in this way, the numbers of 5-year-olds saved from measles attack would, as shown in Table II, amount to 78 out of a total of 221. In addition, about 35 would have mild attacks instead of severe attacks.

Assuming that all the "primary" cases really arise by infection from some other primary case ten to fifteen days before, it is an easy matter to calculate the number of children who would subsequently be saved from measles by the suppression of the 78 5-year-old sources of infection, by multiplying the number suppressed in a given period by the ratio of new cases arising in a period ten to fifteen days later to those arising in the period in question according to the epidemic curve. Thus the 7 cases suppressed ten to twenty days after the point A would have been expected to give rise to 135/96 times 7 fresh cases developing in the period twenty-five to thirty-five days after A, or 5 cases in the period twenty to thirty and 5 in the period thirty to forty. These 10 cases would again be expected to have given rise to others further on, which can be calculated in the same way. Thus the chain of 215 children who would be indirectly saved from measles attack is arrived at, giving a total of 293 cases suppressed out of 1,000. The modification of the epidemic curve thus produced is shown by the dotted line in Fig. 2.

In this calculation it is of course assumed that the children thus saved from measles would not contract infections from other sources than those which have been removed, and also takes no account of the fact that the epidemic might by such interference be merely prolonged until almost the full 1,000 children had been attacked. This last event is not an unlikely one if the theory of the natural termination of epidemics of measles through temporary latent active immunization of the bulk of the child population is correct. Nevertheless, the calculation serves to show the utmost possible effect which might be produced through treating all the 5-year-olds who had not had measles with serum in the early stages of an epidemic. The number who would have to be so treated may be estimated thus. From St. Pancras data⁴ it appears that the number of 5-year-old children at risk at the start of an epidemic is approximately equal to the total children of all ages who are subsequently attacked in the epidemic, and on this basis there would be about 900 requiring immunization at point A, the utmost result of this being to delay the attack of measles, by two years perhaps, in about 300 children.

CONCLUSIONS

The immunization of all home contacts with convalescent or parent's serum is therefore the more practical procedure, and the more certain in its results, but the total volume of an epidemic could not be reduced by more than about 13 per cent. by this means, and only about one-third of the injections would have any useful effect at all.

The second method, the immunization of all children of certain ages who have not had measles, is more problematical in its results, but presents the theoretical possibility at least of reducing an epidemic temporarily to any proportions desired, though probably only thus making inevitable a larger epidemic at a later date.

There remains another possible method of procedure which may provide the solution—namely, artificially to expose children of certain ages to measles infection, and also give them a partial immunity. Herrman advocated and carried out the inoculation of infants before they had lost their maternally derived immunity by applying the nasal discharge from a measles case to the nasal mucous membrane of children in the fifth month of age. This has the disadvantage that they may infect their

older brothers and sisters in the mild attack which follows, though if adopted as a routine practice this would soon cease to occur, since they would all have been previously immunized. A better method, suggested I think by Zingher, is to apply the virus to the nasal mucous membrane of rather older children, and several days later inject convalescent serum subcutaneously so as to ensure a mild attack and permanent active immunization.

Such inoculation from child to child is of course open to serious objections, but more natural though less certain methods of exposure could be substituted. For instance, we have heard of "measles tea parties" and frowned upon them, but when coupled with subsequent artificial immunization they would cease to be barbarous, and become humane. Perhaps 50 per cent. would respond to such exposure in the way desired; the remainder would escape infection for a year or two by the combined protection of active latent immunity and artificially produced passive immunity, and would have to be either left to their own devices, or given another chance some two years later. There is no theoretical reason why by applying some variety of this method systematically measles epidemics could not be completely controlled or done away with as we know them, and the mortality and harmful sequels reduced to a negligible quantity.

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A NOTE ON SEPTICAEMIA*

BY

SIR W. I. DE C. WHEELER

The largest contribution which surgery has made towards the treatment of septicaemia is in the field of prophylaxis. A discussion on prophylaxis would revolve naturally round Listerism, but it is too wide a sphere for a meeting such as this.

A few weak links in the prophylactic chain are worthy of consideration. We know, for example, that if there is a discoverable focus of infection which can be adequately dealt with, the infected blood stream usually takes care of itself and the prognosis becomes good. The search for this microbic fountain may tax all our resources; it may be found in the gall-bladder or in the root of a tooth. The onset of septicaemia is often traceable to the injudicious management of a primary focus—for example, early incision or milking of an abscess near the lips is attended by real danger. I have known of four deaths from such interference. I have also seen a fatal case of acute septicaemia following injury by a razor to a septic pimple on the face. Rowlands mentioned a case of septicaemia following the too free incision of a furuncle in the external ear. By too early incision of a facial focus a rich plexus of veins may be wounded; the organisms enter the opened venous radicles and are carried via the facial vein to the cavernous sinus, with fatal results. Again, death from general sepsis may follow prostatectomy in cases which have been treated beforehand by radiation. It seems probable that the epithelium of the rectum occasionally is so injured by

* Introductory remarks in a joint discussion in the Sections of Medicine and Surgery at the Annual Meeting of the British Medical Association, Eastbourne, 1931.

radiation of the prostate that organisms permeate from its interior into the space from which the gland has been removed. The raw prostatic bed is a suitable incubator, and violent sepsis may result. I have had experience of two such cases. Thus we learn the necessity of caution in dealing with a primary focus. After the onset of general infection, abscesses may form in any situation; their discovery and evacuation is often the signal of recovery.

Aseptic technique in the operating theatre may be of a high order, but the best efforts may be nullified if nurses and assistants in charge of, or in contact with, septic cases are part of the team. I have had a case of *Streptococcus haemolyticus* septicaemia after a simple appendicectomy which was traceable to a nurse who, when not in the theatre, was in charge of a septic gynaecological case in an adjoining room. Again, epidemics of septicaemia have been traced to the throats of seasonal carriers when there was laxity about masking all those within the reach of operative work. We cannot yet claim that prophylactic measures in surgery have reached perfection.

REMARKS ON TREATMENT

Surgeons, physicians, and biochemists see many cases of septicaemia without discoverable cause, and the treatment of this group is in consequence not satisfactory. What is the best line of treatment in a case with a positive blood culture? Assuming that there is no accessible primary focus, and that the organism is the streptococcus, serum should be employed. Fifty cubic centimetres of the univalent form given intravenously on three consecutive days has been suggested by Horder. The results of serum therapy justify immediate and adequate dosage. Should we employ intravenous injections of such substances as mercurochrome and gentian violet? The literature in favour of these and allied remedies is interesting. There are strong advocates for this line of treatment. My own practice has been to use mercurochrome, 20 c.cm. of a 1 per cent. solution intravenously on two or three consecutive days when everything else had been tried without success, but I am not convinced that intravenous injections of any antiseptic are useful. Horder recommends arsenic as the most useful drug. Colebrook states that in the treatment of syphilis by the salvarsan group the blood serum becomes a destructor of streptococci and that the leucocytes remain unaffected. There is therefore a *prima facie* case for the more extended use of arsenic in septicaemic conditions. Blood transfusions have little or no direct effect in the control of sepsis; indirect benefit may be derived in the more chronic cases.

Large quantities of fluid given intravenously and by the rectal and subcutaneous routes are always beneficial, and 3,000 to 4,000 c.cm. daily of 10 per cent. dextrose solution in normal saline may be given continuously by the drip method through a cannula in the internal saphenous vein without disturbance to the patient, or in divided doses through a needle into the veins of the arm. The patient is thus fed, the glycogen reserve of the liver is raised, the heart is stimulated, and diuresis is increased. Tap water can be administered simultaneously by the drip method into the rectum, or saline into the subcutaneous tissues of the breast. Such methods assist in the dilution and elimination of toxins. Murphy's arguments in favour of ample fluids were not confined to cases of septic peritonitis.

Finally, treatment of septicaemic cases in the open air when practicable should be employed. There is no comparison between the results of treatment of local sepsis in an open-air hospital and in a city hospital. In like manner, patients suffering from infection of the blood stream respond to treatment better in the open air.

OCULAR COMPLICATIONS OF CHRONIC EPIDEMIC ENCEPHALITIS*

BY

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During the last six years I have been examining cases at the post-encephalitis lethargica unit of the London County Council, at the Northern Hospital, Winchmore Hill. It was felt, therefore, that some remarks on the ocular conditions met with, based on notes of 174 cases of the later stages of the disease in children, might be of interest, and that it might be well to review the subject briefly from the ophthalmological standpoint, in the light of more recent knowledge and longer experience.

Ophthalmologists are interested in epidemic encephalitis (or encephalitis lethargica, so-called) for many reasons, which can be summarized thus: (1) As regards the diagnosis of the disease, the ocular phenomena being of great importance in this respect, both in the acute and chronic stages. (2) On account of the peculiarity of these ocular signs, some of the most extraordinary of which occur only in this disease. (3) Because the correlation of these ocular phenomena with the known pathology of the disease helps to throw further light on the neurology of some of the ocular movements, and is closely related to the subject we have been discussing† in this Section—namely, ocular palsies. (4) Lastly, because the great benefit obtained in chronic encephalitic Parkinsonism by the use of the belladonna group of drugs is now well recognized. As a result, the ophthalmologist is called on to counteract the visual disabilities which may be produced by this treatment.

OCULAR SIGNS IN THE ACUTE STAGE

You scarcely need to be reminded of the importance of the ocular signs and symptoms of the acute stage, which result principally from varied kinds of ophthalmoplegia. There are the transient nerve-root paralyses, giving rise to transient diplopia, and, as I shall suggest, to the ptosis. There are the irregular ophthalmoplegias due to deeper lesions, resulting in altered movements of the eyeballs, defects in the movements of the pupils, and peculiarities in the movements of the lids. In the Ministry of Health Report, No. 11,¹ 78 per cent. of the patients, in a series of 1,152 case reports, had the external ocular muscles affected in some way or another. Thus, ptosis occurred in nearly 50 per cent., squint in 34 per cent., diplopia without obvious squint in 18 per cent., and nystagmus in 18 per cent.

In the acute stage epidemic encephalitis presents multitudinous symptoms, and may, and does, simulate many diseases of the brain. I would suggest, however, that there are two common types with which, particularly, the ophthalmologist may meet. The first is a type showing ocular disturbances occurring in a febrile disease, with marked disorder of sleep. The second is that of a so-called "influenza" with diplopia—a milder type often missed, but equally liable to sequels.

It should also be added that the presence of papilloedema or of optic neuritis is decidedly against the diagnosis of encephalitis.

OCULAR SIGNS IN THE CHRONIC STAGE

One can contrast these ocular complications of the acute stage with those seen in the chronic stage. It has been

* Paper read in the Section of Ophthalmology at the Annual Meeting of the British Medical Association, Eastbourne, 1931.
† See report, *British Medical Journal*, August 8th, 1931 (p. 265).