BACTERIOLOGY OF SUPPURATIVE EAR DISEASES.*

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While the great importance of the science of bacteriology as an adjunct to the study of infection and suppuration has long been demonstrated, it is of comparatively recent years that its application to, and significance in otology have received the recognition its value should command.

Bacteria, being causative agents of most specific diseases, must necessarily play a particular etiological part in suppurative ear diseases. Even among those diseases whose causative agents are unknown, a complicating suppuration will always show definite forms of bacteria; as, for instance, while the germ of scarlet fever has not been isolated, accompanying suppuration, wherever present, is always streptococcic.

Whatever the causal agent in suppurative processes, it is a surgical axiom, that egress should be provided for the pus, and it is equally important that, when such egress has been made possible either by nature or by surgical means, an examination for the cause of the suppuration should be made at once.

While the results from such examinations are perhaps by no means entirely satisfactory, in so far as they give only the type of organism, it is important to know the exact character of the disturbing agent, as indicative of the probable virulence and future progress of the disease. Any examination made at a later stage is uncertain, as the possibility of secondary infection has to be considered.

Until very recently it was not generally accepted that the normal tympanic cavity was sterile. Since Preysing's observations and results (*Otitis Media der Säuglinge*) it is conceded that the presence of microorganisms in the tympanic cavity constitutes, per se, a pathological lesion.

Schwartz and Grünert advance two probable theories for this normal sterility, claiming it is caused either by reason of the bacteriocidal qualities of the tympanic mucous membrane or by the action of the ciliated epithelium of the Eustachian canal, the wave motion being directed outward from the tympanum.

* Read at a Scientific Meeting of the Surgical Staff of Dr. Wendell C. Phillips' Clinic, Manhattan Eye, Ear and Throat Hospital, New York, April, 1906.

Let us, therefore, briefly consider the routes through which infection may assail the middle ear. In doing so, we must primarily divide our cases into two classes; those in which the drum is intact, and those in which it is perforated. In the first class, the routes are through the blood and through the Eustachian tube; in the second class we have, in addition to these routes, that through the external auditory canal.

In infection through the blood, certain specific diseases always occasion the causative factor of the suppuration. In infection through the tubes the general condition of the throat, the existence of excessive lymphoid tissue in the rhino-pharynx and the presence of hypertrophied tonsils play the most important part. To an audience of rhinologists and otologists, it is unnecessary to emphasize or dilate upon this latter fact. The relation between pharyngeal hypertrophies and ear suppuration, and the danger and possibilities of systemic infection through tonsillar portals are generally understood and accepted.

W. H. Park (Bacteria and Protozoa) lays it down the fact "that when enough bacteria are introduced into the human body to overcome its inherent resistance, they produce disease." In the ear this suppuration takes on a specific type, being limited to mucous membrane and bone; we find not only bacteria as such, but also the results of necrosis of bone and destruction of mucous membrane tissue. This is especially true in cases clinically characterized as chronic.

While the bacteria found in the pus of suppurative otitis media are numerous, but few have any important bearing as diagnostic or prognostic factors. Phillips (Archives of Otology, 1903) in an interesting paper on the "History of Bacteriological Examinations in Suppurative Otitis Media" mentions at length some twenty-one varieties.

Funk (Amer. Med., 1901) states their frequency of occurrence to be in the order of 1st, pneumococci; 2nd, streptococci; 3rd, pyogenic staphylococci; 4th, Friedlander's bacillus, and 5th, diphtheria bacillus.

In the examination of a large number of cases in the New York Polyclinic Laboratory, Jeffries found practically the same results; mentioning in order pneumococci, streptococci, staphylococci and tubercular bacilli. Both lay stress on the uncertainty of examination of the pus alone for the tubercular bacillus.

Hastings (Amer. Jour. Med. Sciences, July, 1905) in a report of cases from the New York Eye and Ear Infirmary, says: "In the canal discharge diplococci were found in 49 cases, streptococci in

39, pneumococci in 37 and a mixed infection in 43 cases. Influenza bacilli were found in only two cases, and in two cases the spirillum of Vincent were found. Of the 69 cases where the mastoid pus was examined, streptococci were found in 50% and pneumococci in 29%. Unfortunately the value of Hastings' report is somewhat destroyed by no mention being made of the age of the patients (i. e., whether children or adults) nor of the possibilities of secondary infection having taken place.

Based upon authorities too numerous to mention, we find bacteria standing in the following order of relative virulence, streptococci and pneumococci, it being unnecessary to consider the others in this regard. All are modified by the resisting power of the patient and the condition of the tissue with which they are surrounded. MacEwen (*Pyogenic Diseases of Brain and Spinal Cord*) calls attention to the possibilities of diplococcus intracellularis meningitidis, especially in mastoid complications.

The destructive ravages of the streptococcic infection and its clinical significance is strongly emphasized by Phillips (*Archives of Otolaryngology*, 1903) and Dench (*Amer. Med.*, 1901).

In a paper such as this it would be manifestly impossible to detail the given bacteriological findings under all conceivable cases, and we must limit ourselves to such deductions as give the best possible practical results.

From the mass of material on hand we deduce the following:

Bacterial findings from discharges in children under five show in the larger majority of cases pneumococci, whether acute or chronic. Among all other cases there is no constant definite agent found (Freysing, *Otitis Media der Säuglinge*). Acute cases have shown with a fair degree of constancy a mono-microbic invasion, the type of the microorganism being immaterial. Poly-microbic results of examination indicate almost invariably either chronic suppuration or a secondary infection. In this connection, Leutert asserts that poly-microbic findings are an indication of chronicity from the start, and should be regarded as such in prognosis and treatment.

While it is important that a thorough bacterial examination should be made in every suppurative ear case coming under observation, it is too often neglected through a misunderstanding of the knowledge and material needed for such examination, which is generally taken to mean an exhaustive knowledge of bacteriology and the employment of a laboratory, with its extensive appliances. While such conditions are ideal, and while the information furnished would un-

doubtedly enhance the scientific value of the examination, results of benefit to the patient and of clinical significance to the otologist, can be obtained with but little paraphernalia and comparatively elementary knowledge.

A microscope, a few slides, a bottle of alcoholic solution of methyl blue and a spirit lamp constitute the laboratory equipment and the ability to distinguish a monomicrobial from a polymicrobial field and recognize two or three types of microorganisms the mental.

Now just a word in regard to the technique of obtaining the smear for the slide. The same specialist who carefully and conscientiously takes a culture from a throat, fearful lest his swab touch and be contaminated by the tongue and lips, will plunge a pledget of cotton into the external auditory canal, regardless of secondary extrinsic invasion.

To be of real value, the pus should be taken from the tympanic cavity as far as possible. In the case of suppurative otitis with imperforate drum, the pus adhering to the paracentesis knife is best and sufficient. The external auditory canal should, as a matter of course, be thoroughly cleaned and dried before paracentesis. In cases of perforate drum, where the incision is made for enlargement of perforation, the same method may be pursued, and in cases of large perforation, a flat sterile probe carefully introduced into the tympanic cavity and as carefully withdrawn will produce enough material for a stain.

In conclusion, we would say: That bacteriological examinations should be made, at least as far as indicated above, in each and every case; that a monobacterial invasion points to favorable prognosis in acute conditions; that a poly-microbial invasion, variety of germ being immaterial, points to chronicity and indicates operation as soon as necrotic areas can be demonstrated by probe or other technique of observer; that bacteriological findings give no absolutely definite evidence, the case often running a course diametrically opposite to that expected. Finally, we must remember that the microscope and the clinical picture are but complements of each other, and he who relies on the one or the other must necessarily fall short of giving full justice to himself or patient.

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DISCUSSION.

DR. PHILLIPS said he had come to believe that the normal tympanic cavity is sterile, and that in some way it has the power to maintain this sterile condition, the presence of bacteria being evidence of some

disease. He believed that in the catarrhal forms of inflammation there is probably a bacterial invasion, but an invasion of milder organisms. Even more virulent types may be present in the blood of an individual without producing the symptoms of septicemia or pyemia, and it is only when other conditions of the patient favor their development that the more virulent symptoms manifest themselves. This is an important subject because so much reliance is put upon bacteriology, yet it is known that the blood may carry virulent bacteria in considerable quantities.

Concerning the routes of invasion Dr. Phillips said he had taught for years that the principal avenue of entrance of infection into the tympanic cavity is through the Eustachian tube. He believed this to be the mode of entrance in 90 per cent of cases. Bacterial invasion may take place, however, through the open tympanum and through the blood. Two other modes of infection, not mentioned by Dr. Dougherty but recognized by many observers to be possibilities, are through the lymphatics and the mechanical boring of the pus from nearby foci.

It is generally conceded that the streptococcus is the most virulent type of organism, and in all probability the pneumococcus is next, though for some years he had believed the diplococcus intracellularis meningitidis, or Weichselbaum's intracellular diplococcus, to be a very virulent form.

He agreed with Dr. Dougherty that in acute cases the bacterial invasion is mono-microbic in the majority of instances. In chronic cases there is always a mixed infection.

DR. HUBBY emphasized the importance of making the tests mentioned in all suppurative cases and said he had begun the practice of doing this in the Manhattan Eye and Ear Clinic. In every case a smear is sent to the laboratory, and the prognosis and treatment are based largely upon the results of this examination. There seems to be so much difference of opinion, however, with reference to prognosis in mixed infection cases that he had been unable to formulate any idea in regard to prognosis.

DR. KOPETZKY agreed, in the main, with the points brought out in the paper. In connection with the theory of invasion, he called attention to the role that the adenoid plays as a protection against the invasion of the tympanic cavity in children under five years of age. In the adult the Eustachian tube is closed except during the act of swallowing, while in the child it is open, and the ruthless removal of adenoids leaves it patent. It had occurred to him in

noting the different cases that come into the hospital to ask how long after the adenoid operation the ear began to run, and in children under five years of age it often followed the operation. If the loose connective tissue which has not yet been differentiated from pathological adenoid tissue is removed it paves the way for many a tympanic invasion which would not have occurred had the normal adenoids not been removed.

Referring to Dr. Dougherty's technic, Dr. Kopetzky cited a case in the hospital in which an incision was made with the knife and a mono-microbic infection found upon examination. While under observation a second examination was made, a probe wrapped in cotton being employed, and a poly-microbic infection was found.

Dr. Kopetzky did not agree with Dr. Phillips concerning the bacterial nature of catarrhal otitis; he believed it to be non-bacterial, simply an exudative stage, bacteria not yet having entered.

He did not know whether Dr. Phillips, in speaking of the lymphatics as an avenue of invasion, meant through the cochlea. It is not infrequently the case that in meningitis, where the ear is continuously under observation, the patient is deaf when the meningitis subsides. Infection takes place in the following manner: From the meninges, through the perilymphatic spaces to the cochlea, here destroying the organ of Corti, before evidence of its destructive presence is manifest at the ear drum.

Dr. HELD called attention to a club-shaped bacterium, a little larger than the diphtheria bacillus, which he had noticed from three to six months after acute suppuration, or even in chronic suppuration, of diphtheritic origin.

Dr. FOWLER asked why, if the diplococcus intracellularis is so virulent, as suggested by Dr. Phillips, otitis media does not more frequently result.

With reference to ears running after the removal of adenoids and tonsils, Dr. Fowler asked if it were not more often due to the fact that latent suppuration exists which is lighted up by the removal of adenoids. He had noticed this in children who had previously had running ears, but not in other children.

The method of getting smears, mentioned by Dr. Dougherty, impressed him as an excellent one, but he suggested that it might also be well to get them from the canal.

He had always held that the moment a catarrhal inflammation becomes infected by bacteria, it thenceforth becomes purulent. In

other words, that it was the presence of the pathogenic bacteria which made the inflammation purulent.

DR. PHILLIPS said the diplococcus intracellularis of meningitis is not so virulent except when in contact with a serous membrane.

That catarrhal invasions of the tympanic cavity are of bacterial origin could be proved by the simple statement that a large proportion of invasions of the nose and nasopharynx are catarrhal, without pus, yet the pus-producing bacteria are present.

DR. DOUGHERTY was of the opinion that the order of virulence of the different organisms is largely a matter of the individual making the examination, one microscopist finding the order one way and another another way; but taken as a whole the order of virulence is as expressed in the paper, the streptococcus being the most virulent, the pneumococcus next.

He had not taken up the matter of infection from some other part through the lymphatics, the time being hardly long enough to enter into such details.

With reference to Dr. Fowler's suggestion that pus from the external auditory canal should be examined, Dr. Dougherty said that in looking for the cause of suppurative otitis media it would be found in the tympanum and nowhere else.

He called attention to the fact that in speaking of the removal of tonsillar and adenoid tissue he specially referred to hypertrophied tissue. The lymphoid tissue of a child five years old might be called normal tissue, but as the child grows it may become hypertrophied, in which event it should be removed in order to free the breathing. It might then be called abnormal. Pathologically speaking he could not tell where the normal tissue ends and the hypertrophied begins, but he did not believe the latter begins at the age agreed upon by many rhinologists.