TYPES OF PNEUMOCOCCI IN RELATION TO DISEASE

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During the past two years over 150 strains of pneumococcus, isolated from lesions in different parts of the body, have been typed, as a matter of general interest. The results are shown in Table I.

TABLE I

Condition	Type I	Type II	Type III	Group IV	Total
Nasal catarrh, sinusitis, dacryocystitis	1	0	0	15	16
Meningitis	4	5	7	8	24
Otitis media, mastoiditis	2	1	4	7	14
Lobar pneumonia	12	35	0	13	60
Broncho-pneumonia	3	3	2	1	9
Empyema thoracis	14	1	1	5	21
Endocarditis	1	0	0	2	3
Peritonitis	2	1	0	2	5
Miscellaneous, including pericarditis, arthritis, osteomyelitis, abscesses	2	2	1	1	6

In the pneumococci obtained from the eye, nose, and accessory sinuses the preponderance of Group IV organisms is in accordance with general experience. Whittle¹ has tested the virulence of strains isolated from such situations, and has found that they possess a low order of virulence and mostly belong to Group IV. The only type strain met with was one from a case of sphenoidal sinusitis. Spread of the infection from the sinus to the brain led to a fatal meningitis. A Type I pneumococcus was isolated from the cerebro-spinal fluid during life and from the brain and sphenoidal sinus by cultures made at necropsy.

MENINGITIS

Of 24 cases of meningitis investigated, 17 were dealt with during life by examination of the cerebro-spinal fluid and 7 after death by cultures from the brain. An analysis of the cases is given in Table II.

TABLE II.—Meningitis

Antecedent Condition	Type I	Type II	Type III	Group IV	Total
Otitis media and mastoiditis	0	0	6	2	8
Pneumonia	1	4	0	0	5
Fractured skull	1	0	0	3	4
Sinusitis	1	0	0	1	2
Osteomyelitis	0	0	1	0	1
Ulcerative endocarditis	0	1	0	0	1
Bronchiectasis	0	0	0	1	1
Unknown	1	0	0	1	2
Total	4	5	7	8	24

It will be seen that in a third of the cases the intracranial complication was due to spread of infection from the middle ear and mastoid. The results are noteworthy for the large proportion of Type III infections. As in the majority of cases the infecting organisms in middle-ear suppuration reach the ear by way of the Eustachian tube from the nasopharynx, we would expect that the im-

plicated organisms would be present with a certain amount of frequency in the throats of normal people.

The incidence of pneumococci in the saliva and nasopharynx of healthy people has frequently been investigated in America. I have been unable, however, to trace any work on a big scale in this country with a view to determining the types normally present, though it seems to be accepted that the pneumococci of healthy mouths belong to the heterogeneous Group IV. On the other hand, in America it has been observed that while the Group IV organisms predominate, the presence of Type III strains is not at all uncommon. Thus Stillman,² in a series of 116 strains isolated from the mouths of normal individuals, found that 53.7 per cent. belonged to Group IV, while 27.6 per cent. were Type III organisms. Glynn and Digby of Liverpool³ failed to find the Type III pneumococcus in twenty-five salivas examined; all the ten strains isolated belonging to Group IV. By way of explanation of their absence they comment on the greater prevalence of Type III pneumonia in America as compared with that in this country. The prevalence of Type III organisms in cases of mastoiditis in the present series seems to suggest that they may occur in the normal British oropharynx with greater frequency than has so far been observed.

Comparison of the figures in Table III with one published in America is instructive.

TABLE III.—Twenty-two Cases

Lesion	Type I	Type II	Type III	Group IV
Otitis media and mastoiditis (see Table I)	2	1	4	7
Otitis media and mastoiditis with meningitis (see Table II)	0	0	6	2
	2	1	10	9

TABLE III(A).—Pneumococcus Types in Acute Mastoiditis and Pneumococcal Meningitis, by John T. Bauer and Huston St. Clair,⁴ Philadelphia. Thirteen Cases

Lesion	Type I	Type II	Type III	Group IV
Otitis media and mastoiditis	2	0	6	0
Otitis media and mastoiditis with epidural abscess	0	0	1	0
Otitis media and mastoiditis with meningitis	0	0	2	2
	2	0	9	2

Both sets of figures show that of the type-specific strains Type III is that most commonly found in acute middle-ear and mastoid disease. In the cases under review the Type III infection showed a greater tendency to extend to the meninges.

In order to put pneumococcal infections of the middle ear and mastoid into their true perspective, it is perhaps not irrelevant to point out and to emphasize the fact that, while such infections are not uncommon, it is the streptococcus which is *facile princeps* in the role of infecting agent. That this is so may be readily seen from the following results obtained by routine examination of 120 swabs from the middle ear and mastoid submitted by the ear, nose, and throat department of the Royal Infirmary, Edinburgh.

TABLE IV.—Acute Otitis Media and Mastoiditis

Haemolytic streptococcus	73	90 or 75%
Other forms of streptococcus	17	
Pneumococcus	17	14.2%
Staphylococcus	11	9.2%
Diphtheroids	2	1.6%

Fisher (Ontario), in a series of 50 cases of acute otitis media or acute mastoiditis, found:

Haemolytic streptococcus	...	...	...	37 or 74%
Staphylococcus	...	...	...	8 or 16%
Pneumococcus	...	...	...	3 or 6%
No growth	...	...	...	2

Two of the pneumococci were Type III, and one Group IV.

By reference to Table II it will be seen that five of the meningitic cases occurred as complications of lobar pneumonia, one being Type I and four Type II. The predominance of Type II infections in this connexion is in accord with the type incidence in lobar pneumonia in Edinburgh at the present time.

Fracture of the skull was responsible for four of the cases. All the fractures were through the anterior fossa, with involvement of the orbit and some of the accessory sinuses. One pneumococcus was Type I, and three belonged to Group IV. This result is in keeping with the commoner occurrence of Group IV organisms in such situations. In face of gross trauma, these organisms (although of low virulence, as Whittle has observed) are unfortunately powerful enough to give the patient his quietus.

One interesting case of meningitis, following on a pneumococcal osteomyelitis of the spine, is worthy of mention because of its comparative rarity. A Type III pneumococcus was isolated from the cerebro-spinal fluid during life, and a similar organism was obtained from the pus surrounding the spine at the post-mortem examination, at which the pathologist found an osteomyelitis of the tenth dorsal and first lumbar vertebrae, together with a large psoas abscess.

All the twenty-four cases of meningitis were fatal. Some cases of recovery, however, have been recorded. For instance, Broadbent⁵ states that he cured two cases occurring as a complication of pneumonia, despite the fact that in one of them the cerebro-spinal fluid resembled the pus of an empyema.

LOBAR PNEUMONIA

Sixty cases were examined, either by blood culture of sputum test during life, or by post-mortem cultures from the consolidated lung. The results were as follows:

Type I	Type II	Type III	Group IV
12, or 20%	35, or 58.3%	0	13, or 21.7%

The figures serve to show that Type II pneumococcus has been the chief causal agent in lobar pneumonia in Edinburgh during the past two years, and they support those recently published by Alston and Stewart.⁶ They also prove that the type incidence in lobar pneumonia varies from time to time in the same locality, since five years ago the predominant type was Type I (Davidson and McLachlan). Statistics from Manchester, Liverpool, and Cambridge all show a prevalence of Type I infections in these areas. In connexion with this variation in type incidence, Armstrong is of opinion that Type II infections may become for a time very prevalent and then almost disappear, whereas Type I is the common and persistent type, and is especially concerned in producing the more severe forms of the disease.

As a rule, in our cases, the pneumococcus was isolated from the lung at necropsy without much difficulty. The culture obtained was sometimes pure, but often contaminating organisms were present, such as *B. coli* and occasionally a streptococcus. On two occasions a streptococcus only was isolated, no pneumococcus being found. No Type III lobar pneumonia was encountered. In passing, it may be mentioned that in one case a pure

growth of Friedländer's bacillus was obtained. The patient gave a history of having been gassed with "mustard gas" during the war, and since then he had had a chronic cough, with much thick, green, evil-smelling sputum.

BRONCHO-PNEUMONIA

Specimens from nine cases only were examined. In contrast to their absence in lobar pneumonia, two cases of Type III infection were met with. One case of broncho-pneumonia deserves special mention. It occurred during the pregnancy of an unmarried girl of 16, and caused the premature birth of an eight months' foetus. The question arose as to which was the primary infection—the pulmonary or the uterine. As there were signs of lung consolidation on admission to the infirmary, and no outward evidence of uterine infection, it was thought that the pulmonary condition was the more likely to be the primary one, the uterus being subsequently infected by the blood stream. A Type II pneumococcus was isolated from the sputum; a similar type was obtained along with *B. coli* from the uterus after death, while a Type II organism was also got from the meninges. The pathologist found a confluent broncho-pneumonia, a septic endometritis, and an early meningitis.

EMPYEMA

Twenty-one cases of empyema were examined, fourteen being Type I, or 66.6 per cent.; one Type II, or 4.8 per cent.; one Type III, or 4.8 per cent.; and five Group IV, or 23.8 per cent. The outstanding feature is the marked preponderance of Type I infections.

In a series of thirty-one cases, Whittle found 77.4 per cent. belonging to Type I. Certain combined British and American figures, quoted by Glynn and Digby, bring out the high incidence of Type I and Group IV infections, and the low incidence of Type II. Remembering that the Type II pneumococcus is the most prevalent organism here so far as pneumonia is concerned, the frequency of Type I empyemata is all the more noteworthy. It seems to demonstrate the superior invasive power of the Type I organism. Of twelve cases occurring as a complication of pneumonia, eight were Type I, or 66.6 per cent.; of these four, or 50 per cent., ended in death. The Types II and III cases recovered, while all the Group IV cases were fatal.

To account for the high mortality in the Group IV infections, it may be mentioned that two of them were mixed infections, one being combined with Pfeiffer's bacillus and the other with *Staphylococcus aureus*. Another case was associated with acute pericarditis.

ENDOCARDITIS

Vegetations from the heart valves were examined on twelve occasions. A non-haemolytic streptococcus was obtained from six of the cases and a pneumococcus from three. Attempts to isolate the infecting agent in the other three cases were foiled by the overgrowth of Gram-negative contaminating organisms. One of the pneumococci was Type I, and two belonged to Group IV.

The Type I case was interesting in that no pneumococcus was isolated from the consolidated lung, only a haemolytic streptococcus and Pfeiffer's bacillus being obtained.

OTHER DISEASES

Peritonitis.—Of the five cases investigated, one accompanied a pneumonia, one was a spread from a septic endometritis following an incomplete abortion, while another followed a tubo-ovarian abscess.

Arthritis.—A purulent arthritis of the ankle-joint was met with. It yielded a pneumococcus corresponding in type to that isolated from the lung.

Abscesses.—Subcutaneous abscesses have been described as concomitants of pneumonia. One case was encountered. From an abscess in the arm a type of pneumococcus was obtained similar to that isolated from the sputum. Two other and rarer kinds of abscesses were investigated. They were gluteal abscesses occurring at the site of injection of quinine-urea, used in the routine treatment of pneumonia. A pneumococcus was isolated in both instances. Unfortunately, in one case it was not typed. In the other, however, a type was secured which tallied with that previously isolated from the sputum. Perhaps some mishap at the time of the injection had permitted the quinine to devitalize the tissues, and so allowed the blood-borne organisms to settle there. The abscess, in the case that was typed, gave rise to a pyrexia, which subsided on evacuation of the pus.

SUMMARY

1. The pneumococcus most commonly found in the eye, nose, and accessory sinuses belongs to Group IV.

2. In acute otitis media and mastoiditis, Type III strains and Group IV organisms were found in about equal numbers. The type-specific strains showed a greater tendency to infect the meninges.

3. Attention is drawn to the important part that the streptococcus plays in acute middle-ear and mastoid disease. *Streptococcus pyogenes* was found in the majority of cases.

4. The most prevalent type of pneumococcus in cases of lobar pneumonia was found to be Type II.

5. In cases of empyema due to pneumococci, Type I strain was present in a large percentage.

The type serum used in this investigation was obtained from Dr. Wadsworth and Miss Kirkbride, of the Division of Laboratories and Research, Department of Health, State of New York, to whom I wish to express my indebtedness.

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BLACK HAIRY TONGUE*

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The condition known as hairy tongue appears to be more common in France than in England. General interest was first aroused by Raynaud in 1869, who likened the curious appearance to that of a field of corn laid low by the wind, a description which has struck successive observers as very appropriate. He also described the presence of numerous round bodies in the lesion, which he believed were fungus spores similar to those of ringworm. Much controversy took place among subsequent writers as to the relation of these spores to the disease, and it was established that though they were often present they were sometimes absent, as in the carefully described cases of Féréol. It was not until 1901 that Lucet identified these spores as yeast cells. He carefully investigated the yeast he obtained from a case, and it has since been known as *Cryptococcus linguae pilosae*. Attempts to transmit the condition failed. Dessois (1878) made inoculation experiments on his own tongue without success, and though "a sort of epidemic" of black tongue was seen in the Hospital for the Aged at Issy, Professor Chantemesse never succeeded, in numerous attempts, in transferring the condition to a healthy tongue.

A few cases have been recorded in England. R. Lake¹ of Barnes in 1891 had a typical case that showed the spores. The curious tongue described by Balfour-Graham,² in which the dorsum "looked exactly like the surface of a dog's nose," was probably of a different category, perhaps the result of mercurial treatment. Another case was described by Hunt and Leslie Roberts³ at a meeting of the Liverpool Medical Institution in December, 1902. Other organisms have been suggested as a cause. Dinkler, in 1889, found the hairs covered with a Gram-positive filiform bacillus, as did Morelli in 1893. Guégan (1909)

announced the discovery of a new species of oöspora, a fungus showing a mycelium composed of bacillary elements and bearing conidiophores and chlamydo-spores, which he believed, in symbiosis with the yeast of Lucet, was the causative organism. This organism is now classified in Brumpt's *Parasitologie* as an actinomyces. Weidman also isolated an organism which he believed was an actinomyces. Valuable recent observations are those of Catanei⁴ (1928), who watched a case in a man, aged 80, for two years, and made four examinations of the hairs. On each occasion the yeast of Lucet was present, along with other moulds and bacteria, but none of these were pathogenic to animals, and inoculations into the healthy or scarified tongue of monkeys were without result. Charpy⁵ attributed the disease to a nerve lesion, traumatic or functional, while Barnard⁶ believed it was a disease of old people, and was an overgrowth of the filiform papillae due to the lack of normal rubbing of hard food. He states that he has known examination candidates mistake the condition for melanotic sarcoma. Heidingsfeld,⁷ as a result of biopsy examinations, believed there were two forms of the disease—a spurious or evanescent, and a true or permanent, the latter dependent on a primary tendency to hyperkeratosis.

The nature of the pigment in these cases is uncertain, and we regret we did not investigate it fully in the case reported below. The prussian blue reaction for iron was negative. According to other observers it is insoluble in acids and alkalis, and bleaches in the mouth on treatment with hydrogen peroxide, but in our case a treatment on the spot with peroxide had no effect. Pigment-forming moulds have been reported in the lesion from time to time, but not with sufficient constancy to be considered an etiological factor. The yeasts of Lucet and Green are described as producing a certain amount of brown discoloration of the media, but in our case this did not take place.

The hairs are filaments of more or less keratinized epithelium attached to the summits of the filiform papillae. We consider the condition is probably a great exaggeration of the thick fur often seen in disease. An acid reaction of the mouth seems to be the essential underlying factor, whether produced by excess of fermentable food, gastritis, or paucity of saliva in the aged. The acid

* Read at a meeting of the Liverpool Medical Institution.