A BACTERIOLOGICAL INVESTIGATION OF THE SUPPURATIVE EAR DISCHARGE OCCUR- RING AS A COMPLICATION IN SCARLET FEVER.

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Before recording my own results, I will briefly give an abstract of some of the more important researches of other observers which bear upon this subject. It is evident that this class of cases presents us with an association and causative relation of two processes which may be distinct and independent. Thus I shall endeavour to separate the literature on these subjects into three parts, taking first that which relates to the scarlatinal process *per se*; secondly, that which deals with the bacteriology of otitis media, both acute and chronic; and, thirdly, that which relates to the combination of the two processes, as in my own cases.

I.—THE BACTERIOLOGY OF SCARLET FEVER.

The specific pathogenic nature of Klein's¹ micrococcus or Edington's² bacillus has not been established. Croke³ discovered cocci in various parts of the body in scarlatinal cases, and Fraenkel and Freudenberg,⁴ in three cases, noticed the constant presence of streptococcus pyogenes; they considered that in all probability this organism played a most important part in the causation of the secondary infections. Babes⁵ considers that the whole scarlatinal process may result from a modified streptococcus infection; but Raskin,⁶ finding this organism only in the epidermic scales in some cases, and never in the blood, whereas it was constant in all cases complicated with suppuration, is of opinion that the streptococcus is the principal factor of the secondary infections, but that it has nothing to do with the etiology of the specific disease. Lenhartz⁷ also found the streptococcus in pure culture, in the blood stream of a case complicated with suppuration of the glands of the neck. D'Espine and de Marignac,⁸ from the blood of the finger of a scarlet fever patient obtained a streptococcus which curdled milk, but was not pathogenic for mice, showing that it was not identical with the ordinary pus streptococcus. Thus most observers agree that in scarlet fever the organism which plays the most important part, at any rate in regard to the secondary infections, is the streptococcus pyogenes.

II.—THE BACTERIOLOGY OF OTITIS MEDIA.

This has been the subject of research by many eminent observers, but as, in the majority of the cases investigated, the cause of the disease has not been stated, it may well be that some of them would have been more properly placed under the third division. Netter⁹ endeavoured to find the cause of the otorrhœa in newly-born children, and for this purpose made twenty necropsies on infants varying in age from 9 days to 2 years, and found constant changes in the middle ear. In 18 cases he found the streptococcus pyogenes 13 times, the staphylococcus 6, and the pneumococcus 5 times, but Gradenigo and R. Penzo,¹⁰ after a more careful examination of 20 cases, found no pathogenic organisms, but a large number of saprophytes, and came to the conclusion, as Politzer¹¹ previously had done upon more general grounds, that the discharge was due to the rapid decomposition of the delicate fetal tissues of the middle ear, and not to an inflammatory process. Allusion is made to these reports to demonstrate the difference between such cases and those which are truly inflammatory, for of this nature alone are those now under consideration. Netter¹² out of a series of 11 cases, found the streptococcus pyogenes 9 times, 4 times in pure culture, and twice the diplococcus pneumoniae, once in pure culture. The staphylococcus pyogenes aureus was present with bacilli in

a few cases. Zaufal,¹³ the chief authority upon this subject, was the first who examined in the living the secretion obtained by paracentesis of the middle ear. In the first case he obtained Friedlaender's bacillus pneumoniae, and in the second the diplococcus pneumoniae. In 12 cases examined after rupture of the membrane, he found the diplococcus pneumoniae in 4, the streptococcus pyogenes in 5, in 2 the staphylococcus pyogenes aureus, and in 1 the micrococcus tetragenes in pure culture.

Zaufal also found the diplococcus pneumoniae in 6 cases, and he believes it to be the cause of otitis media acuta, whilst in the secondary forms he chiefly found the pus organisms, especially the streptococcus, but including besides those organisms already mentioned the staphylococcus albus—staphylococcus cereus albus, staphylococcus tenuis, bacillus tenuis, and the bacillus pyocyaneus. The last named he obtained in pure culture after paracentesis of the membrane.

Upon these grounds he divides otitis into three forms (1) that due to pneumococci; (2) that due to staphylococci—*aureus*, *albus*, and *cereus albus*; (3) that due to streptococci.

Zaufal was the first to assert the importance of the streptococcus pyogenes in the complications of otitis media. In this he is supported by Moos and Netter, and also Scheibe, for in 6 cases in which the last named found streptococci in 4 was the mastoid affected. Zaufal has also succeeded in setting up an acute inflammation in the ears of rabbits by means of inoculations of pure cultures of diplococcus pneumoniae, and also of Friedlaender's bacillus pneumoniae. Scheibe¹⁴ examined by paracentesis the secretion in 11 cases. Twice he found the staphylococcus pyogenes tenuis, three times the staphylococcus pyogenes albus, in 4 cases the streptococcus pyogenes in pure culture, and in 1 case streptococci with staphylococcus albus and diplococcus pneumoniae. He never found the staphylococcus aureus. Rohrer¹⁵ found staphylococcus pyogenes albus and saprophytic bacilli in some cases but only cocci in non-fœtid cases.

Moos¹⁶ in 3 cases found streptococcus pyogenes and diplococcus pneumoniae. Again, in 18 cases he found the streptococcus 11 times, 5 times with tubercle bacilli, and once with the diplococcus pneumoniae, this last case being one of caries after scarlet fever. Kanthack¹⁷ examined 57 cases. In the acute stage he found most abundantly the diplococcus pneumoniae sometimes in pure culture, also staphylococci, streptococci, and a number of non-pathogenic organisms. In chronic cases he never found the diplococcus pneumoniae, but pathogenic staphylococci and other bacteria. In suppuration of the mastoid he found the diplococcus pneumoniae frequently; but, on the other hand, in both acute and chronic cases the streptococcus pyogenes was remarkable by its scarcity.

Bordoni-Uffreduzzi¹⁸ in acute cases found the diplococcus pneumoniae and pyogenic cocci, but in chronic cases only the pus organisms and once the proteus vulgaris. Maggiora¹⁹ in 13 cases of catarrhal affection of the middle ear examined before rupture of the membrane found the staphylococcus pyogenes albus 10 times, and the staphylococcus pyogenes aureus 6 times.

Bordoni-Uffreduzzi and Gradenigo,²⁰ in 4 cases of acute otitis media after spontaneous perforation found three times in the pus—twice in pure culture and once with staphylococci—organisms, morphologically and culturally resembling the diplococcus pneumoniae, but differing from that organism by growing upon gelatine at 18 to 20° C., and by being found as chains within the cells. They suggest that the organism is an attenuated diplococcus, and that the streptococcus so frequently found by others is really an attenuated diplococcus pneumoniae. They observed the same thing in a case of otitis media after influenza. Martha²¹ records 2 cases of purulent otitis media out of 53 examined, in which the bacillus pyocyaneus was found in pure culture; in none of the other cases was it present. Crévoisier de Vomécourt,²² who has worked much at the subject, states that the most important organisms are the streptococcus, the pneumococcus, Friedlaender's bacillus pneumoniae, the staphylococci, and the bacillus pyocyaneus. Nathan²³ examined 40 cases of ear discharge, and in 12 found tubercle bacilli.

It will be seen from the foregoing that the organism to which the first place is assigned in the etiology of acute

otitis media by many authorities is the diplococcus pneumoniae of Fraenkel. This point has been emphasised by Zaufal's successful inoculations of animals, but he has also been similarly successful with Friedlaender's bacillus pneumoniae which has been recognised by several observers. Next in importance comes the streptococcus pyogenes, and much stress has been laid upon the activity of this organism as the cause of the complications which follow otitis media; and finally subsidiary to these are the pyogenic staphylococci and the bacillus pyocyaneus.

III.—THE BACTERIOLOGY OF OTITIS MEDIA IN SCARLATINA.

In the third series of cases—namely, those which consist of cases of otitis media occurring as a complication in scarlet fever—there is but little to quote. In one case, already mentioned, recorded by Moos of caries after scarlet fever, diplococcus pneumoniae and streptococcus pyogenes were found. Marie Raskin,²⁴ however, who examined bacteriologically many cases of scarlet fever, out of 30 complicated cases found 8 with otorrhoea. In these the streptococcus pyogenes and, later, the staphylococcus pyogenes aureus and albus were found invariably.

My own investigations were carried out at the British Institute of Preventive Medicine, under the superintendence of Professor Macfadyen, to whom for most valuable assistance and consistent kindness I am greatly indebted. Out of 287 cases of scarlet fever, 36 suffered from otitis media, occurring mostly from the twentieth to the thirtieth day after the onset of the disease. Of these, 14 cases were examined bacteriologically, 4 of them twice at different periods.

The method of obtaining the pus was as follows: After spontaneous rupture of the membrana tympani, in some cases almost immediately after, the cheek, pinna, and external auditory meatus, were cleansed with an antiseptic solution—perchloride of mercury 1 in 2 000, or carbolic acid 5 per cent. solution—and then carefully dried with antiseptic wools.

A fine capillary glass tube, previously sterilised by heat, was passed through the aperture in the membrane, with every endeavour to avoid contact with the walls of the external auditory meatus, and the pus from the middle ear aspirated into the tube. The tube was then withdrawn with similar precautions, and sealed at both ends.

From the pus thus obtained were made as soon as possible:

1. Microscopic specimens. Cover-glass preparations of the pus were stained with Ehrlich's aniline dyes and after Gram's method.

2. An emulsion in peptone beef broth or peptone water. From this emulsion were immediately made plate cultivations in nutrient agar-agar and nutrient gelatine, according to Koch's method, and placed in incubators, the one at a temperature of 37° C., the other at 22° C. From the isolated colonies obtained in this manner were made inoculations upon suitable media, and the various organisms were differentiated according to their modes of growth on different culture media, their staining properties, and their morphological appearances, further evidence being obtained in some cases by inoculations of animals. Some of the cases were examined immediately after perforation of the membrane, others at a later date, and, as before mentioned, 4 were examined a second time after an interval had elapsed.

The results obtained I have tabulated in order that the different organisms isolated in each case may be perceived at a glance.

This table shows, and the microscopic preparations of the pus even more clearly showed, that the shorter the interval between the rupture of the membrane and the examination, the more the pyogenic cocci predominate over rod forms. Cases I, II, and III showed almost pure cultures of cocci, whilst in the cases taken after a few days the presence of adventitious organisms was very marked, such as yeasts and sarcinae. But even in the earliest cases the cocci were not in pure culture, but were associated with bacilli, and in one

Case.	Age.	Date of Examination after Perforation.	Organisms Found.									
1	4 years	1st day	Streptococcus pyogenes	Staphylococcus aureus	Staphylococcus albus	—	—	—	—	—	—	Saprophytic bacilli
2	1 year	"	"	"	"	Bacillus striatus albus	—	—	—	—	—	Oidium albicans.
3	3 years	"	"	—	"	"	Micrococcus albus liquefaciens	—	—	—	—	—
3	"	9th day	—	—	"	"	"	—	—	—	—	Pink yeast; chromogenic coccus (air); bacillus (unknown).
4	6 years	2nd day	Streptococcus pyogenes	—	—	"	"	Bacillus subtilis	—	—	—	Sarcina lutea; sarcina alba.
5	4 years	3rd day	"	—	—	—	—	—	—	Bacillus pyocyaneus	—	Spirilla (probably from mouth).
6	4 years	1st day	"	Staphylococcus aureus	Staphylococcus albus	Bacillus striatus albus	—	—	—	—	—	—
6	"	17th day	"	"	—	"	—	—	—	—	—	Torulae.
7	6 years	7th day	"	"	—	"	—	—	—	—	—	—
8	4 years	9th day	"	"	—	"	—	—	—	—	—	Bacillus acidilactici and a few saprophytic bacilli.
9	4 years	7th day	"	—	Staphylococcus albus	—	—	—	—	—	—	Yellow yeast; bacterium unrecognised.
9	"	19th day	"	—	—	Bacillus striatus albus	—	—	—	—	—	Aspergillus niger; bacterium unrecognised.
10	5 years	4th day	"	Staphylococcus aureus	Staphylococcus albus	—	Micrococcus albus liquefaciens	—	—	—	—	—
10	"	11th day	"	—	"	—	—	—	—	—	—	Bacillus acidilactici; bacterium as in Case 9.
11	7 years	6th day	"	—	"	Bacillus striatus albus	—	—	—	—	—	Tubericle bacilli, aspergillus niger, penicillium.
12	10 years	4th day	"	—	"	—	—	—	—	—	—	Three kinds of saprophytic bacteria.
13	5 years	21st day	—	—	—	Bacillus striatus albus	—	—	—	—	—	White yeast; diplococcus unknown.
14	6 years	26th day	—	—	—	"	—	—	—	—	—	White yeast, pink yeast, sarcina lutea, and coccus (air).

case with spirilla, which had probably ascended from the mouth and air passages.

Out of the 14 cases chosen for examination, the various organisms were found as follows:

Streptococcus pyogenes	12 times	Bacillus acidi lactici	2 times
Bacillus striatus albus	9 "	Bacillus subtilis	1 "
Staphylococcus pyogenes	8 "	Bacillus pyocyaneus	1 "
albus	8 "	Tubercle bacilli	1 "
Staphylococcus pyogenes	5 "	Yeasts	6 "
aureus	5 "	Sarcinae	3 "
Micrococcus albus liquefaciens	3 "	Moulds	4 "

And a few other bacteria, whose recognition was not absolute, and which were found to be non-pathogenic for mice.

This list shows the frequency with which the streptococcus pyogenes was found, and it will further be observed that I was never once successful in finding the diplococcus pneumoniae. This may be due to the fact that the purulent discharge was not suited for direct inoculation, or that the prevalence of the pyogenic cocci hindered its growth or hastened its decay, or because the diplococcus pneumoniae does not play such an important part in the etiology of otitis media of scarlet fever as in that due to other causes. But it has been suggested, and I have already quoted the authors, that the streptococcus so frequently found is really an attenuated form of the diplococcus pneumoniae; and in support of this view might be adduced Kanthack's report, since he found in acute cases the diplococcus pneumoniae very frequently, but the streptococcus very rarely. That the diplococcus pneumoniae in an "attenuated" form may have been mistaken for the streptococcus is no doubt possible, and *vice versa*. In my own cases great attention was directed to the discovery and recognition of the diplococcus, but without success.

The points that were considered necessary for the identification of the streptococcus pyogenes were these:

1. That in fluid media it should appear in its characteristic chain formations, and give the typical growth in beef broth.
2. That it should flourish upon nutrient gelatine (tube and plate cultures) from 18° C. to 22° C., giving its characteristic growth, and that it should not liquefy the gelatine.
3. That it should remain stained after treatment with Gram's method.
4. That it should be capable of being cultivated from generation to generation on gelatine or in beef broth.
5. That it should be capable of living at 18° C. to 22° C. for a considerable time.

The points that were considered necessary for the identification of the diplococcus pneumoniae were these:

1. That its growth upon nutrient agar-agar at 37° C. should present its characteristic "dewdrop" appearance.
2. That it should remain stained with the Gram method.
3. That its growth should cease or be markedly hindered on nutrient gelatine at room temperature.
4. That inoculations into animals should produce their death, and that the organism should be found in the tissues encapsuled.

Answering to this last description no organism was found, but corresponding to the first set of conditions was the organism which was isolated 12 times in 14 cases, and in the microscopic specimens of the pus from these same cases was seen in its characteristic chains in each. This organism I consider to be the streptococcus pyogenes.

Mention may here be made of a distinction that has lately²⁵ been drawn between two forms of the streptococcus, according to the length of the chain formation: the streptococcus longus and the streptococcus brevis. The latter is said to be less pathogenic and to liquefy the gelatine slightly. It was never met with in my research.

As far as I have been able to ascertain, the diplococcus pneumoniae has only been recognised once in connection with scarlet fever (H. Moos), and this case was one associated with caries (suggesting a chronic process), whereas most authorities lay stress upon its occurrence only in acute cases. Again, I was equally unsuccessful in finding the bacillus pneumoniae of Friedlaender, but, as seen by the table, the bacillus pyocyaneus occurred once in connection with the streptococcus and spirilla.

The bacillus isolated nine times, and mentioned as the bacillus striatus albus, was an organism resembling morphologically and culturally the organism described by Von Besser²⁶ under that name as occurring in normal nasal secretion. The case in which tubercle bacilli were found was discovered subsequently to have suffered from ear mischief some years before the onset of scarlet fever, that disease having set up a recrudescence.

The occurrence of the bacillus acidi lactici twice is interesting as following an acute illness in children, during which the staple food had been milk.

The other rod forms and cocci isolated were most of them inoculated upon mice, and found to be non-pathogenic, and since they did not resemble any of the commoner varieties of saprophytic organisms, were left unnamed.

I have already quoted weighty authorities to prove that in scarlet fever the secondary infections are due to the activity of the streptococcus pyogenes, and therefore in otitis media consequent to that disease we should expect to find that organism most prominent. In this my observations agree. Raskin found it invariably present. The fact that I did not find it in 2 cases out of 14 is probably due to the pus having been taken for examination later, and after the influence of antiseptics.

CONCLUSIONS.

It appears from my observations:

1. That the organism most potent in the etiology of the otitis media of scarlet fever is the streptococcus pyogenes.
2. That the less chance there is of contamination from the outer air through the external orifice the more the pyogenic cocci predominate over rod forms, but that prior to perforation of the membrane the occurrence of such organisms is not precluded, since they may ascend from the mouth and air passages.
3. That next to the streptococcus the most important organisms are the staphylococci albus and aureus.
4. That apparently the diplococcus pneumoniae of Fraenkel or the bacillus pneumoniae of Friedlaender do not play such an important part in the otitis media of scarlet fever as in that due to other causes.

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THE TREATMENT OF UTERINE FIBROIDS BY ABDOMINAL SECTION.

Read at a Meeting of the Plymouth Medical Society.

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It does not lie within the limits of this paper to enter upon any general disquisition as to the nature of uterine fibroids, or, as they may be more correctly called, fibromyomata. I shall content myself with calling attention to those conditions which demand surgical interference; and, in the next place, I shall refer only to their treatment by abdominal section. But it may be as well in *limine* to state that which is probably within the experience of most medical men, that a very large proportion of women affected with this disease recover without surgical interference. A subperitoneal or interstitial fibromyoma may grow to an enormous size, and, save for its bulk, cause no inconvenience to the patient. Smaller tumours are not infrequently destroyed by pregnancy. When submucous they are sometimes extruded in the form of polypi, or through some rupture of the capsule they break down and come away piecemeal. And, finally, at the menopause, we expect, and are not often disappointed in our expectation, that these tumours will vanish away, and "leave not a wrack behind." Still, there are few conditions which require such prolonged watchfulness, extending often over a period of many years. A fibromyoma, which to-day is un-