The ground at Gailes has been used yearly for over two decades for camp purposes; refuse pits have been opened and covered over; much traffic, horse and otherwise, has occurred in the vicinity of the drains, and indiscriminate use of sand meant the use of polluted material. A bacteriological report on the sand in question and valuable suggestions made by the bacteriologist are appended.

BACTERIOLOGICAL EXAMINATION OF SAND.

Sample 1 was collected from a small heap which had been used for cleansing food utensils and which presented a soiled appearance. It was examined same day to determine the nature and amount of bacterial contamination, if any. Sample 2 was collected from foundation pit for comparison with Sample 1.

Sand I.

Bacterial Content: 2,060,000 per gram in gelatine at room temperature; 95,200 per gram on agar at 37° C.

Colon Group (Lactose+ Indol+).—Details:

<i>B. coli</i> ...	Present in 0.01 gram.
<i>B. neapolitanus</i> ...	Present in 0.01 gram, absent in 0.05 gram.
<i>B. coscoroba</i> ...	Present in 0.05 gram.
<i>B. acidi lactici</i> ...	Present in 0.001 gram.
<i>B. proteus</i> ...	Present in 0.001 gram.

Sand II.

Bacterial Content: 21,200 per gram in gelatine at room temperature; overgrown with colonies of mould (mucus).

Colon Group (Lactose+ Indol+).—Absent in 1 gram. Details:

<i>B. coscoroba</i> ...	Present in 0.01 gram.
<i>B. proteus</i> ...	Present in 1 gram, absent in 0.1 gram.

The results obtained from the examination of Sand I serve to show the extent to which sand becomes polluted by its use in the cleansing of food utensils. The nature of the pollution indicates that this practice may become a source of dangerous contamination. The danger would be sufficiently guarded against by the use of clean sand from a sandpit placed in boxes. The requisite amount of sand would be lifted out and the possibility of its use a second time would thus be obviated.

R. M. BUCHANAN.

December 10th, 1914.

The result of an investigation into the water supply is added, as every year complaints are made as to its colour and turbidity, especially in wet weather. A large more or less permanent camp has been erected at Gailes, which may be further extended, the sandy soil and healthy situation, with ample manœuvring ground in the near vicinity, making this one of the most suitable localities for training purposes. It is desirable that an authoritative statement as to the water supply should be put on record.

SUMMARY OF REPORT ON WATER SUPPLY.

The water supply as delivered from several taps was examined bacteriologically on November 30th and on December 4th and 10th.

Owing to the interval between the collection and examination of the first and second samplings the numerical results have no value beyond indicating (1) the possibility of rapid multiplication of bacteria if the water is allowed to remain for any length of time in the end pipes, and (2) the need for systematic flushing of those standard taps which are not much in use.

The results of the third sampling (gelatine count 68 to 154 per c.cm.; agar count 26 to 52 per c.cm.; colon group—(a) *B. coli* "lactose + indol + " present in 100 c.cm., absent in 10 c.cm.; (b) other coliforms present in 10 c.cm., absent in 1 c.cm.) may be interpreted as indicating a fairly pure upland supply when local conditions and circumstances are fully taken into account. At the same time it may be stated that the total number of bacteria per c.cm. and the colon group content are comparatively high, and point to some contamination which, although not presenting evidence of a specifically dangerous nature, is undesirable, and most probably preventable. It is of a nature that suggests pollution of the reservoir by the intermittent visits of sea birds.

R. M. BUCHANAN.

DR. R. THOS. JONES, J.P., Harlech, has been appointed High Sheriff for the County of Merioneth for 1915-16.

THE Foundation Oration of the Union Society of University College, London, will be given by Lord Parmoor on Thursday evening, March 18th, at 8.45 p.m. The lectures will be founded on a text from George Herbert: "Do well and right, and let the world sink." The annual dinner will be held in the college refectory on the following evening at 7.30 p.m. It is particularly hoped that members serving with His Majesty's Forces will avail themselves of this opportunity of meeting old friends. Tickets for the dinner, 5s. each (men only), can be obtained from Mr. Godfrey H. Ince, at the college.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.

BY

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WHAT I have got to say in regard to the bacteriology of epidemic cerebro-spinal meningitis is doubtless familiar to many, but it is perhaps well, in a general discussion, to restate briefly certain points in connexion with the biology and distribution of the meningococcus which have a distinct bearing on the epidemiology of this disease.

The meningococcus of Weichselbaum is universally regarded as the essential specific cause of epidemic cerebro-spinal meningitis, as also of certain forms of sporadic meningitis. It belongs to a small group of Gram-negative diplococci, the only other important member of which is the gonococcus. In many relationships, and especially the serological relationships, it bears a close family resemblance to the gonococcus, and if the distribution of the gonococcus were other than it is, there is no doubt that the difficulties in differentiation surmountable though they are, might be greatly increased. Records of cerebro-spinal meningitis, as we know it, are wanting before the year 1805, and the daring hypothesis has been put forward that the meningococcus may have arisen as a mutant form of the gonococcus, with its seat of predilection in the meninges instead of the genital tract.

It would be idle, however, to speculate further on this point at present, as research is hampered by our inability to communicate either cerebro-spinal meningitis or gonorrhoea, as we know them, to laboratory animals. The serological and other affinities that exist between the meningococcus and the gonococcus find an interesting parallel in those that exist between the bacillus which causes pseudo-tuberculosis in rodents and the bacillus of human plague.

The meningococcus is a delicate short-lived organism and requires for its successful isolation and for a variable time after isolation the presence of serum, ascitic fluid, or some such substance in the nutrient medium. Later it can grow without these additions, but it still retains certain properties which mark it off as an organism which cannot under any circumstances lead a saprophytic life outside the human body. These properties are its great susceptibility to (1) cold, and (2) to drying. It will not grow below 25° C., and cultures kept at room temperature very rapidly die out. If no precautions are taken against drying the organism dies out even at 37° C. in a few days, but if such precautions are taken it has been found possible to keep the organism alive for so long as six to ten months. The observations of various authors vary somewhat, and it is unnecessary to cite details, but all are agreed that the meningococcus is an organism which is extremely susceptible to external influences of the kind mentioned.

When found in the lumbar fluid of cases of meningitis, the meningococcus is readily identified by its Gram-negative character and its frequent intracellular disposition. After isolation, the growth is distinguished by its emulsibility in saline, its action on certain carbohydrates, and its behaviour towards an agglutinating serum. As organisms other than the meningococcus are only very rarely met with in samples of fresh lumbar fluid from cerebro-spinal cases, some of these tests may legitimately be dispensed with, especially if work is pressing; but in the case of suspicious organisms isolated from the naso-pharynx of cases or carriers, identification tests have necessarily to be more strict in view of the fact that other Gram-negative diplococci, such as the *Micrococcus catarrhalis* and the group of chromogenic diplococci, are liable to occur in this situation. The criteria employed for the identification of meningococci from the naso-pharynx have probably not always been of a uniformly strict character, and this fact has undoubtedly to be taken into consideration in appraising the percentages obtained by various workers who have searched for carriers either during the epidemic season or at epidemic-free periods.

It would be exceedingly desirable to have an agglutinating serum which would act with some uniformity against meningococcal strains of various origin. In hunting for carriers it would be invaluable, but so far the difficulties

presented by the fact that a considerable number of strains are relatively inagglutinable have not been surmounted. A serum prepared by immunization with one strain may agglutinate only a small proportion of other strains. For example, Elser and Huntton in America tested a mono-valent serum against 65 strains, with the result that 25, or 40 per cent. of them, were not appreciably affected. Similar results have been got by Arkwright and other workers.

On the other hand, some of these inagglutinable strains may have slight but definite absorptive powers, and may, when injected into animals, produce serums which affect agglutinable strains, though remaining without action or with only slight action on the homologous organisms.

It is possible, however, that these difficulties may yield to further research, which the present outbreak will doubtless stimulate, but it has to be remembered that in the coccal group generally these serological difficulties due to apparent high specificity of the individual strain are constantly met with—for example, in the case of the *pneumococcus*. The phenomenon is not confined to this group, however, as very occasionally strains of *B. typhosus* are met with which are relatively inagglutinable, but which are able to produce agglutinins for other strains.

With regard to the distribution of the *meningococcus*, it has never been isolated from dust, air, or fomites generally, and, indeed, its short-lived character renders very remote the possibility of its transmission by such media.

Apart from the actual case of the disease, the *meningococcus* is found in the naso-pharynx of a certain proportion of persons living in more or less contiguity with cases. I will refer only to its occasional presence in the naso-pharynx of healthy persons at epidemic-free periods. In the book on the *carrier problem* by Arkwright and myself¹ a list of observations on this point is found, and Sophian in his book² publishes a similar list. Some observers have found a small percentage of carriers in such populations, while others have found none, but the total number of cases examined has not been large. The only large series is that by Mayer and Waldmann (1910), who examined 9,111 men in the Munich garrison at an epidemic-free period and found roughly 2 per cent. of carriers amongst them. In a recent paper in the *BRITISH MEDICAL JOURNAL*, Sir William Osler quoted these figures and added a point of exclamation, the inference to be drawn probably being that he (Sir William) was inclined to subscribe to Mayer's sweeping generalization from his figures—namely, that the *meningococcus* was an ubiquitous organism occurring in 2 per cent. of normal people.

This question is, of course, a most important one. If one were to accept a generalization of this kind, it would amount to placing cerebro-spinal meningitis on the same plane as pneumonia, where epidemiology does not come in—that is, if we accept the current view that a person gets pneumonia by infection from a strain which has been growing saprophytically in his respiratory tract.

Now, it must be said that at the time some doubt was cast on these observations of Mayer by his own compatriots, and in a footnote to his paper Mayer refers to this feeling of scepticism; but probably the feeling was one rather of disagreement with his generalization above referred to. In my view there is no reason to doubt the figures, but in appraising them one has to remember that the population examined was one in which cases had been occurring yearly. It is therefore not at all improbable that some of his carriers revealed at the meningitis-free period had been chronic carriers for some months, while others had been infected by such carriers. As a matter of fact, Mayer admits that 4 out of 35 persons who were carriers during the meningitis season proved to be still harbouring the *meningococcus* at the meningitis-free period. The way in which one carrier gets surrounded by a zone of carriers has been very clearly demonstrated by Selter, whose observations are to be found in the book on the carrier problem.

The presence of such carriers at an epidemic-free period is indeed necessary to explain the peculiar manner in which cerebro-spinal meningitis springs up in areas between which and previously infected areas no apparent connexion can be traced. The chronic carrier, with probably a zone of carriers round him, acts as the bridge between one epidemic and the next. A generalization, therefore, like that propounded by Mayer is entirely

unjustified at the present time, and is calculated to give a false sense of security to the general and medical public.

REFERENCES.

¹ Ledingham and Arkwright: *The Carrier Problem in Infectious Diseases*, London, 1912 (Edward Arnold). ² Sophian: *Epidemic Cerebro-spinal Meningitis*, London, 1913 (Kimpton).

CEREBRO-SPINAL MENINGITIS: DIAGNOSIS AND PROPHYLAXIS.

BY

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SUCCESSFUL prophylaxis depends upon a clear conception of what the disease actually is. The name is unfortunate. It recognizes only one set of symptoms that are practically terminal.

The disease is more prevalent than is commonly known. It has three stages:

1. Catarrhal.
2. Septicaemic.
3. Meningeal.

The catarrhal stage is probably very prevalent. It causes no symptoms that occasion any alarm, and is looked upon as a pharyngitis, or that and a laryngitis combined.

The septicaemic stage sets in when invasion of the blood stream has taken place. It is apt to be mistaken for influenza, and often it ends there and nothing occurs to cause any suspicion that there has been a mistake in diagnosis. Occasionally it happens that the true nature of the disease is recognized, and it is notified, but before time has been found to perform lumbar puncture the whole train of serious symptoms has disappeared. The result is a reversal of the diagnosis, and some degree of discredit to the original examiner of the case.

The diagnosis depends upon the recognition of the existence of these three stages.

Fever, headache, and other constitutional symptoms need not be expected in the mild catarrhal stage. An examination of the pharynx shows redness—catarrhal as opposed to granular pharyngitis is seen. But it must be remembered that the former may be superimposed upon the latter, and thereby confusion may arise. The question of the nature of the infection can only be settled bacteriologically. A pure culture is practically never to be got directly, and the usual methods must be observed to separate different organisms. Certain streptococci and pneumococci are very frequently found, but the important point is to find out the presence or absence of meningococci. This is done by the excellent method devised by Gordon.

The question arises whether if meningococci are found and there is no other symptom but pharyngitis, is the disease to be attributed to the meningococcus? It certainly ought to be, for the following reasons:

1. The meningococcus resembles the gonococcus in having great vitality in a favourable nidus, and in being extremely susceptible to adverse influences when removed to situations where other organisms could still survive. Implanted successfully upon the pharyngeal wall it tends to hold its own, just as does the gonococcus when it reaches the site of its predilection. (The utility of gargles and other forms of local treatment has yet to be proved in dislodging it, but the attempt to do something in the way of thorough local treatment should not be neglected.)

2. In all probability the tendency is for the organism to make headway and to enter wandering cells and travel eventually into the blood stream. Even in the blood it may do little mischief beyond causing a toxic headache and other symptoms usually attributed to influenza. Cases of this sort may have typical or more usually atypical and protean nervous symptoms, and may suddenly recover or become quite easily diagnosable clinically.