report of it were made.

BRAIN ABSCESS is much more common from chronic than from acute tympanic suppurations, the proportion being variously given at from 83 (Jansen) to 91 (Grunert) per cent. for chronic, against 17 to 9 per cent. for acute. In 92 (Körner) per cent. of the cases the bone is diseased directly on to the dura, and the abscess is usually connected directly with the suppurating ear, either lying directly against the diseased bone, or situated within the brain at a distance of from a quarter to half an inch from the diseased bone, but connected with the latter by a fistulous tract. In 9.5 per cent. of the cases there are multiple abscesses, usually connected by fistulae. In 6.6 per cent. (Körner) the abscess lies within the brain, and is separated from the bone by normal brain tissue, it being

assumed, in these cases, that the infection was communicated by phlebitis of the minute blood-vessels or along the connective tissue accompanying the blood and lymph ves-

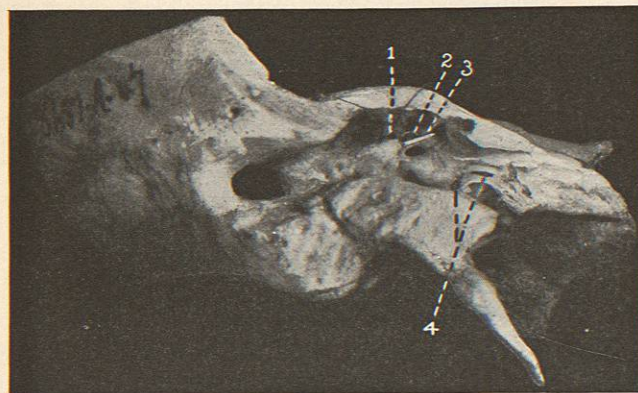


FIG. 1785.—Abscess of Cerebellum from Infection Through the Labyrinth and Meatus Internus. 1, Caries extending into external semicircular canal; 2, caries involving the vestibule; 3, facial nerve exposed by carious destruction of the bone; 4, caries extending into the carotid canal.

sels. The common seats of abscess are, in the cerebrum, the middle and posterior portion of the temporal lobe in the third temporo-sphenoidal convolution; in the cerebellum, the outer portion of the lateral lobe close to the inner wall of the mastoid. Less common seats of abscess are, in the cerebrum, the second or first temporo-sphenoidal convolutions of the temporal lobe, the frontal lobe, and very rarely the occipital lobe; in the cerebellum, in its extreme anterior portion. The path of infection decides this; when the latter travels by direct contiguity through the roof of the tympanum or mastoid the abscess is in the third temporo-sphenoidal convolution; when it extends along the vessels or connective tissue, the abscess may be in the other portions of the cerebrum; when it extends by direct contiguity through the inner wall of the mastoid, the abscess will be in the lateral lobe of the cerebellum; and, finally, when it extends by continuity through the labyrinthine cavities, the collection of pus will be found in the extreme anterior portion of the cerebellum, close to the aqueductus vestibuli or meatus internus.

Symptoms.—These are divided into four stages: *initial*, marking the beginning of the encephalitis, and often showing a slight inflammatory fever, but this usually so slightly marked that it is referred to the tympanic suppuration; *latent*, sometimes of weeks' or even months' duration, with only occasional slight brain symptoms, slight headache, depression, and perhaps moderate evening temperature; *manifest*, from a few days' to several weeks' duration, when many of the characteristic symptoms of brain abscess to be spoken of show themselves; *terminal*, usually rapidly fatal from increasing brain pressure, brain oedema, or rupture into the ventricles.

The manifest symptoms are well classified by von Bergmann into (1) general, (2) brain and brain pressure, (3) local.

The general symptoms are referable to the suppuration alone, but are seldom very pronounced—usually a slight

evening rise of temperature and anorexia; chills are rare. Slight intermittent rises of temperature are common, but a steadily rising temperature is against the probability of abscess. In children the fever may be more pronounced.

Brain and brain-pressure symptoms are produced by a diminution of the space within the skull. There is headache, persistent, varying in intensity, but not usually severe. Its location, however, is no indication of the situation of the abscess. Slowing of the pulse is often present, but is not constant, and sometimes disappears, probably from the breaking down of the brain tissue and consequent relief to the pressure. Dizziness, nausea and vomiting, and constipation are common; disturbances of the sensorium in the form of slow cerebration and drowsiness are very common, but delirium is rare. Convulsions of the extremities and of the facial may come from pressure on the temporal lobe of the opposite side; general convulsions are usually due to pressure on the cerebellum. Optic neuritis is often seen, usually of slight degree. All of these symptoms may disappear and then reappear, being most pronounced during the evening fever; and von Bergmann says that if, at this time, the pulse becomes slow and the patient somnolent the suspicion of abscess is increased.

Local brain symptoms are produced by (a) direct injury of brain substance, (b) by action of the abscess on parts away from the seat of disease, or (c) by injury of the cerebral nerves.

(a) If the abscess is in the white substance—the common position,—no localizing symptoms are present; such are only to be expected when some centre of the gray matter of the cortex is involved, and it is extremely rare for an abscess actually to destroy the centres in the cortex, and symptoms from these centres are consequently rather due to pressure from a distance than to actual destruction. In very exceptional cases such destruction may occur.

(b) Pressure of the abscess on distant parts (Fernwir-

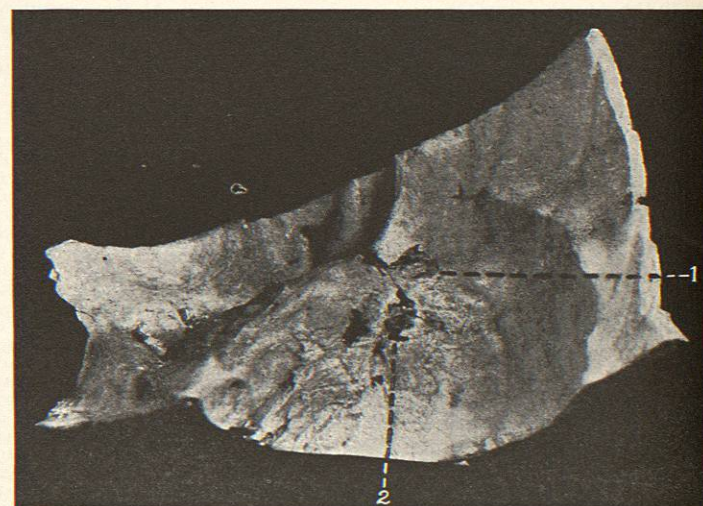


FIG. 1786.—Caries of the Whole Labyrinth. Abscess of cerebellum.

kung, as the Germans term it) through the intervening tissue is the most common cause of localizing symptoms emanating from the brain and the usual cause of injury of the cerebral nerves. Any such pressure is limited,

however, absolutely by the tentorium, and consequently cannot extend from the cerebrum to the cerebellum or vice versa. It is not limited toward the internal capsule, the lenticular nucleus, the facial, and the motor and psycho-sensory tracts, and is only partially limited by the pia between the temporal, frontal, and occipital lobes. In the cerebrum the seats of otitic abscess are almost universally in the temporal lobes, lower frontal lobes, and the occipital lobes; rarely if ever in the parietal lobes. The temporal lobes are by far the most common situation. The determined focal centres in these parts are the motor speech centre, in the lower part of the third frontal convolution in the Rolandic cortex; the general auditory area in the superior (first) temporal convolution in the cortex surrounding the temporo-parietal sulcus, where the auditory nerves have their ultimate distribution, probably by complete decussation; the sensory speech centre in the posterior two-thirds of the superior (first) temporal convolution, just in front of the angular gyrus; the visual centre in the posterior portion of the inferior parietal lobe, *i.e.*, the angular gyrus; and the primary visual centre in the occipital lobe (cuneus). The inferior frontal (third), the superior temporal (first), and the inferior parietal gyri represent the confines of the zone of language, the former for kinesthetic perceptions, the next for auditory perceptions, the last for visual perceptions.* Perversion of function of the zone of language gives aphasia, and, as the most common seat of abscess is in the temporal lobes, aphasia in some of its many forms would be looked for in these cases if any localizing symptoms existed. As a fact this is the case; in 83 abscesses in the left temporal lobe 52 showed disturbances of speech—*viz.*, 7 word-deafness, 11 paraphasia, and 23 amnesic aphasia, which included 14 cases pure, 5 with monophasia, 4 with alexia or agraphia, and 3 with optic aphasia; while in 12 no accurate analysis of the variety of aphasia was made.†

It must be remembered, however, that these determined centres apply to the left cerebrum in right-handed persons, and to the right cerebrum in left-handed persons, although it seems probable that the same centres exist in the opposite hemispheres, but are only partially developed.

In most cases an accurate and careful analysis of the exact form of aphasia is impossible to the surgeon who finds the case urgent. What he wishes to know is whether he is to look for the pus near the Rolandic fissure or in the central or posterior portions of the temporal lobes. Given the aphasia, if he can decide whether it is motor or sensory, he has an answer. Sensory aphasia is a defect in speech due to interference in the reception and interpretation of speech; motor aphasia is a disability in respect to externalization of speech.‡ To put it roughly, it may be said that if speech is not understood we have sensory aphasia, if speech is not possible we have motor aphasia; that, however imperfect the patient's speech may be, if he understands what is said to him, the aphasia is motor; that if he cannot think of the word wanted, although he is able to say it, the aphasia is sensory; but that, if he can think of the word but is unable to say it, the aphasia is motor. Absolute impossibility of speaking must not be looked for, however, in motor aphasia, and Collins adds to the above description of motor aphasia that the patient may be able to articulate one or several words which he uses pertinently or non-pertinently; that the words used are often recurring utterances; that agraphia always exists and is proportionate to the aphasia, showing itself in voluntary writing and in writing from dictation, but not in writing from copy, for in copying he copies print in script, and script in script, thus proving not a mechanical but an intellectual act; finally, that defective internal speech is present.

Sensory aphasia points to the posterior portions of the temporal convolutions, while motor aphasia points to the neighborhood of the Rolandic fissure. From pressure on

the motor, facial, and psycho-sensory tracts of the internal capsule may be produced crossed pareses of the extremities, crossed convulsions, and crossed hemianesthesia and hemiplegia.

Abscesses of the cerebellum encounter no distinct brain foci. The function of the cerebellum is still but imperfectly understood. Luciani describes it as an organ giving motor innervation to all the voluntary muscles, but particularly to those of the lower extremities and to the spinal stretchers, and having also a tonic, static, and trophic function. The vermiform process of the cerebellum is considered by Nothnagel and von Bergmann to be concerned in equilibration. From these observations we should expect motor disturbances with convulsive action in the muscles, especially of the lower extremities and back, and disturbances of equilibrium,—symptoms which have been observed but not with sufficient frequency and critical analysis for us to speak very positively of their value. Action from a distance of a cerebellar abscess is but little, if at all, limited by the pia, and may affect not only any part of the cerebellum and vermiform process, but may extend its influence to the pons and medulla oblongata.

(c) **Injuries of the Cerebral Nerves.**—Of these the most common is pressure on the third (oculomotorius), giving paralysis of the upper lid and pupil with ptosis and dilatation—symptoms which are observed in the case of an abscess of the lower (third) temporal lobe; occasionally paralysis of the sixth (abducens) comes from this same cause. Injury of the fifth (trigeminal), producing neuralgia, may be due to pressure on the nerve in its course or to pressure on the Gasserian ganglion from abscess in the temporal lobe. Paralysis of the seventh (facial) may be due to pressure of a cerebellar abscess on the meatus internus, or to pressure on the pons; in the former case the paralysis is on the affected side only; in the latter it may be on the affected side only, or it may be a crossed paralysis on the opposite side, or it may be on both sides, according to the pressure on the pons where the fibres cross.

It must be confessed, however, that in the majority of brain abscesses localizing symptoms are not present, at least in the earlier stages when surgical interference is often of great value, and the surgeon is guided in his search for the abscess by finding the spot where the infection penetrated the skull. This he does by exposing the ear cavities and following the disease inward through the carious penetration of the skull, and thus exposing the dura, through which in many cases a fistula leads directly to the abscess.

Diagnosis of otitic brain abscess is almost impossible in the initial and latent stages; it is often uncertain in the manifest stage unless we are able to build up a connected series of symptoms; in children it is specially difficult on account of the impossibility of making out the nicer distinctions of symptoms. It is comparatively easy when a fistula through the bone leads to the abscess, and this is fortunately the case in a very large proportion of the cases.

As a first help in diagnosis we have a distinct etiological cause in the suppuration of the ear; next, we look for general brain and brain-pressure symptoms. The general brain symptoms are not in themselves of diagnostic value, and only become in a measure confirmatory in connection with other symptoms. Brain-pressure symptoms point to some process within the skull which is diminishing its capacity, and this process in connection with a suppurating ear may be extradural abscess, tumor, or brain abscess. As it is possible for an extradural abscess to press on the cortex of either the cerebrum or the cerebellum, we may have from the extradural collection all the brain-pressure symptoms which exist with a brain abscess except those due to pressure on the internal capsule, and differentiation from these alone is often impossible except by opening the ear cavities and skull. Crossed pareses of the extremities, crossed convulsions, and crossed hemianesthesia and hemianopsia, if present, point distinctly to abscess. To differentiate

* Collins: "Faculty of Speech."
† Hansberg: "Encyclopädie der Ohrenheilkunde."
‡ Collins: *Op. cit.*
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an abscess from a tumor, we have, in favor of the former, a distinct etiological cause in the aural suppuration, and more or less fever and a remission of the head symptoms; while, in the case of a tumor, there are an absence of cause, rarely any fever, and a steady increase in the head symptoms without remission. In children tuberculosis of the brain, associated with suppuration of the ear, may render the diagnosis very difficult; but brain tubercles are usually multiple, and symptoms which can only be referred to several different situations point to the presence of tubercles, while symptoms which point to the disease solely in those parts of the brain where otitic abscesses usually lie render an abscess probable.

Injuries of the cerebral nerves are common with leptomeningitis, not infrequent with brain abscess, and common with tumors, but with extradural abscess they are rare and are confined to the seventh and fifth nerves.

PHLEBITIS OF THE SINUSES OF THE DURA AND OF THE JUGULAR VEIN is less common than simply pachymeningitis, but more common than leptomeningitis and brain abscess. It occurs usually in the lateral sinus, being due to an extension of inflammation from an extradural (perisinous) abscess in the posterior fossa, but it occurs occasionally only in the superior petrosal sinus, in which case it is due to a collection of pus upon either the posterior or the superior surface of the petrous bone; it also occurs, though very rarely, in the inferior petrosal sinus only, and is then due to suppuration in the labyrinth or to caries at the apex of the pyramid. In the case of the jugular vein it is almost always due to extension of phlebitis from the lateral sinus. Phlebitis of the cavernous sinus is always associated with, and caused by extension *ex continuo* from, phlebitis of the lateral sinus. It is not unusual for all of these sinuses, together with the jugular, to be involved secondarily by extension from a primary phlebitis of the lateral sinus. It is rather the rule than the exception for these phlebitides to be complicated with the other otitic intracranial diseases of which pachymeningitis is the most frequent. The bone is diseased in immediate contact with the dura in eighty-two per cent. of the cases (Körner); and the diseased bone is on the inner wall of the mastoid, usually in the sigmoid groove.

Symptoms are dependent upon the stage of the pathological process, upon the phlebitis and thrombosis, upon suppuration of the thrombus, and upon stasis of blood within the brain.

The *phlebitis* alone gives no symptoms; the thrombus may exceptionally obstruct the circulation in the veins which drain into the sinus, but a collateral circulation is so soon established that these symptoms are generally absent. From obstruction of the mastoid emissary we may have swelling and edema just behind and below the mastoid process; from obstruction of the cavernous sinus we may have congestion of the ophthalmic veins, choked discs, edema of the eyelids and conjunctiva, protrusion of the eyeball, and congestion of the vena frontalis; and from the periphlebitic swelling we have, very rarely, paralysis of the oculomotorius (third) or of the abducens (sixth), or neuralgic pains in the trifacial (fifth). From obstruction of the jugular there are often cording of the vein, swelling and edema of the tissues and glands about the vein, and cellulitis of the neck; very rarely, from the periphlebitic swelling at the jugular foramen, there is paralysis of the glossopharyngeus (ninth) or of the pneumogastric (tenth).

The *Suppuration of the Thrombus* usually gives the characteristic symptoms of the disease. These are generally well-marked pyemic and septicæmic symptoms; well-defined rigors (one or more); high temperature (104° to 106° F.), remitting or intermitting several times a day, even falling to the normal. Metastatic infarcts are most frequent in the lungs, for the emboli are seldom small enough to pass these organs; but occasionally they are found in the spleen, the joints, or the muscles. Not all emboli are necessarily infected, however, and non-infected infarcts without abscesses occur. Metastatic abscesses in the lungs are usually in the periphery of these organs, and multiple, giving the symptoms of a profuse bronchial catarrh; they often break into the pleura and

give an empyema. It is said that non-infected infarcts may produce bloody sputa.

The *Stasis of Blood within the Cranium* may give headache, either diffuse, or unilateral on the affected side; vomiting, especially in the beginning of the disease; congested papillæ and optic neuritis, although these are not so common as was formerly thought; nystagmus, particularly on turning the eyes away from the diseased ear; psychic depression; and occasionally delirium, but serious disturbances of consciousness are unusual.

Diagnosis.—Pyæmic symptoms, chills with sharp variations in temperature, during a suppuration of the tympanum, either acute or chronic, immediately suggest involvement of the sinuses. Inflammatory symptoms in the mastoid are confirmatory; and if, on opening the mastoid, its inner wall is found to be inflamed and exposure of the dura at this spot fails to discover a large extradural abscess, the diagnosis of sinus disease is almost certain. Cording of the jugular is a sure indication of the disease and occurs, according to Jansen, in one-third of the cases. Leucocytosis I regard as of no diagnostic value, for I have found that it is present in nearly eighty per cent. of uncomplicated tympanic suppurations.

Sinus-phlebitis alone, without other intracranial disease, is found in less than half of the cases; it is usually combined with pachymeningitis and occasionally with brain abscess, and consequently the clinical picture is often bewildering till opening of the bone reveals the path of inflammation from the ear to the sinus. Sometimes a natural cure takes place by a connective-tissue obliteration of the sinus. *J. Orne Green.*

EAR DISEASES: MASTOID OPERATIONS. See *Mastoid Operations.*

EAR DISEASES: METHODS OF DIAGNOSIS.—The condition of each part of the ear may be determined with a fair degree of accuracy after a careful consideration of the subjective and objective materials at hand, notwithstanding the fact that the internal ear is entirely beyond the range of vision and that when it is in its normal condition but little can be seen of the middle ear. The examination of the ear is logically divided into the subjective examination, which includes the history and the tests for hearing, and the objective examination.

The *subjective examination* embraces the investigation into the history of the case and the carrying out of the hearing tests both for the ear as a whole and for the perceptive apparatus alone.

In ascertaining the history of the case it is important to learn what is the most prominent symptom complained of, whether one or both ears are affected, and if both, which of the two seems to be the more seriously involved. In chronic cases, when but one ear is complained of, it will often be found that both are affected though in different degrees. It is well to examine the better ear first so as to ascertain the normal direction and shape of the canal and thus facilitate a comparative test.

The duration of the affection is of importance in determining the prognosis as well as the diagnosis. The shorter the duration the better the prognosis, as a rule. The time of onset may usually be determined with accuracy in the acute cases, for these date from a "cold," from a traumatism, from one of the exanthemata, from typhoid fever, from influenza, from the expansion of a mass of cerumen, or from the introduction of a foreign body or the hatching out of maggots; while in the chronic cases, especially in those belonging to the sclerotic form of otitis media, the disease may, owing to its insidious onset, exist for a long time before its presence is noticed by the patient. The origin in such cases is often dated from the time when the tinnitus made its appearance. In other cases, however, the patient discovers by chance, long after the true onset of the disease, that he is hard of hearing in one ear. Thus, for example, he may, while lying on the good ear, miss certain familiar sounds, as the ticking of a clock. There are cases, furthermore, in which both ears have been insidiously growing hard of

hearing for a long time, but in which the patient does not become aware of his deficiency until he finally observes that he has considerable difficulty in carrying on a conversation. In still other cases the patient's attention is first drawn to his ears by the development of tinnitus or by the aggravation of the defective hearing that follows a "cold." In the early stages of hardness of hearing the patient frequently complains of a confusion of words when in company; he can hear one speaker very well, but, when several are talking at the same time, he cannot distinguish the words.

The probable *cause* can in many cases be ascertained from the answers given by the patient, and such knowledge is often a decided aid to diagnosis. The important points to be learned are: (a) whether the affection is due to any cause which affects the ear directly, as cold, traumatism, scalds, burns, frost-bite, explosions, fungi, or insects; (b) whether it is the sequel of some general malady, as one of the exanthemata, influenza, smallpox, syphilis, tuberculosis, diphtheria, gout, mumps, rachitis, malaria, whooping-cough, or some one of the numerous diseases of the nervous system, the lungs, or the circulatory apparatus; (c) whether it is the effect of some drug—usually quinine or the salicylates; or, finally, (d) whether it is a result of heredity, which, in the ear as in other diseases, often skips a generation. Unfortunately, there are many cases in which the cause cannot be traced.

Earache or pain, if present, is usually the most prominent symptom. If it develops in an ear that has previously been healthy, it indicates the existence of an acute inflammation of the middle ear or a furunculosis of the external auditory canal; if it occurs, on the other hand, during a chronic process, it very probably signifies the spreading of bone caries, or the damming up of pus, or the pressure caused by a cholesteatomatous mass. Pain may at times be purely a reflex otalgia dependent upon carious teeth or upon some inflammatory process in the pharynx or tonsils, or it may in reality be a part of a trifacial or a cervico-occipital neuralgia. It may or may not be present in mastoiditis. Careful observation of the objective signs will often determine the origin of the pain. Thus, for example, pain caused by pressure on the tragus or due to drawing on the auricle indicates an inflammation of the auditory meatus; the presence of tenderness in the depression below the lobule indicates an otitis media; while a tender mastoid indicates the existence of an inflammation in the interior of that bony prominence.

Subjective ear noises (tinnitus aurium) occur in two-thirds of all ear cases, according to Politzer. They are probably due to pressure and irritation of the nerve endings in the labyrinth. Ear noises are variously described as singing, ringing, blowing-off of steam, hissing, rushing, roaring like the waves of the seashore, certain musical notes, clicking, or voices. In some cases the noises are heard only during perfect silence, as after retiring or when the patient is reading alone. They are especially marked when the patient is fatigued, or during a "cold," or when his general condition is below par. Noises are more common in the sclerotic form of chronic middle ear catarrh than in the chronic suppurative conditions. In the sclerotic cases the tinnitus is frequently described as a singing or a blowing sound, and here it often precedes the deafness by many years, if indeed the latter ever follows. Tinnitus may occur in cases of aspergillus or of impacted cerumen, or it may follow the use of quinine or the salicylates. When it is due to drugs it is evanescent and probably is caused by anæmia of the labyrinth. If the noises are diminished by compression of the carotid artery they are probably caused by congestion of the arterioles in the middle or external ear, and in such cases they are often synchronous with the pulse. The clicking or crackling forms of noises are generally due to spasm of the palatal muscles acting on the Eustachian tube and causing separation of its sticky walls. They may also be due to spasm of the tensor tympani or the stapedius muscle. In a certain number of cases these noises may be heard by the examiner as

well as by the patient. When the subjective sounds are sustained musical notes they usually represent the high A of Beethoven. Hysterical patients may describe the subjective musical sounds as "entire operas." Voices are rarely heard except in insanity. A small epithelial scale attached to the drum membrane has at times been the sole cause of distressing subjective noises. When the tinnitus intermits the prognosis is more favorable than when it is constant.

Dizziness or vertigo is occasionally due to pathological conditions in the ear. This symptom suggests hemorrhage in the labyrinth, especially when accompanied by the chain of symptoms described by Ménière (tinnitus, nausea, vomiting, and depression). Dizziness may be a symptom in any ear disease in which there is pressure upon the membrane of the oval or of the round window, which pressure is in turn transmitted to the nerve endings. Thus, fluid in the middle ear may be a cause, or there may be increased tension of the ossicular chain in consequence of adhesions or of an increase in atmospheric pressure upon the tympanic membrane (from occlusion of the Eustachian tube). Vertigo has also been set up by syringing the ear, or by pressure made with a probe upon the free stapes, or by inflation of the middle ear. Vertigo may be a symptom of meningitis with ear involvement. It must be remembered, however, that vertigo from brain or other lesions may coexist with an independent affection of the ear. Impacted cerumen has been known to cause vertigo.

Discharge.—The character and duration of a discharge are important diagnostic factors. The discharge may indicate an otitis media, a furunculosis, an otitis externa diffusa—either simple or complicated by aspergillus,—or a fracture of the temporal bone. Should the onset of the disease be sudden, as after a cold, bathing, or one of the acute diseases mentioned above as causes; should it be accompanied by pain and by a clear or blood-streaked serous discharge; and, finally, should the pain cease as the discharge begins, an acute otitis media may rightly be suspected. A discharge that commences without pain and becomes purulent in character, indicates a tuberculous condition, especially if multiple perforations of the membrana tympani are found. The quantity of the secretion varies greatly in different cases. Thus, in diffuse otitis externa or in furunculosis it is usually slight in quantity, while in scarlet fever, in diphtheria, in influenza, in bone caries with granulations, and in mastoiditis, it is generally excessive. It is often bloody in the different forms of cachexia, in leukæmia, in cases of traumatism, and in persons in whose ears there has been a post-diphtheritic erosion of an artery. In bone caries the discharge often resembles meat washings, or else it is like serum and irritating in character. In fractures of the base, and at times after operation on the stapes, there is an excessive serous discharge, which rapidly fills the meatus if it is not firmly packed. The presence or absence of odor does not throw any light upon the question whether bone caries is present or not, for the unpleasant smell simply indicates that there is retained discharge which is undergoing decomposition. The discharge may be continuous or it may intermit. Periodical brief discharges preceded by a pain indicate attic trouble, and a perforation of the membrana flaccida should be looked for. The color of a chronic discharge may be modified to any shade and it may contain detritus and numerous cocci, bacteria, and vibriones, together with epithelial scales when cholesteatoma is present. In some cases the objective examination reveals cicatrices, perforations, or adhesions, all of which lesions indicate that a discharge has existed at some previous time. Thus, for example, the small perforations which are found in Shrapnell's region, and which were formerly referred to as the foramen of Rivini, represent the remains of such a pathological process. After long-standing chronic suppuration much destruction of tissue may be expected. Thus, for example, large perforations in the drum membrane, and caries, or even the complete disappearance of the ossicula and neighboring bony parts, may be found.