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THE INDICATIONS FOR THE LABYRINTH OPERATION WITH SPECIAL REFERENCE TO ACUTE DIFFUSE DESTRUCTIVE LABYRINTHITIS*

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IT is my intention to deal exclusively with the inflammatory labyrinthine diseases of non-specific nature, which arise from the middle ear in cases of acute and chronic ear suppuration. Tuberculosis and syphilis of the labyrinth, as well as inflammatory processes during scarlatina and other epidemic diseases, are outside the scope of this paper.

1. Labyrinthitis chronica diffusa destructiva. By this I understand those cases of labyrinthitis of tympanic origin in whom obvious vestibular symptoms are noted (the rare cases of "symptomless" labyrinth destruction are included), and in whom at the time of examination no symptoms of vestibular irritation are to be seen, but in whom a complete cessation of the acoustic and vestibular functions occur. This group is called by the Vienna School diffuse purulent latent labyrinthitis.

2. Labyrinthitis circumscripta. This group includes all cases of circumscribed inflammation of the bony wall of the labyrinth, with a fistula through the latter, in which the function of the labyrinth remains. When the function has

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been totally lost, the case would, after its clinical lapse, be transferred to group 1 or 4, i.e. the chronic or acute, diffuse destructive labyrinthitis.

3. Labyrinthitis serosa includes cases in which obvious vestibular symptoms are observed, and in whom there is a strongly diminished or temporarily suspended, but returning, function or partial function of the acoustic or of the vestibular labyrinth or of both.

4. Labyrinthitis acuta diffusa destructiva includes all cases in which the acoustic and vestibular functions are completely and definitely lost in a very short time, either suddenly or in the course of few days. This group corresponds to the acute purulent labyrinthitis of the Vienna School.

The expression purulent was replaced in my first paper by the term, " diffuse destructive ". This is a purely clinical expression and has nothing to do with the pathological-anatomical processes in the labyrinth. But the conception " diffuse destructive " is, in my opinion, the best description of the condition. It is at the moment when the labyrinth disease becomes diffuse, as manifested through the destruction of the nervous function of the whole labyrinth, that the danger of extension to the meninges becomes imminent.

This complete and lasting loss of function may be, and often is, contingent upon a disease in the labyrinth of a non-purulent character. The experienced operator will often have found this on opening the labyrinth, and Zange's very thorough histological researches have shown that the acute, serous inflammation of the interior of the labyrinth may cause an acutely occurring, complete and lasting loss of function. Here we face a toxic inflammation with or without invasion of the labyrinth with bacteria. In the first case the toxins are formed in the interior of the labyrinth by slightly virulent or few bacteria. In the second case the toxins from the middle ear attack the inner ear through the membranes or through a fistula in the bony labyrinth. Such a diffuse, toxic destruction is often the cause for the acute, diffuse, destructive labyrinthitis, which occurs during acute middle-ear suppuration, especially in the first days of the latter. Other purulent conditions in the middle ear, such as cholesteatomata with labyrinthine fistula, can be the starting point.

Thus the term " purulent " in a series of cases might involve an absolutely unjustified resort to a surgical operation on the

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labyrinth according to the rule: *Ubi pus, ibi evacua.* How unjustified this resort would be will be seen sufficiently clearly in the following Table (I), which comprises the whole material from the Ear Department of the Municipal Hospital of Copenhagen in the period of 1907-27 (inclusive).

TABLE I.

	Intracranial complication.*	No intracranial complication.	Total.	Labyrinthectomy.	Died of	
					Labyrinth Disease.	Non-labyrinth disease.
Labyrinthitis chronica diffusa destructiva ..	5	42	47	15	5	1
Labyrinthitis circumscripta ..	4	108	112	6	1	4
Labyrinthitis serosa	15	87	102	9	3	3
Labyrinthitis acuta diffusa destructiva	87	43	130	96	41	17
Total	111	280	391			

* By intracranial complication is understood every cell-increase in the cerebrospinal fluid from very few cells to quite turbid fluid, accompanied by the other intracranial labyrinthogenous complications.

If we look at the column " Labyrinthitis chronica diffusa destructiva " it indicates that the labyrinth disease has absolutely quieted down without operation on the labyrinth in the large majority of cases (thirty-two out of forty-seven cases). Only in a minority of the cases (fifteen as a whole) a labyrinth operation has been necessary, either because an intracranial complication occurred (five cases) (in these there was a slight increase in the number of cells in the cerebrospinal fluid), or because the labyrinth was found to be attacked by the osseus disease (cholesteatomatous-invasion, labyrinth necrosis, etc.) when the radical mastoid operation has been done.

Ruttin, at the Vienna Congress in 1927, and others have stressed the point that chronic labyrinthitis very often causes complications, especially in the posterior cerebral fossa (deep epidural abscess, cerebellar abscess, meningitis). We must, however, after systematic examinations of the cerebrospinal fluid of our patients, maintain that this rule hardly holds.

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Among forty-seven patients we have found only three in whom the meningitis was induced by a latent labyrinthitis, one case, in which a deep epidural abscess came into existence, and, lastly, one case in which the possibility that a cerebellar abscess has been induced through the labyrinth in the latent stage of the inflammation could not be excluded with certainty. On the other hand we have eight cases of labyrinthogenous cerebellar abscess, in which our examinations of the cerebrospinal fluid have told us with certainty that the cerebellum was infected while the labyrinth disease was in its acute stage, even though the abscess in several cases did not manifest itself until the latent stage of the labyrinth disease.

A relatively large collection of material has shown us, which later observations have always corroborated, that the chronic diffuse destructive labyrinthitis in the large majority of cases completely and definitely ceases to exist without causing intracranial complications. We have, therefore, for many years adopted the rule in cases of chronic diffuse destructive labyrinthitis, to do labyrinthectomy only if there are symptoms of intracranial complication, or if the labyrinth has been attacked also by the osteitic process in the middle ear and processus mastoideus.

The results of this conservative therapy have not, as far as I know, been surpassed by the results in any other otological service with a similar large collection of material, and a large number of patients will be saved from an unsatisfactory and somewhat dangerous operation and injury of the facial nerve by its adoption.

It must be added that among the forty-seven cases of chronic diffuse destructive labyrinthitis there are patients who were found to suffer from paralysis of the nervus facialis before any surgical operation. In these cases, except for a single one (in whom, for other reasons, no surgical operation whatever was done) labyrinthectomy was made, the operation showed that the labyrinth was attacked by osseus inflammation in every case. The paralysis of the facial nerve beforehand tells us that a labyrinthectomy in cases of chronic labyrinthitis must in all probability be done at the same time as the radical operation on the middle ear. Moreover, the paralysis of the facial nerve does not aggravate the prognosis (only one out of these eight patients had an intracranial infection).

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Indications for the Labyrinth Operation

The danger of chronic diffuse destructive labyrinthitis has undoubtedly been very much over-estimated. As a matter of fact the danger of circumscribed labyrinthitis, labyrinth fistula, as well as that of serous labyrinthitis is at least as great. It is true that this cannot be seen directly from the quoted statistics (Table I), from which we can only see that, among 112 cases of fistula and 102 of serous labyrinthitis, there were respectively one and three deaths. What I am postulating here, however, will be obvious when I call attention to the fact that among the 130 cases of acute diffuse destructive labyrinthitis with sudden cessation of the labyrinth function, thirty-three patients went on to a meningitic stage. Or, in other words, among 159 cases of fistula we find $4+33=37$, which directly or indirectly—i.e. with an acute labyrinth destruction as a connecting link—had intracranial complications which resulted in death in $1+11=12$ cases.

If anybody should think that there is a well-defined intermediate stage between the circumscribed labyrinthitis and the meningitis, namely the acute diffuse labyrinthitis, and that it may be possible at this stage to do a labyrinthectomy, this view is I think only partly correct. Not only had the infection of the meninges in four of the cases been established before the extinction of the labyrinth function, but subsequent elaborate examinations of the cerebrospinal fluid have shown us that about half of the cases were infected intracranially on the very same day, when the function, or rather the remainders of the function, were extinguished, as it was possible immediately to prove an increase of the number of cells in the cerebrospinal fluid, and even to find in some cases definite turbidity of the fluid.

Thus we have often in cases of fistula, in spite of careful watching of our patients, missed the connecting link, the diffuse labyrinth extinction, before the meningeal infection.

When it is nevertheless absolutely justifiable, in the case of the fistulous labyrinthitis with retained function or remains of function, to take a purely conservative view, this is due to the fact that the large majority of cases of fistulous labyrinthitis are arrested completely and definitely by the clearing out of the middle ear and the mastoid process which is almost always indicated. That this is so, is to be seen numerically from the material (1907-27) mentioned in Table I, which consists of 112 cases of fistulous, circumscribed labyrinthitis.

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Among 130 cases of acute, diffuse, destructive labyrinthitis which are mentioned there are furthermore thirteen cases in which an acute, diffuse destruction of the labyrinth occurred after the radical operation on the middle ear and the mastoid process in cases in which a fistula was previously present. Of these thirteen cases six had intracranial complications with a fatal issue in two cases. The 112+13 =125 cases of fistulous labyrinthitis all had the radical operation. In other words in about 10 per cent. there occurred a post-operative, acute extinction of the labyrinth function, and 5 per cent. had intracranial complications.

Thus we adhere to our purely conservative view in fistulous labyrinthitis with retained function (or remains of function), because we have in the examination of the cerebrospinal fluid the means of controlling the inflammation with a timely labyrinthectomy in view of possible intracranial complications —a question, that is discussed in more detail in the following paragraph.

I have drawn attention as early as in my first paper in 1921 to the fact that labyrinthogenous meningitis can be produced by a circumscribed as well as by a serous labyrinthitis with retained remains of function. Holmgren, at the Fourth Northern Otolaryngological Congress in Helsingfors in 1923, reported no fewer than ten cases of this nature. At the Fifth Northern Congress in Aarhus in 1926 I mentioned fourteen cases belonging to the same group, and at the Congress in Vienna in 1927 five more cases.* As can be seen from Table I, four of our nineteen cases from 1927 were infected intracranially through a labyrinthitis circumscripta, and fourteen through a serous labyrinthitis. Besides the nineteen verified cases mentioned here there are also some cases among our patients in which it appears from the notes that the meninges were probably infected before complete cessation of function, although this cannot be verified, because at the critical time no examination either of the cerebrospinal fluid or of the labyrinth was made. Thus we maintain that the labyrinthogenous

* The following case may be added (watched after 1927) : Journ. 593/31. 19 years ♂. Received in the hospital on 30.4.31. Diagnosis : Otit. cholesteatomatosa sin. Fistula can. semicircul. lateral. Nystagmus to right. Positive fistula symptom, no caloric reaction. Hearing in the ear. 18/3 cells in the cerebrospinal fluid. Radical operation + labyrinthectomy. Recovery.

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meningitis is induced by a labyrinth with remains of function more often than we are able to prove statistically.

It is by examination of the cerebrospinal fluid and only this that severe circumscribed and serous labyrinth cases can be discovered. Examination of the cerebrospinal fluid is therefore absolutely necessary in every case of definite serous labyrinthitis as well as in cases of circumscribed labyrinthitis with definite labyrinthine symptoms and markedly reduced function, if the other clinical observations call attention to the possibility of an incipient meningeal infection. The indication for lumbar puncture with a timely labyrinthectomy in practice works in the same way in which it does in a case of acute labyrinthitis with complete destruction of function.

It is necessary to say something here about the significance of paralysis of the facial nerve as an accompanying symptom of the circumscribed and the serous labyrinthitis.

As I mentioned before, this paralysis, in cases of the chronic destructive labyrinthitis is, as a rule, identical with a deep inflammatory process in the bony labyrinth, but the meninges are seldom infected for the reason (an early operation being presupposed) that the chronic inflammation with granulation tissue creates a, temporarily, fixed barrier. This is also the case with regard to the paralysis in cases of circumscribed labyrinthitis. Among the 112 cases of circumscribed labyrinthitis mentioned in Table I (page 427) there are thirteen which were found to have a one-sided paralysis of the facial nerve, only one of these thirteen cases having intracranial complications.

Conditions are quite otherwise in cases of the acute, serous labyrinthitis. Among the 102 cases mentioned in Table I there are fourteen with unilateral paralysis. In six of these fourteen cases (in other words very frequently), there occurred with absences of labyrinthine function or rather—remains of function—a labyrinthogenous infection of the meninges. Therefore we look upon facial paralysis as an absolute indication for lumbar puncture in any case of serous labyrinthitis. Stressing the fact, however, at the same time, that in eight of these fourteen cases no infection of the meninges occurred, I must very definitely dissociate myself from Ruttin and Leidler, when they state that labyrinthectomy is indicated in every case of labyrinthitis combined with paralysis

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of the facial nerve, even those with retained labyrinth function. The labyrinth disease as well as the paralysis may, in the last-mentioned eight cases, be looked upon as localized—non-bacterial—toxic inflammatory phenomena without a tendency to extend to the meninges. Finally, as always, it is the result of the fluid examination that will decide as to whether a labyrinth operation is necessary or not.

We may now consider acute diffuse destructive labyrinthitis. In Table II, below, are included the total number of acute cases of labyrinthitis with extinguished function before or after surgical operations, watched at the Ear Department of the Municipal Hospital during the period October, 1907 to May, 1935, + the cases which have been treated in the Ear Department of the Sundby Hospital from September, 1933 to May, 1935 (fourteen cases in all). The total number of labyrinth cases, diffuse and non-diffuse, chronic and circumscribed, amount to a little more than 500 cases in both departments.

TABLE II.

Labyrinthitis acuta diffusa destructiva in case of	Total number of cases.	Complicated by meningitis or increase of cells $\geqq 6/3$.	Not complicated by increase of cells.	Died of labyrinthogenous meningitis.
Acute middle-ear suppuration ..	27	19	8	18 (67%)
Chronic, simple middle-ear suppuration ..	20	15	5	7 (35%)
Chronic, cholesteatomatous middle-ear suppuration ..	80	57	23	20 (25%)
Post-operative ..	70	46	24	21 (30%)
Total	197	137	60	66 (33%)*

* Mortality of 124 cases since the middle of 1921 : 31 per cent.

It is on the basis of this material in 197 cases of acute diffuse destructive labyrinthitis, that the following views are advanced. It must be mentioned here that we in the Ear Department of the Municipal Hospital after a period of about six years, 1908-13, in which the labyrinthectomy was made according to the radical indications of the Vienna School—

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and with a fairly good result—went through a very conservative period to the middle of 1921, in which no labyrinthectomy was done, except when there were clinical signs of meningitis. In this second period we had very bad results, having a mortality of almost 75 per cent. From the middle of 1921 till now we have in the Ear Department of the Municipal Hospital, as well as in that of the Sundby Hospital, worked according to the indications established by me, which may be commented upon as follows.

Table II contains our aggregate material. I remark that our mortality in intracranial labyrinthine complications is 33·5 per cent. If we reckon the mortality only of the cases from the last period of fifteen years, since 1921, it is 31 per cent. of all 124 cases. These figures of mortality, 75 per cent. to 31 per cent., are sufficiently suggestive to make it appear that a real conservative attitude towards labyrinthectomy must be abandoned.

We have not, however, followed the purely radical view of the Vienna School, such as has been expressed, e.g. in Neumann and Ruttin's, V. and E. Urbantschitsch's and Politzer's works.

The Vienna School maintains that every case of acute labyrinthitis in connection with an absolutely dead labyrinth indicates the necessity for an immediate labyrinthectomy. This clear and simple indication-theory of the Vienna School has gained many supporters in Scandinavia, notably G. Holmgren. The view of the Vienna School is based upon the fact that when first the clinically proved labyrinthine meningitis has set in, then labyrinthectomy in most cases will be too late. This is undoubtedly true. Our second, above mentioned, period has fully convinced us of that. Now it is furthermore maintained, that it is impossible clinically to distinguish the malign labyrinthitis with a tendency to spread to the meninges, from benign cases in which the inflammation is limited to the labyrinth. The consequence then will be that one must always do a labyrinthectomy the moment that the function of the labyrinth is extinguished in order to avoid the possibility of being too late with the operation. This second postulate, however, is not correct.

It is, as I proved in 1921, through the counting of cells in the cerebrospinal fluid, possible to distinguish the malign from the benign form. For that reason I have taken up the opposite view to that of the Vienna School and maintain that the

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labyrinth disease in itself does not indicate labyrinthectomy. The indications are dependent upon the results of the examination of the cerebrospinal fluid.

Before estimating the value of the examination of the cerebrospinal fluid as an indication of the possible severity of the labyrinth disease the following facts must be considered.

It is a fact that any acute, diffuse labyrinth destruction at any time of its course may result in the catastrophe of deadly leptomeningitis. The consequence of this would be the unconditional support of the indications of the Vienna School if it were that the next stage after the complete destruction really was always diffuse, deadly leptomeningitis. But it is not so. Disregarding cases (unfortunately not so very rare) in which the extinction of the labyrinth function and diffuse meningitis take place at the same time, and in which naturally only immediate labyrinthectomy affords the possibility of saving life, it will be found that before the diffuse leptomeningitis develops there is a connecting link, which I have called " the meningeal stage of irritation ". This stage may be diagnosed clinically. The symptoms are: local or diffuse headache, causeless vomiting, slight rigidity of the neck, slight Kernig's phenomenon and lastly a slight increase of temperature. Any of these symptoms may be the first indication of the onset of diffuse meningitis, yet it is often possible to demonstrate the presence of more than one of these symptoms. The cardinal symptom is the slight increase of temperature. We have experienced (as have Neumann and others) that the labyrinth disease in itself does not cause any increase of temperature. The slight unexplained increase of temperature (37·8° to 38·0° C. as evening temperature, 37·4° to 37·8° C. as morning temperature) that may appear during the labyrinth destruction, is the most important and often the first announcement of the spread of the labyrinth inflammation to the meninges. This symptom has almost always to be proved, disregarding the cases (mostly acute middle-ear suppuration) in which there is no interval whatever between the acute labyrinthitis and the diffuse meningitis.

As soon as one or more of these symptoms appears, showing that the patient has arrived at the stage of meningeal irritation, the examination of the cerebrospinal fluid is indicated. Hereby the clinical observation is verified. Only the number of cells in the fluid is important.

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Indications for the Labyrinth Operation

Before me, Knick in Germany stressed the importance of the counting of cells for the diagnosis and the treatment of the labyrinthine meningitis, yet without being able to appreciate the extraordinary importance of the minimal increase of cells and, therefore, without seeing the necessary consequences of it. This is due to the fact that the number of cells in the normal cerebrospinal fluid was not known in earlier days.

Neel has, on the basis of the fluid of 6,004 individuals from the neurological and psychiatrical departments of the Municipal Hospital, proved with certainty that the normal cerebrospinal fluid is practically devoid of cells, i.e. it contains 0 to 1/3 cell per c.mm. I myself, after several thousands of fluid-examinations from the otological services of the Municipal Hospital and the Sundby Hospital, have arrived at exactly the same results as Neel. From this it follows that even quite a few cells mean a pathological cerebrospinal fluid, a meningeal stage of irritation, demanding immediate labyrinthectomy. Before 1921, when this matter was not clear to us, time after time we were too late in performing labyrinthectomy. I have given examples of this in my earlier works, examples which Hinsberg (in *Handbuch der Hals-Nasen-und Ohrenheilkunde*, vii., 502) wrongly used as an attack on my indication for labyrinthectomy. After 1921, when we have always performed labyrinthectomy in cases in which there was a minimal increase of cells in the fluid, we have never been too late with our labyrinthectomy for that reason. By this I mean, that in the cases developing most unfavourably we have not operated later than if we had followed the indications of the Vienna School. In my work from 1926 I have given an account of five cases with fatal issues, although the labyrinthectomy was done with an increase of 14/3, 6/3, 42/3, 180/3 and 40/3 cells per c.mm. of the cerebrospinal fluid. Zange (the Vienna Congress, 1927) used these cases as a proof that it is impossible to use the fluid-examination as a basis of indication, although I, in my paper, drew attention to the fact that all these five cases were lumbar punctured and labyrinthectomized at the moment when the labyrinth destruction happened, i.e. exactly at the moment when the radical operator would operate. Later we have watched two more cases with a fatal issue, labyrinthectomized with an increase of respectively 25/3 and 138/3 cells. Cases of this nature cannot be used as an

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argument against my indication, but they clearly show us that labyrinth destruction and fatal meningitis really may happen at the same time. The only possibility of saving life will be in doing the labyrinthectomy before the extinction of the labyrinth function, that is after a possible increase of cells at the serous stage of the labyrinthitis has been proved. If we do our labyrinthectomy on the basis of the examinations of the cerebrospinal fluid our operation will sometimes be made even earlier than that of the radical clinical hospitals in Vienna. And that is exactly the view we in consequence of our indication-theory have taken up during the later years, having frequently been able to prove a pathological cerebrospinal fluid before the definite extinction of the function of the labyrinth, and so avoid the possibility of a fatal issue owing to the infection of meninges. Opposite to this is a series of cases of acute labyrinthitis with completely extinguished function but which remain uncomplicated. Therefore the examination of the cerebrospinal fluid in many cases is absolutely the best indication of the benignity or the malignity of the labyrinth disease, nay, even better than the examination of the function of the labyrinth.

My indication-theory has been adversely criticized from various sides (Borries, Neumann, Hinsberg, Zange) on the ground that it is impossible, as Neumann says, " unceasingly to stay at the bed of the patient, day and night with the lumbar puncture-needle in one's hand ". But this is a completely wrong understanding of the problem. In my publication, in 1926, after working by this method for five years (supported by statistics), that it is almost always possible through a careful observation of the patient by means of one single or a few punctures at the right moment to reveal the early presence of cells in the cerebrospinal fluid. The right moment is the exact time when it is proved that it is a case of acute labyrinthitis with complete extinction of the function of the labyrinth.

By means of our systematic fluid-examinations we have realized that most intracranially complicated, acute, diffuse labyrinth destructions from the first moment of the destruction are accompanied by an increase of cells in the cerebrospinal fluid, being immediately in the meningeal stage of irritation. If therefore at the first—important—fluid-examination immediately after the destruction, the cerebrospinal fluid

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is found devoid of cells, i.e. with 0/3 to 5/3 cells per c.mm., then the case as a rule is and will continue to be uncomplicated.

Undoubtedly there are many exceptions to this rule. But this does not necessitate daily repeated examinations of the cerebrospinal fluid, because, as already mentioned there will be before the fatal meningitis a stage of meningeal irritation. When the patient arrives at this stage—which is at first shown by a slight increase of temperature, possibly also by slight rigidity of the neck—a second lumbar puncture will immediately be indicated. At the next examination, if meningitis is beginning, one will find an increase of cells of about 10/3 to 500/3 cells, which is an indication for immediate labyrinthectomy.

After once more stressing the point that the normal cerebrospinal fluid is practically devoid of cells, for which reason 6/3, i.e. 2 cells per c.mm. of the fluid can be said to be definitely abnormal, I shall now go on to define the plan according to which we make our surgical operations on the labyrinth.

Every patient who has been admitted to the department with an acute, diffuse labyrinth destruction, or in whom during the hospital period a sudden extinction of the function of the labyrinth is proved, is immediately lumbar punctured. If 6/3 cells or more are found in the cerebrospinal fluid, labyrinthectomy is done at once. If fewer cells are found, further development is awaited. A renewed examination of the cerebrospinal fluid will then be indicated, if signs of meningeal irritation appear, but not before. Cases of circumscribed and serous labyrinthitis with marked acute, vestibular symptoms are treated accordingly. Yet labyrinthectomy is made only in cases in which function is not extinct, if the number of cells from one puncture to another is increasing, or if at the first counting of cells an increase of 15/3 to 20/3 cells per c.mm. in the cerebrospinal fluid had already been found. (*Cf.* my work from 1926.)

Exceptions to this general rule are the traumatic acute diffuse labyrinth destructions which occur after surgical operations on the ear—such as for instance removal of polypi. Here immediate operation on the labyrinth is made in case of complete loss of function, in this case without immediate increase of cells, as it has proved to be a fact that the latter almost always appears later.

We have in the Ear Department of the Municipal Hospital since 1921, and in the Ear Department of the Sundby Hospital

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since its opening in September, 1934, worked according to the above-mentioned indication-theory. In order to be able to judge of the value of our results it is necessary to make the following group-division :

124 cases of acute diffuse destructive labyrinthitis, treated during the period of 1921 to May, 1935 :

(*a*) Admitted to the hospital with fully developed meningitis : 28 cases with 16 deaths.*

(*b*) Meningitis after admission, but before the operation of the labyrinth :

1. Labyrinth destruction with supervening meningitis : 7 cases with 5 deaths.†
2. Not operated upon in spite of meningeal stage of irritation : 5 cases with 5 deaths.

(*c*) Cases treated according to my indications :

1. Acute labyrinth destruction without meningitis, not labyrinthectomized : 19 cases without death.‡
2. Acute destruction with meningeal stage of irritation, labyrinthectomized during the latter : 60 cases with 13 deaths.§
3. Post-operative labyrinth destruction, labyrinthectomized at once : 5 cases without death.‖

ad (*a*). In all these twenty-eight cases labyrinth operation was performed immediately after admission, as it would be done everywhere.

ad (*b*) 1. Here also immediate labyrinthectomy was performed.

ad (*b*) 2. In these five cases labyrinthectomy was not done in the meningeal stage of irritation for the following reasons : deafness in the other ear (journ. 274/22). Operation is thought to be hopeless on account of debility (149/31) or

* Besides one death later (journ. 540/32) of septic angina.

† Besides one death (journ. 48/23) of non-labyrinthine cerebral abscess, after having recovered from the labyrinthine meningitis.

‡ Two deaths in this group, of non-labyrinthine diseases, one of thrombophlebitis (journ. 974/32), one of cancer auris ext. (journ. 234/21).

§ Besides three deaths of non-labyrinthine diseases ; one of thrombophlebitis (1208/31), two of non-labyrinthine cerebral-abscess, after recovering from the labyrinthine meningitis (journ. 334/27 ; 1245/31).

‖ One death in this group of thrombophlebitis at a later date (journ. 290/22).

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very advanced cancer somewhere else (1202/33). The labyrinth disease was not recognized (1070/29). Meningitis arising from a panosteitis partis petrosae with secondary labyrinth destruction occurring after the onset of meningitis (678/25).

ad (*c*). It is only on the basis of this group that it is possible to judge our method and its results. In this group we find in all eighty-four cases. In nineteen of these we avoided a useless operation on the labyrinth. In sixty cases the operation on the labyrinth was done because the patient went over to the meningeal stage of irritation.

Thirteen of these patients died of labyrinthine intracranial complications (meningitis, cerebellar abscess, deep epidural abscess, etc.). All these thirteen patients, however, were subjected to labyrinthectomy immediately after the destruction of the labyrinth, i.e. at the same time as is practised by adherents of the radical indication-theory, for which reason nothing more would have been gained by following the indications of the Vienna School. Lastly, in five cases of postoperative, diffuse labyrinth destruction, immediate labyrinthectomy was done without awaiting an increase of cells in the cerebrospinal fluid, which in all probability would have appeared, as a labyrinth destruction with marked symptoms began immediately after the surgical operation of the mastoid process of the middle ear.

The mortality in group (*c*), treated according to my indications, of eighty-four cases is 15 per cent., a result which may probably be compared to the best that has been reached in any other hospital with a sufficiently large material. But at the same time we have spared every fourth patient from a useless and serious operation with the possibility of injury to the facial nerve.

The underlying disease of the middle ear plays an important part in the severity of the disease of the labyrinth. This is seen on the figures in Table II, as it will be noticed that the mortality in cases of acute middle-ear suppuration is very much higher than in the case of other diseases of the middle ear.

Allow me to state here, that the diffuse destructive labyrinthitis is a disease which seems to be dependent to some extent on external—probably climatic—conditions in different countries. The disease for instance is rare in France and in Holland, common in Austria (Vienna) and, in relation to the

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size of Copenhagen, extraordinarily common in the two municipal ear departments of Copenhagen (which are recruited from about 600,000 inhabitants).

If we look at the acute labyrinth destruction which occurs during the acute or sub-acute inflammation of the middle ear the comparison below between the conditions in Neumann's clinic in Vienna (reported by Ruttin with an addition of case records from the literature, in the hospital at Breslau, ten cases published in 1930 by Hinsberg) and in the departments in Copenhagen shows also very marked differences. The comparison is here made on the basis of Ruttin's group-division, according to the stage at which the labyrinth disease occurred: (1) at the serous stage of the inflammation of the middle ear; (2) at the suppurative stage, shortly after the perforation of the membrana tympani; (3) one to four weeks after the beginning of the suppuration and, lastly, (4) in case of sub-acute middle-ear suppuration.

TABLE III.

	Ruttin.		Hindsberg.		Our Material.*	
	Number of cases.	Died.	Number of cases.	Died.	Number of cases.	Died.
I.	11	3	3	2	0	—
II.	7	4	0	—	20	14
III.	5	4	2	1	2	1
IV.	14	11	5	4	5	3

* The figures are from our aggregate material of 197 cases.

In the table it will be seen that acute destruction of the function of the labyrinth at the serous stage of the middle-ear disease is a common condition in Ruttin's cases, while we have never observed this with certainty. Relatively seldom, Ruttin finds the acute diffuse labyrinth destruction in the first week of the middle-ear suppuration. It is at this period, on the contrary, that we find almost all our cases (except for small groups of sub-acute middle-ear suppurations). Nay, in thirteen out of twenty cases, the labyrinth destruction was completed within two days of the beginning of the suppuration (but the

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vestibular symptoms had not begun at the serous stage of the middle-ear disease). When Ruttin, on the basis of his above mentioned material, arrives at the conclusion that the prognosis for the labyrinth disease is better, the earlier it appears during the acute otitis, this is due to the observation of a series of relatively favourable labyrinth cases, possibly of toxic (not bacterial) origin, during the serous stage of the middle-ear disease, cases which we have never had the opportunity of observing in the hospitals in Copenhagen, where on the contrary we almost always see the labyrinth destruction in the first days of the suppuration and then—as in the corresponding cases in Vienna—with an extraordinarily high percentage of mortality.

As for the indications for labyrinthectomy in the case of acute labyrinth destruction during the acute middle-ear suppuration opinions differ strongly. This is no doubt due to the fact that satisfactory results up to the present have been reached neither by a radical nor by a conservative therapy. The French School (Hautant, Ramadier, Bourgeois, Baldenweck, Lemaitre, etc.*) take a very conservative view, and do not operate on the labyrinth in the first weeks of the middle-ear suppuration, unless a meningitis sets in. The Vienna School generally does the labyrinthectomy when the disease of the middle ear has arrived at the suppurative stage.

Hinsberg, in a period before 1930, went in for conservative treatment with the result that seven of his ten patients died, after which he returned to the radical view of the Vienna School, except in cases of extinction of the labyrinth at the serous stage of the middle-ear disease.

Our twenty-seven cases of acute labyrinth destruction during the acute middle-ear suppuration† has shown me, that at no time is the careful examination of cells in the cerebrospinal fluid so necessary and important for our position as it is at this stage, if we wish to have any hope of improving the gloomy prognosis. It is seen from our material that in cases in which the labyrinth disease is complicated by meningitis, we have without exception been able to prove a more or less important increase of cells, nay, more often a turbid cerebrospinal fluid, at the moment when the labyrinth function had

* See for instance Séance 23.3.27 in Société de Laryngologie des Hôpitaux de Paris.

† From our aggregate material of 197 cases.

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been completely extinguished. In our material nineteen cases of this kind are reported. If on the other hand no increase of cells can be proved in the fluid immediately after the extinction of the function of the labyrinth, then no labyrinthine, intracranial complication will arise. Our last eight cases followed this course. Thus it seems absolutely necessary to ascertain the true position by immediate examination of the cerebrospinal fluid. If operations are performed according to my indication, then the labyrinthectomy will be done at the same time as in the services of Vienna, but labyrinthectomy will be avoided in a number of cases, in which it is not only quite superfluous, but also dangerous.

Even if we do not perform immediate labyrinthectomy, then the prognosis of cases with intracranial complications is still worse than in any other sort of primary, otogenous meningitis. Only in one out of nineteen cases was there a recovery.

There seems to be no doubt that meningitis, in the case of the acute diffuse labyrinth destruction, is induced in some cases, at any rate, through the labyrinth, before the complete destruction of function. This we have recorded several times at the examinations of fluid, and we have then in such cases performed labyrinthectomy at the serous stage of the labyrinthitis. I believe that here we are now upon the most satisfactory road, along which it is possible to improve the prognosis in these otherwise hopeless cases.

As for the common chronic—non-cholesteatomatous—middle-ear suppuration, the labyrinth disease generally arises during an acute exacerbation of the middle-ear suppuration. In fifteen of the twenty cases which are included in our total material, an intracranial labyrinthine complication occurred (here also are included cases with slight increase of cells with as much as 500/3 cells in fluid). The infection of the contents of the labyrinth in six cases was caused through a fistula in the bony wall of the labyrinth; four of these patients died. In one case (90/21) with fatal issue the labyrinth was infected through an osteitis in the petrous bone, a perilabyrinthitis. In the other eight cases the infection probably entered through the window membranes; two of these patients died. Of our twenty patients, then, seven, 35 per cent., died; five of acute, diffuse meningitis; one of cerebellar abscess; one of subdural abscess in the posterior cerebellar fossa (with deep osteitis in the pars petrosa as a connecting link (90/21)).

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Indications for the Labyrinth Operation

Here we find—just as in the case of acute middle-ear suppuration—cases, where the extinction of the function of the labyrinth is immediately followed by an important increase of cells in the cerebrospinal fluid (five cases), and where the operation of the labyrinth has therefore been made at the same time as in the hospitals in Vienna. It is still more common to find an interval between the labyrinth destruction and the infection of meninges of several days to a week (in one case even two weeks), an interval which unfortunately in several cases has been passed before the patient was admitted to hospital. The meningitis in itself is, throughout, less fulminating than in the case of the acute middle-ear suppuration, and while even a slight commencing increase of cells in these last cases generally means death, then we have at the chronic middle-ear suppuration obtained recovery in several patients, who were admitted to the hospital with an even turbid cerebrospinal fluid (one case with 2400/3 and one case with 2720/3 cells in the fluid). The mortality, therefore, is high, it is true, but is yet only half as high as the terrible mortality we find in cases of acute middle-ear suppuration.

In the third main group, the cholesteatomatous middle-ear suppurations, we find extraordinarily significant differences as compared with the two groups just mentioned, the acute and the ordinary chronic suppuration. For documentation of this the following data must be mentioned:

Our eighty cases of cholesteatomatous disease of the middle ear may, on the basis of the examination of the cerebrospinal fluid, be divided in the following way:

1. Without intracranial complications: twenty-three cases without a death.*

2. Slight meningeal infection (increase of cells $\leqq 150/3$): twenty-three cases with three deaths.†

3. Definite meningitis (four cases of labyrinthine cerebellar abscess are included): thirty-four cases with twenty deaths.

ad 2. In this group there are three deaths. In one of these cases (journ. 47/19) labyrinthectomy was done with an increase of 19/3 cells in a patient, who was very well, except for dizziness. Immediately after the operation the temperature increased, and a fulminating meningitis began after

* Among these five patients died of non-labyrinthine disease.
† Among these two patients died of non-labyrinthine disease.

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one and a half days, resulting in death. In the two other cases (journ. 1433/32 and 16/11-77) a labyrinthectomy was done with an increase of relatively 114/3 and 18/3 cells. In both cases the early meningeal infection was arrested (in one of them after one single day's increase from 18/3 to 104/3 cells), and a feeling of comfort prevailed. Then there appeared signs of deep osteitis in the pars petrosa, from which the meninges were infected again with fatal result.

In one of these cases the fatal meningitis was due to the surgical operation, in the other two to a deep petrositis.

ad 3. In twenty-five of these cases labyrinthectomy was done at a time when the cerebrospinal fluid was very turbid (as the patients were not sent to the hospital until then), yet thirteen of these patients recovered.

It will be seen from the above-mentioned notes that the contents of the cranium are infected with about the same frequency when labyrinth destruction occurs on account of the cholesteatomatous middle-ear suppuration, as in the other diseases of the middle ear, but the infection is of a much milder nature, and the prognosis for the meningeal infection is, therefore, very much better. If the increase of cells is slight ($<150/3$ cells) you can be sure of almost 100 per cent. cure as regards the labyrinthitis (while in the case of acute middle-ear suppuration one can be certain of almost 100 per cent. mortality). And even with a turbid cerebrospinal fluid more than half of the patients with cholesteatomatous suppurations are saved by the labyrinthectomy (and we have only seen this in one single case of labyrinth destruction as a consequence of acute middle-ear suppuration).

The meningitis is here of a different type than that observed during the labyrinth destruction in the course of both acute and simple chronic middle-ear suppuration as in post-operative labyrinthitis. In cases of cholesteatomatous middle-ear suppuration the meningeal infection does not occur in most cases until some time after extinction of the function of the labyrinth, and it passes off more slowly, with much less pronounced meningeal symptoms and a slower increase of cells in the cerebrospinal fluid.

Allow me to stress the point that the comparison between the different groups we have made here, emphasizes the missing prognostic importance of the very number of cells found in the cerebrospinal fluid. We have seen how a minimal increase

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of cells (20/3 to 50/3 cells) in the case of an acute middle-ear suppuration almost always means death, while with several thousands of cells we can obtain more than 40 per cent. of cases of recovery in the case of cholesteatomatous middle-ear suppuration.

As for the post-operative, acute, diffuse labyrinth destruction I shall repeat, that in cases where the destruction occurs immediately after the operation on the ear and with marked vestibular symptoms very quickly producing a complete loss of function, we have done during the last eight years immediate labyrinthectomy without waiting for the increase of cells in the cerebrospinal fluid. Our material has shown us that the meninges under the conditions mentioned are almost always infected, so that nothing is gained by postponing the surgical operation on the labyrinth. Again, a traumatic-operative opening of a semi-circular canal followed by more or less definite vestibular symptoms does not call for a labyrinthectomy, unless the acoustic and vestibular function is lost immediately after the trauma, or if (in spite of the presence of labyrinth function) an increase of cells occurs in the cerebrospinal fluid.

Also among cases of post-operative labyrinth destruction we find cases in which the meninges are infected before the final, complete loss of the labyrinth function, thus now and then a labyrinthectomy is necessary in cases of increase of cells in the cerebrospinal fluid, in spite of remains of function being present in order to avoid meningitis.

As it will be seen in Table II (page 432) we have an aggregate material of seventy cases under this category: post-operative, acute, diffuse labyrinth destruction.

With regard to the path of infection of the labyrinth, see Table IV.

It will be seen that there are seventeen cases in which osteitic changes in bony tissue surrounding the labyrinth can be proved. The labyrinth was infected in most of the cases *viâ* the labyrinthine osseus inflammation. We shall revert to this question later.

In the other seventeen cases complete extinction of the labyrinth function occurred after the mastoid operation, when a fistula of the labyrinth was present. In these then, the labyrinth was affected beforehand. In nine of these seventeen cases the meninges were infected. Three of these patients

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could not stand the labyrinthine, intracranial complication (meningitis or cerebellar abscess).

It is generally known that the radical operation in the case of circumscribed labyrinthitis with fistula formation in the bony capsule has certain risks, as is shown numerically in the introduction to this work (page 427). This risk is greatest if the operation is done at a time when the formation of the fistula has just occurred, and this time ought therefore to be avoided as far as possible. Besides, it is not without danger to operate during an acute exacerbation of the chronic middle-ear suppuration, as we have experienced several times. For several reasons—retention-phenomena with increase of temperature, etc.—it is unfortunately not always possible to wait. Where this is possible, however (with careful watching of the labyrinth function) it is certainly to be recommended.

TABLE IV.

Path of infection of labyrinth.	Total.	Intracranial infection.	Died.
Path unknown (window-infection ?)	32	18	7
Operative labyrinth trauma ..	3	3	3
Infection by paralabyrinthine osteitis	17	15	9
Infection through fistula of labyrinth	17	9	3
Tuberculous petrositis	1	1	1
Total	70	46	23*

* Two patients died of non-labyrinthine meningitis.

Disregarding the seventeen paralabyrinthine cases, and the seventeen cases of fistulous labyrinthitis, as well as one case of tuberculous petrositis (*cf.* Table IV) there remain thirty-five cases of post-operative labyrinthitis. In three of these cases a healthy labyrinth was opened by direct chisel-trauma during the operation ; in all three cases the meninges were infected with fatal issues. In thirty-two of the cases the path of infection cannot always be proved with absolute certainty. Yet in the twenty-two cases of the radical operation belonging to this group, it may be supposed that it has most often been

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a case of infection through the oval window after displacement of the stapes. Eighteen of the thirty-two cases mentioned were infected intracranially, in seven cases with a fatal issue. These thirty-five cases amount to—calculated on the basis of the collected material of the two services—about 0·75 per cent. of all the mastoid operations done during the course of the years.

If out of all these cases "only" the twenty-one were infected intracranially then these figures do not give a true impression of the danger of infection. We have, as mentioned before, during the last eight years adhered to the view to do labyrinthectomy immediately in cases of post-operative, complete labyrinth destruction, where the labyrinth was healthy before. No doubt we have by this means succeeded in saving at least some patients before even the slightest increase of cells in the cerebrospinal fluid has taken place.

The nature of the original middle-ear suppuration is of some importance in the production of post-operative labyrinthine destruction. The meninges are infected with about the same relative frequency in our cases, whether it was originally a case of an acute a simple chronic or a cholesteatomatous ear suppuration. But just as in the case of the pre-operative acute diffuse destructive labyrinthitis (*cf.* page 432) the cholesteatomatous ear suppurations are less dangerous; the labyrinthine meningitis occurs with the same frequency, it is true, but the mortality is less. Of twenty-eight cases of cholesteatomatous middle-ear suppuration with post-operative labyrinth destruction (these include the cholesteatomatous, paralabyrinthine cases) nineteen were infected intracranially with fatal issue in six cases, i.e. 21 per cent. (aggregate material). When the percentage mortality nevertheless is relatively so high it is due to the fact that four of these six cases died as the result of a labyrinthitis = paralabyrinthitis with deep cholesteatomatous invasion of the pars petrosa.

The condition of the labyrinth before the mastoid operation is of importance. In cases in which the labyrinth is healthy before the operation the risk of the post-operative labyrinth destruction is increased. Of thirty-six cases belonging to this group the meninges were infected in twenty-eight, whereas among the thirty-one cases in which even before the mastoid operation there were signs of acute infection of the labyrinth,

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but without complete extinction of function, an intracranial labyrinthine complication occurred only in seventeen cases. These figures do not give quite a correct impression of the difference in the two groups, as the paralabyrinthine infection, especially in the latter group, has an ominous influence. That a labyrinth infection that exists even before the mastoid operation, for a shorter or longer time without complete destruction, must have to some extent a repressive effect on the further extension of the infection to the meninges in the case of the post-operative, complete labyrinth destruction is self-evident and needs no further explanation. But owing to this fact it is in such cases advisable to adopt an expectant attitude when the complete destruction occurs, and not to do a labyrinthectomy unless an increase of cells in the cerebrospinal fluid occurs.

To estimate the danger of the post-operative labyrinth destruction there still remain two factors of essential importance : the time of the destruction and the rapidity with which the labyrinth destruction occurs.

These two factors may, with some reservations, be ascertained statistically by means of Table V below.

TABLE V.

Time after operation.	Rapidity of labyrinthine destruction.	Total.	Intracranial complication.	Died.
Immediate	immediate destruction	31	25	14
Later	immediate destruction	15	12	4
Immediate	slow destruction	13	5	2‡
Later	slow destruction	8	3†	0
Total ..		67*	45	21

* Three cases are omitted ; the time not ascertained.

† One of these was supposed to be a case of collateral meningitis with a non-labyrinthine epidural-abscess. In another case there was an increase of 9/3 cells. In the third case 92/3 cells.

‡ One patient died of a labyrinthine cerebellar abscess, in the other fatal case the meningitis was due to a deep petrositis, it was hardly labyrinthine.

As the table shows, the most dangerous destruction is that which follows the mastoid operation immediately and which occurs with severe acute labyrinth symptoms : in twenty-five

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cases the meninges were infected, with fatal issue in fourteen cases. Even these figures are deceptive, as we have now and then, through an immediate labyrinthectomy, succeeded in preventing the meningeal infection before a possible occurring increase of cells. But also the labyrinth destruction which occurs later after the mastoid operation is dangerous, if it occurs in a pronounced acute form, and demands immediate labyrinthectomy. In sharp contrast to this is the post-operative labyrinth destruction, whether it occurs at once or later after the mastoid operation, where the extinction of function occurs by degrees. The danger of intracranial infection is not only less, but the infection can be much more certainly controlled. A labyrinthectomy is here contra-indicated, unless the examination of the cerebrospinal fluid shows that the meninges are infected, an infection that relatively seldom happens.

We must now mention labyrinth disease in relation to the deep inflammation of the bony tissue of the temporal bone, the petrositis, especially where the latter expresses itself as an osteitis around the bony capsule of the labyrinth situated in the pneumatized bony tissue, the paralabyrinthine osteitic foci in their relation to the labyrinthine inflammatory process itself.*

Among the patients with pre-operative, acute, diffuse, destructive labyrinthitis I have found fifteen cases where there undoubtedly was an inflammatory process in the paralabyrinthine bony tissue. In one of these cases, a simple, chronic middle-ear suppuration† as well as in six cases of cholesteatomatous suppuration‡ there was massive destruction of the tissue or cholesteatomatous invasion of the bone between the semi-circular canals. These seven patients all had labyrinthectomy, by which the paralabyrinthine focus was eliminated at the same time. The six cholesteatomatous cases were cured ; in the seventh case—with simple chronic suppuration—the patient soon died of a labyrinthine meningitis. In two of these seven cases there was a fistula-formation in the bony capsule of the labyrinth. Whether the infection of the labyrinth happened this way, as might most probably be the case, or if it was induced by the paralabyrinthine osteitis, it is impossible to state with certainty. In the remaining five cases it presumably took place through such a path of infection.

* In another work the deep petrositis is treated as an independent malady.
† 370/18.
‡ 433/12, 965/33, 187/33, 1300/32, 283/31, 770/28.

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In the remaining eight cases there was a definite deep petrositis. In two patients it was a case of an acute, in two of a simple, chronic middle-ear suppuration; finally in four cases, of a cholesteatomatous suppuration. In all these eight cases labyrinthectomy was done on account of increase of cells in the cerebrospinal fluid or even of leptomeningitis which was manifest on admission to the hospital, which in two of the cases* in spite of immediate labyrinthectomy plus partial petrosectomy quickly ended with death. In the remaining six cases† the conditions as a result of the labyrinthectomy, by which the petrositis also is drained to some extent, temporarily improved with decrease of cells in the cerebrospinal fluid, then it again increased with the occurrence of the meningeal infection and symptoms of deep petrositis, which called for a further surgical operation on the deep osteitis in the pars petrosa. In spite of this only one of these patients was saved (26/10.00). In five of the above-mentioned eight cases the clinical picture as well as the operative findings permit us to believe with some certainty in an infection of the labyrinth with the perilabyrinthine osteitis as a connecting link. In the remaining three cases (451/14, 1433/32, 913/27), where there was a fistula in the bony capsule of the labyrinth towards the middle ear or antrum, it is most likely that the infection was induced through this fistula. In all these cases we may suppose that the meninges were primarily infected through the labyrinth itself which, as mentioned before, in two cases resulted in death. In the remaining six cases the meninges were once more infected through the deep petrositis with fatal issue in five of the cases.

Now I will mention the cases—belonging to the group of post-operative labyrinth destruction—seventeen in all, which show mainly the same condition as the pre-operative labyrinth destructions, only that the final extinction of the function of the labyrinth has not occurred until after the first surgical operation on the middle ear and the mastoid process. This applies to seven cases‡—four acute, two simple chronic, and one cholesteatomatous middle-ear suppuration—with an almost similar course of disease: After the mastoid operation, there was continued suppuration and labyrinth infection with extinction

* 451/14, 240/34.
† 8/12.96, 90/21, 26/10.00, 16/11.77, 1433/32, 913/27.
‡ 1210/33, 565/34, 678/25, 1140/31, 484/25, 539/25, 807/25.

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of the function and early increase of cells in the cerebrospinal fluid. In spite of labyrinthectomy the condition only improved temporarily, finally one or more surgical operations for deep osteitis in the pars petrosa were necessary. In four of these cases it resulted in death. These seven cases are of the same nature as the latter group of pre-operative labyrinth destructions with petrositis.

Corresponding to the first group of the pre-operative labyrinthine destructions with paralabyrinthine foci there are among post-operative labyrinth destructions to be found six cases*—one acute, one chronic, and four cholesteatomatous middle-ear suppurations—where osteitic foci were curetted out between the semi-circular canals, after which labyrinth destruction occurred ; in some of the cases presumably because the deep osteitis was not eliminated satisfactorily, in another case because, on the contrary, it was dealt with too thoroughly and the labyrinth itself was injured. In three of these cases the patients died.

(In the remaining four cases conditions are unable to be explained in more detail, in two of these cases it was presumably also an empyema of the saccus endolymphaticus.)

As the explanation above shows the dividing up into pre-operative and post-operative labyrinth destruction is rather illusory in cases where there is an inflammation of the deep bony tissue in the pars petrosa as paralabyrinthine foci may be present or—in more or less pronounced degree—a deeply situated petrositis. The extinction of the function of the labyrinth and the infection of the meninges have only temporary relation to the commencing encroachment upon the middle ear and the mastoid process, but are also without any great importance for the extension of the deep inflammation ; the latter must be treated as an independent malady.

We have earlier been apt to make the labyrinthectomy as conservative as possible, i.e. in cases of acute middle-ear suppuration we formerly only opened the lateral semi-circular canal and chiselled away the promontory ; in cases of chronic middle-ear suppuration two or three semi-circular canals plus the promontory were opened. It was seldom thought necessary to go as deep as the saccus endolymphaticus, and

* 605/25, 18/26, 404/24, 315/25, 867/25, 1135/33.

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certainly not as far as the internal auditory meatus according to Neumann's method.

The experiences of the later years of the deep petrositis combined with a renewed study of our material seem to be of such a character as to necessitate more radical methods of operation.

In cases of acute middle-ear suppuration it is possible (with the aid of the X-ray picture) to anticipate the likelihood of a deep petrositis, so that the opening of the lateral semi-circular canal and promontory alone is thought to be sufficient, when the infection apparently spreads through the windows in the early days of the suppuration, whereas at a later stage of the acute, middle-ear suppuration, a labyrinthectomy becomes necessary, owing to commencing infection of the meninges, possible paralabyrinthine foci or a possible petrositis ought to be subject to a more careful operative exploration.

In cases of chronic cholesteatomatous suppuration it is true that the opening of two or three canals plus the promontory will often be sufficient, but not if the deep bony tissue has been attacked at the same time by the inflammatory process, in which case this osteitis must be followed as far as possible; here in some cases Neumann's operation will be indicated. This is naturally also the case if there is a possibility of an inflammation of the saccus endolymphaticus.

At the labyrinth operation itself in Sundby Hospital we always use a drill; it has the advantage that splintering of the lamina vitrea in the fossa cranii posterior behind the labyrinth is avoided, as this almost inevitably leads to an injury of the dura, which is dangerous, especially in cases of early meningeal infection. The drill does not remove more bony tissue than is wanted and gives a very accessible area in which all anatomical details are gradually exposed.

Any deep petrositis is dealt with with the sharp spoon.

In conclusion I wish to point out that for twenty-eight years we have adopted definite views as to the treatment of the diffuse, destructive labyrinthitis: first a radical indication theory for six years, then for eight years a conservative one, and finally a last period of fourteen years, in which our indications for the labyrinthectomy were made dependent upon the result of the examination of the cerebrospinal fluid. In this last period the best results have been obtained.

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Indications for the Labyrinth Operation

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. . . .

In dieser Arbeit gibt Verf. Einzelheiten über die verschiedenen Arten der Behandlung von allgemeiner zerstörender Labyrinthitis. Während der vergangenen 28 Jahre hat er seine Behandlungsweise wesentlich geändert. In den ersten 6 Jahren wurden die Fälle durch Radikaloperation behandelt, in den darauffolgenden 8 Jahren bevorzügte er das konservative Vorgehen, während in den letzten 14 Jahren die Indikation zur Labyrinthectomie vom Ergebnis der Untersuchung der Cerebrospinalflüssigkeit abhängig gemacht wurde. In diesem letzten Zeitraum wurden die besten Ergebnisse gezeitigt.

. . . .

Dans cet article l'auteur donne des détails sur la conduite à tenir en présence de la labyrinthite destructive diffuse. Au cours de ces vingt-huit dernières années, sa manière de procéder s'est considérablement modifiée. Pendant six ans, les cas étaient traités par une méthode très radicale, puis pendant les huit années suivantes, il employait des méthodes plus conservatrices; enfin au cours des quatorzes dernières années les indications de la labyrinthectomie étaient posées d'après les résultats de l'examen du liquide cephalo-rachidien. Les meilleurs résultats ont été obtenus au cours de cette dernière période.

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