The presence of an undulating membrane, the more central position of the micronucleus and the method of development of *Herpetomonas subulata* suggest that, like the parasite of the water-bug, it belongs to the genus Crithidia.

Léger¹ believes that some of these Crithidia and Herpetomonas found in blood-sucking insects represent stages in the development of haemoflagellates of vertebrates and considers Schaudinn's observations on *T. noctuae* in *Culex pipiens* confirm his opinion. Many parasitologists, however, now believe that Schaudinn was dealing with more than one parasite in *Culex pipiens*, namely, either *Leucocytozoon ziemanni* or *Halteridium danilewskyi*, together with the trypanosome of the owl and the Herpetomonas of *Culex pipiens*; and further, I have often seen many spirilla of large size with more than one chromatic dot in their protoplasm in the mid guts of *Culex pipiens* and *Culex fatigans*. There can be little doubt that the Crithidia of the water-bug is in no way connected with any blood parasite. I shall reserve for a later occasion a complete account of the life-histories of these two parasites.

CONCLUSIONS.

1. The Herpetomonas of *Culex pipiens* and the Crithidia of the water-bug have a stage in their life-cycles in which they are very similar in form to the Leishman-Donovan body, and, further, that the former multiplies in a similar manner to the human parasite. In order to study the early stages of these parasites it is necessary to examine the hind guts and mid guts of the larvae and nymphs of the insects.

2. These two parasites pass their complete cycles in their insect hosts, and have no connexion with any blood parasite.

3. The early stages of these parasites and their method of development, together with the constant anterior position of the blepharoplast and the absence of the fully-developed undulating membrane in the mature flagellates, all suggest that they are quite distinct from the Trypanosomata.

4. There is at present no evidence of a sexual cycle or of the infection being inherited.

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ON

THE DUTY OF RESTORING HEARING BY OPERATION IN CHRONIC AURAL SUPPURATION.

AN ADDRESS DELIVERED BEFORE THE WEST KENT MEDICO-CHIRURGICAL SOCIETY.

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AURAL appendicitis is the name by which chronic aural suppuration might be known, for disease of that mucous cul-de-sac the mastoid antrum or appendix of the ear is responsible, according to my investigations, for the perpetuation of the discharge. Like appendicitis in the abdomen, that in the ear is also a latent danger. In both situations it is a grave disease on account of its liability to infect neighbouring and vital parts. In the abdomen it may cause local abscess or fatal septic infection of the serous peritoneum (peritonitis); in the ear it may cause local or cerebral abscess, or fatal septic infection of the jugular vein or the serous pia mater (meningitis). Now no careful surgeon waits for abscess in abdominal appendicitis, nor in my opinion should he wait for it in the ear, for just as removal of the abdominal appendix will eradicate the danger there, so will timely elimination of the aural appendix usually restore the ear to function and to safety.

Before alluding to the investigations resulting in the proof of these opening words,¹ I will ask you to examine this patient, M. L. Her illness of five years ago has rendered her a person of great interest, for the restora-

tion of hearing which accompanied the repair of the drum of her ear encouraged the hope of ultimately discovering how this remarkable reparative power could be made generally available. She had suffered for many months from a foul aural discharge. This culminated in acute mastoiditis, and the disease having thus become critical, operative relief was urgently needed. The disease had already destroyed the posterior fourth of the drum membrane, and the operation I performed was adapted to the condition of the ear. The mastoid process being extensively diseased was all removed, and the antrum was opened as far forward as the attic of the tympanum. The posterior wall of the bony meatus and parts of the attic bridge and tympanic ring were also removed. The small bones and the remains of the drum membrane were retained and preserved from injury, and though the tympanum was full of granulations they were left untouched. She rapidly recovered, and now you can see there is no external disfigurement, and no internal sign to indicate that she had had an operation, nor that anything has been amiss with her ear. The extensive damage to the drum membrane has been repaired, and there is full restoration of hearing. Careful observation of her recovery encouraged other investigations, and thus little by little information was obtained, which, by the Institution last year of an appropriate operation, has led to the restoration of hearing in over a hundred persons. There can be no doubt that in time to come vast numbers will receive similar relief. This sudden change in treatment is due to the recognition of our ability to restore hearing by the new operation, and implies dissatisfaction with the old radical method which does not do so.²

In 1904 I endeavoured to render more satisfactory the method known as the radical or complete operation, which was the one in general use; but I found, among the other defects of that severe measure (which was founded on the assumption that it was necessary to clear out the drum as well as the mastoid antrum in order to effect a cure), that removal of the drum membrane, which is part of the proceeding, destroyed all chance of full restoration of hearing, and further, there was no certainty of saving the little that remained. Therefore, I returned to the study of the means by which Nature had assisted this patient, M. L., to make such a remarkable recovery. Observation of her ear after operation proved that the drum possessed great capacity for repair. Close attention was therefore given, during and after the performance of many operations, to the state of the tympanic walls, to the changes that appeared in the small bones removed from the ear, to the pathological conditions found in the mastoid antrum, and to the relation they might hold to those in the tympanum. Also to the conditions present in those patients in whom acute disease had caused destruction of the whole or a large part of the drum membrane and ossicles, and where no tympanic barrier existed to free drainage from the dangerous mastoid antrum. Observation of these and other matters resulted in the conclusion that, if the antrum could not recover its health when there was no tympanic obstruction to its drainage, then the operation known as ossiculectomy (that is, removal of drum membrane and small bones), with the object of influencing the disease in that cavity, was futile, in spite of the sacrifice of the vibrating apparatus and consequent certainty of defective hearing. Treatment of the tympanum through the meatus, by dealing also with the effect and not with the cause of this disease, was usually found equally ineffective, and in early cases even worse. The delays such proceedings must entail were found to give time for the affection to advance beyond the point at which restoration of hearing might be brought about by operation. During operations it was also found that slight disease may exist in the mastoid antrum, yet not be identified, because of the obscuring presence of blood, and that all haemorrhage must be prevented if trustworthy observations were to be made.

Now, these studies have shown, as clearly as such things can be proved, that the mastoid antrum is affected in every case of chronic aural suppuration—that is the plain teaching of careful observation of upwards of 500 operations. It was only by the performance of operations that this most important information was forthcoming, and even then it could not be demonstrated except when absolute freedom from haemorrhage permitted of full and critical view.

Conclusions thus founded left little doubt that, though the original disease may have affected the whole middle ear, the mastoid antrum was the part which was least capable of recovery, and was therefore the locality where disease was most prone to persist. The chief disease was therefore shown to be, not in the tympanum, but in the mastoid antrum and its communications in the petromastoid bone, and that these parts must be eradicated in order to ensure safety to life, and to restore the hearing, for discharge from that cul-de-sac was found capable, even if only of small amount, of perpetuating and increasing the disease in the tympanum, and thus causing destruction of the drum membrane.

It was proved, too, that granulations, polypi, and mucous swellings in the tympanum, which had hitherto been considered as implying grave disease of that chamber, far from being so, were generally found to be protective and beneficent and secondary to the advent of irritating secretions from the mastoid antrum, and spontaneously disappeared, with restoration of the drum and hearing, when these secretions were cut off by this conservative operation. Discharges from the mastoid cavity were also shown to be capable of causing caries in the tympanum and facial paralysis, and these are grave conditions which might easily progress so far as to cause labyrinthine suppuration, meningitis, and death. Even these dangerous complications were also proved to be amenable to the same operative remedy without loss of the drum membrane or of hearing.¹

Two important questions, however, arose—first, whether this aspect of the pathology, which was contrary to that hitherto taught and generally accepted (and upon which the old radical operation was founded), could be relied upon; and, secondly, whether these conclusions, although drawn from a very large number of careful clinical observations, were correct. It was difficult to settle these matters except by designing an operation in accordance with these fresh observations, and performing it in a sufficiently large number of cases. This course I adopted in May, 1906, when in a month nine such operations were performed. The results of those operations, with a description of the measure and a record of the case of this patient, M. L., were published in the *Lancet* of August 11th, 1906. The patients who underwent this surgical treatment (I have named it the conservative operation, as it preserves all the structures essential to good hearing) were exhibited before a meeting of the British Laryngological and Otological Association on November 9th last (1906).

The operation has since become extensively adopted and is steadily displacing the radical operation, as the following short record will attest. It illustrates the trend of opinion, though it is from the practice of only three of the many surgeons who have lately adopted this operation, and they have authorized the publication of their names.

Dr. Percy Jenkins, Surgeon to the Central London Throat and Ear Hospital, has recently performed 23 mastoid operations for chronic aural suppuration, and of these 25 were by this new conservative method.

Dr. Frederick Spicer, Surgeon to the Metropolitan Ear and Throat Hospital, has lately done 14 mastoid operations, of which 9 were by this conservative method. He mentions in his letter his intention to exhibit the patients, so complete is their recovery.

Mr. John Bark, Aural Surgeon to the Stanley Hospital, Liverpool, has lately done between 20 and 30 mastoid operations, of which all but 2 were by this conservative method, and the last 20 were all carried out in that way. He says the results are so good that he has twice exhibited the patients—namely, at the conjoint meeting of the Lancashire, Cheshire, and North Wales Branch of the British Medical Association at Chester,³ and also at the Liverpool Medical Society.

A few of my patients (18) have already been exhibited at the British Laryngological and Otological Association; some were referred to in the *Lancet*.¹ The cases mentioned were of old standing; but if the operation were done earlier, and therefore before disease had much advanced, it would be suitable for almost every case; hearing would thus be saved and future danger avoided.

Let me now draw your attention to a few of the advantages of this conservative operation. The following five paragraphs have been drawn up by Mr. Bark, one of those surgeons whose names I have mentioned.

1. Your operation does not destroy the drum (as does the old complete or radical method) nor jeopardise the hearing; therefore it can be performed early and before disease has

caused much destruction. It can also be performed on, and thus restore and save, the only useful ear (as in Case I, the *Lancet*, April 27th, 1907). Neither the radical operation nor ossiculectomy can be adopted under such conditions for fear that total deafness will follow the destruction of the drum.

2. From this operation there is practically no liability to facial paralysis.

3. It is a less severe surgical proceeding than the radical operation, recovery is quicker, and yet it removes the dangers of this disease.

4. It will restore hearing in the majority of cases that come under treatment, and if done early in practically all.

5. The same operation is suitable for acute or chronic suppuration.

While fully approving I will briefly supplement them, for as originator of this treatment it was desirable that I should know the limits of its usefulness. My investigations have shown that full recovery may take place in the old as well as in the young, and apparently after disease of any duration (it has been proved up to thirty-two years), also that perforation in any part of the drum membrane will heal, though in some situations more readily than in others. Also that if the affection of the ear is complicated with disease in the brain, the latter can be dealt with, as can also thrombus of the lateral sinus, without destroying the hearing. I have in one case dealt with the brain; to deal with the lateral sinus is somewhat easier, as it is further from the ear. The operation has also been safely performed in a case of acute mastoiditis occurring in the course of chronic suppuration in an old person (sixty-eight years) suffering from aciduria and diabetes. The operation was quickly performed and but little ether administered—as a rule it is not so suitable as chloroform.

There are three more patients here for your inspection and to illustrate the various advantages of the operation; they were all exhibited before the British Laryngological and Otological Association on December 7th last, though they were not then described.

I.—T. V. was admitted to the Throat Hospital at the end of October with acute mastoid disease. The discharge from his ear had lasted six weeks, and when admitted at 8 p.m. he suffered so much from vertigo that he needed assistance, for he was unable to stand alone.* Operation was performed at once. The disease being extensive, the whole mastoid process was removed. The perforation was found to be large and badly situated for extensive healing, so if other conditions more favourable for repair had not been present, one might have been disposed to perform the radical operation and remove the drum membrane. He was, however, by the conservative method given the chance of complete recovery. Next morning, at 9 o'clock, he was found reading the newspaper quite free from pain and shock, and this satisfactory condition should be attributed mainly to the short duration of the operation (half an hour). The importance of the rapid performance of these operations is not sufficiently recognized, and any detail which will shorten their duration should be taken advantage of, for those patients recover most quickly who are but a short time under the anaesthetic. It was interesting to watch the closure of the large perforation, and you can now observe that the drum membrane is intact and his hearing good.

II.—A. P. suffered from the condition until lately known as "attic" disease, because the perforation was in the loose upper portion of the drum membrane, where it covers in the lower part of the attic of the tympanum, and he could not hear my watch when placed in contact with his ear. This showed that his labyrinthine sensibility was impaired. There was a polypus growing from the attic and protruding through the perforation into the meatus, which recurred after removal; the antrum was filled with thick pus and granulations, yet there were no symptoms to indicate this perilous condition. I have proved that affection of the attic cannot be differentiated from that in the tympanum, and that both are dependent on mastoid disease. By acting in accordance with this pathological fact, and removing from this patient all the mastoid disease, and that only, the attic trouble, being secondary to and depending upon it, was allowed to get well. You may now observe that there is complete recovery, the discharge has ceased, the perforation healed, the hearing returned, and therefore the same conservative measure is shown to be effective in this upper or so-called attic variety of the affection as in the lower and commoner sort, and as both conditions have been proved to be due to disease in the mastoid antrum they should be regarded simply as varieties in the complications of that disease.

Now, had I performed ossiculectomy on this patient (that is, removal of the drum and small bones), not only

* For the cause of this vertigo see my report of similar cases in the *Lancet*, April 27th, 1907.

should I have failed to reach the dangerous disease in the mastoid antrum, but should doubtless have caused deafness, for, as I pointed out last autumn, persons with deficient sensibility of the labyrinth do not hear without a drum. Therefore radical operation, too, as hitherto almost universally practised, by removing the drum, would for the same reason have been a misfortune and destroyed his hearing. He is, I believe, the second person who has been relieved by operation from attic disease without destruction of the drum, the first being a girl on whom I performed a similar operation in hospital last October. To her this matter was of far greater importance, as the affected ear was her only useful one, and was being gradually destroyed by the disease. As this patient, A. P., had no urgent symptoms, and as I desired to avoid operation, I treated him for months without actual benefit, but with what I have since found to have been risk to life and hearing, for at the operation the disease was discovered to be chiefly in the mastoid antrum, and was therefore beyond reach by any other proceeding. In a similar case this line of treatment should not be repeated, but safety to life and hearing should be ensured earlier by operation on the same conservative lines as those that were finally adopted.

III.—E. S., a boy, was admitted as an urgent case to the Throat Hospital during my absence attending the meeting of the British Laryngological and Otological Association (on November 9th) of which mention was made just now. The President had expressed a wish to see this method of operation, so he was informed of the admission to the hospital and was present with other surgeons when it was performed. The boy had been delirious at night for a week, and the purulent contents of the mastoid antrum were found to be under great and serious pressure. It is the rule, during the performance of this conservative operation to examine the drum membrane carefully and be guided by its condition (for it is often impossible to see it before), and the proceeding is so adapted as to permit of this inspection. When exposed in this boy's ear it appeared like a piece of wet scarlet cloth. No signs of normal structure were visible, nor any outline of the malleus, nor indeed of the situation of the perforation, for it was occluded by the granulations which filled the tympanum. I remarked that there was a perforation somewhere, and that it could be found with the aid of a probe. A slender instrument was passed gently over the surface until it found its way through the opening, and the dimensions of the aperture were shown by moving the probe to and fro. The operation was completed, and at its conclusion I expressed to those present my firm conviction that the perforation would be healed within a month. It was actually healed on the ninth day after operation, although it had been in existence seven years. The boy went home on the fifteenth day with restored hearing, and if ever he is called upon to perform such exceptionally responsible duties as those carried out by his father in the police, there is at least the satisfaction of knowing that deafness will no longer render him unfit for the duty. He had suffered all these years from aural suppuration following an attack of scarlet fever, and had thrice undergone operation for the removal of adenoids with the hope of arresting the discharge.

You will now understand that, if it was impossible to see this perforation during the operation when the drum membrane was as visible as a coin in the palm of the hand, how useless are the usual attempts to treat the tympanum through such a perforation and a tiny meatus. Further, how futile such treatment must now appear, for it can at last be recognized that the chief disease is not in the tympanum at all, but in the mastoid antrum, where these investigations have shown it to exist in every case, and there the tympanic treatment cannot reach it.

These three patients are much indebted to the other one (M. L.), for had it not been for her illness and the information derived from observation of her remarkable recovery I should have removed their drum membranes by the usual radical operation, even last year, and they would now be deaf. Such cases are clear proof that by this radical measure patients were rendered permanently deaf, while the method adopted on these four patients is capable, as you see, of restoring the ear to full health and usefulness.

Three of these patients were treated at the Throat Hospital, and at the time of operation were in great danger, and more sufferers are admitted to that hospital in a condition dangerous to life from this disease than from all others together. It is thus perceived how grave a complaint is this of aural suppuration and the serious attention it demands, for the mastoid antrum is the seat of danger. It was by early interference alone that my operations were freed from mortality. While preparing

this address I was summoned to the country on two successive days to operate on patients with mastoid disease which had become acute, one of whom had recently attended a special hospital. The first was found to be dying from meningitis; the second had passed away before my arrival. I feel bound to condemn the dilatory methods which are responsible for such calamities, and to insist on the necessity of earlier operative assistance, for thus alone can safety be assured.

Though the dangerous mastoid conditions can be removed by this operation, the damage to the drum and hearing resulting from long-standing disease may have gone beyond repair. The small bones, too, may have necrosed and disappeared, as sometimes happens in scarlet fever and other acute disease; but this does not occur in chronic suppuration. For such sad cases there will still be the radical operation; but it is a measure far too drastic for general use. The surgeon's aim should be the restoration of a perfect ear; and, after seeing such cases as those before you, surely he would be content with nothing less!

The membrane of the middle or hinder brain is often exposed in the foul mastoid cavity, from destruction of the bony walls; it is over fifty times as common there as above the attic of the tympanum. Rarely is there warning of this danger. Bone, too, is a weak barrier against disease; far more effective is the dura mater. That white and shiny membrane alone is the "silver streak that prevents invasion," it may be for months or years.

Now it has been shown that the mastoid antrum, and not the tympanum, is the chief seat of danger and disease; the old treatment must be changed, for we no longer have the right to dally with such risks. Faith in lotions will abate, for they do not reach the goal. Operations, now bereft of their destruction of hearing and most of their former dangers, will be earlier done. They will, I doubt not, increase tenfold; hearing will thus be saved, and deafness and the many deaths from this disease should well-nigh cease. Not one in 100 of these sufferers has hitherto undergone operation in time to save the hearing, and even when performed the old operation destroyed the drum; but I have given you proof that a wholesome change is coming. The old operations had some dangers, and also destroyed the drum; then there were valid reasons for delay. Now those reasons are removed, for operation by the new method has hitherto been followed by no deaths, and hearing can be restored.

REFERENCES.

¹ *Lancet*, August 11th, 1906; April 27th, 1907. ² See discussion at the British Laryngological and Otological Association, *BRITISH MEDICAL JOURNAL*, January 6th, 1907. ³ *BRITISH MEDICAL JOURNAL*.

MEMORANDA:

MEDICAL, SURGICAL, OBSTETRICAL

TWO CASES OF GUMMA OF THE CILIARY BODY. The following two cases exhibited almost exactly similar symptoms, and as they were of a somewhat unusual and interesting character I think the cases are worth recording.

CASE I.

Mr. W. consulted me on June 18th, 1906, about his right eye. The eye was very much injected at the upper part of the cornea. In the deeper layers of the cornea at its upper border was a quantity of pus. On careful examination no ulceration of the cornea could be made out. A few days later pus began to accumulate in the anterior chamber, and this went on until the chamber was quite full. On July 23rd I incised the cornea near its lower border and evacuated the pus. The eye was now very acutely inflamed, and the cornea hazy, but there was no sign of ulceration. There was now quite distinct appearance of bulging in the upper ciliary region. There was a definite specific history, and I diagnosed gumma of the ciliary body with breaking down. Under liberal anti-specific treatment and the frequent use of atropine the eye began rapidly to improve, and on August 14th was much better. The cornea had now a stippled appearance like that seen in interstitial keratitis. The eye continued to improve and vision to return, but in the course of a week or two the case passed out of my hands.