THE EPIDEMIOLOGY OF MENINGOCOCCAL MENINGITIS, OR CEREBRO-SPINAL FEVER.

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THE prevalence of cerebro-spinal fever is essentially seasonal, as is well illustrated by the fact that in Ipswich, during the three years 1915-1917, 26 cases occurred in the March quarter, 33 in the June quarter, 2 in the September, and 2 in the December quarter. The maximum prevalence of the disease was in the month of March, closely followed by April. The next in order were the months of May, February, and June, but the degree of prevalence in these three months may be judged from the fact that the total number of cases for the three months was equal only to that of the month of March. After June the cases have been sporadic; the only month in which no cases have occurred has been July.

The position, therefore, is that the disease has never been entirely absent from Ipswich during the last three years, but has been most prevalent in February, March, April, May, and June, particularly in March and April. This seasonal prevalence has been characteristic of each of the three years.

Consideration of these facts would appear to establish a *prima facie* case for the association of the disease with some condition, or conditions, common to the whole year, but most in evidence in the winter and spring.

Without entering into details, we may assume that most would agree that an organism found in one part of the body, morphologically, culturally, and serologically identical with an organism inhabiting another part of the human host was one and the same organism. We are therefore justified in the assumption that a nasopharyngeal coccus and the meningococcus, which are morphologically, culturally, and serologically identical, are one and the same organism. The fact that the meningococcus in the cerebro-spinal system produces the phenomena of meningococcal meningitis, and that in the nasopharynx it produces no obvious symptoms, is quite consistent with this conclusion.

A large number of demonstrations go to prove that the nasopharynx of an individual suffering from meningococcal meningitis contains the meningococcus in the early stages of the disease. Failures to demonstrate the meningococcus in the nasopharynx of cases of meningococcal meningitis may be due to many causes, such as the extreme delicacy of the organism, faulty swabbing, possibly the exhibition of an anaesthetic before the swab is taken, the taking of swabs too late in the disease, and so on.

The practical epidemiological point is that there is sufficient evidence to justify the opinion that in every case of meningococcal meningitis the nasopharyngeal precedes the meningeal infection. If this view be accepted, then the spread of the disease is due to the transference of the meningococcus from one nasopharynx to another.

We may now inquire what evidence exists indicating that the meningococcus is spread from person to person. In this relation I quote the figures of a recent report by the Local Government Board, which epitomizes the work done in this matter by the Board's bacteriologists. They found that amongst 1,881 persons from many different sources and places who had not been in contact with cases of cerebro-spinal fever, no less than 13.5 per cent. harboured in the nasopharynx an organism which was morphologically and culturally identical with the meningococcus, and in the opinion of the Board's bacteriologists was, in fact, the meningococcus. If this statement be correct, even if the proportion given is greatly overstated, it affords definite evidence of a widespread nasopharyngeal meningococcal infection. The number of persons infected in an infected area would, on this basis, in a town of the size of Ipswich, in any one year, be very large, each being capable of transmitting the infection to others.

A normal healthy nasopharynx will rid itself of the meningococcus without treatment, or in spite of it, on the average, in something under a fortnight. An unhealthy nasopharynx, with adenoids, etc., can retain the infection for a longer period. Some individuals retain the infection for prolonged periods and become true carriers. I have known one case out of a limited number which remained

infected for over six weeks. Such persons will serve to assist in maintaining the meningococcus in a locality and will help to bridge over the summer and autumn intervals. Naturally, those in this group will be relatively few, so that the numbers infected by them will be few in relation to the total population. Nevertheless, they will assist in maintaining the reservoir.

We are now in a position to go back to the seasonal nature of meningococcal meningitis. Nasopharyngeal infections of all sorts are spread from person to person in the acts of coughing and sneezing, the immediate atmosphere being impregnated with spray or droplets, containing members of the nasopharyngeal flora. Therefore, all nasopharyngeal infections will be most readily spread during the seasons of the year when coughs and colds and other nasopharyngeal and respiratory infections are most prevalent. The spread of infection will be assisted by the closer crowding of the population during these periods of the year and by the closing up of ventilation and the complete ignorance and indifference of the public as to the mode of spread of this group of catarrhal infections.

We should, therefore, expect that meningococcal meningitis, secondary to nasopharyngeal infection, would be most prevalent in February, March, April, and May, which is precisely what does occur, as evidenced by the sudden appearance of cases of the disease in these months.

In my opinion the rise in meningococcal meningitis coincides with an increase in the density of the nasopharyngeal infection, whilst the summer and autumn fall coincides with a corresponding drop. We thus get a vicious circle produced by (1) a rise in the usual winter coughs and colds, a proportion of the sufferers harbouring the meningococcus; (2) a number of people are infected by these, the number varying with the opportunities of infection; (3) these in turn cough on the infection, and thus with an increase of catarrhal infections a constantly increasing number of persons become infected with the nasopharyngeal infection; (4) when the finer weather comes on, coughs and colds diminish rapidly, and so does the meningococcal nasopharyngeal infection.

The question may now be asked, granting all this, Why are there not more cases of meningococcal meningitis? My answer to this is that the invasion of the meninges by the meningococcus is an accident dependent on conditions as yet undetermined. If this view is correct, it is merely a mathematical proposition that the greater the number of individuals involved, granting the possibility of the accident, the greater will be the number of accidents. I believe that the existing evidence tends to show that the height of the meningeal epidemic corresponds to the greatest density of the nasopharyngeal epidemic and that the sporadic cases occurring during the other parts of the year merely indicate the existence of a reservoir of nasopharyngeal meningococcal infection.

If these views are correct, then the present mode of dealing with a few positive contacts of a few cases of meningococcal meningitis is futile.

In support of this view of the epidemiology of the disease is the quite marked independence of individual cases. True, on occasion, more than one member of the same family may be attacked. Thus I have seen three cases in one family and two in another. Nevertheless, the general fact is that the cases are single and independent and occur amongst individuals who have no connexion of any kind with one another. This, in my opinion, is strong evidence of a widespread generalized infection.

A FATAL CASE OF PARATYPHOID B SIMULATING TYPHUS FEVER.

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THE following fatal case of paratyphoid fever due to the *Bacillus paratyphosus* B seems to be worth noting, not only from the extreme severity of the lesions found *post mortem*, but also from the clinical course of the disease.

On admission to this unit the patient presented a clinical appearance almost indistinguishable from an advanced stage of typhus fever. He was in a state of