of 2 years, and 90% during childhood or adolescence. The sex incidence is equal. The picture presented is a combination of acute adrenal insufficiency and the phenomena of a fulminating infection—for example, purpura, pyrexia, etc. Characteristically, a previously healthy child with perhaps brief respiratory catarrhal infection becomes suddenly collapsed, with Hippocratic facies. Vomiting and hyperpyrexia may occur. Purpuric haemorrhages are present at the onset, and rapidly become extensive, even to the simulation of post-mortem lividity. Meningitic signs are usually absent. Diagnosis must be made on the clinical features of the case, as the cerebrospinal fluid is usually normal and little time is available for study of blood electrolytes. Death occurs usually within twenty-four hours of the onset.

Treatment

These patients die from a combination of the results of fulminating infection and acute adrenal insufficiency. The former must be combated with chemotherapy (the infection in 60% of cases being due to the meningococcus and less often to the haemolytic streptococcus). The acute adrenal insufficiency is treated with large doses of sodium chloride (enterally or parenterally) and adrenal cortical hormone—the extract or desoxycorticosterone. That treatment is practicable and possible was demonstrated in the case of Carey's (1940), in which recovery was effected in a patient with this syndrome.

Summary

A case of fulminating septicaemia, purpura, and adrenal haemorrhage (Waterhouse-Friderichsen syndrome) is reported. The salient features of the clinical picture are described, and rational and effective therapy is outlined.

My thanks are due to Dr. W. Allen Daley, medical officer of health, L.C.C., for permission to publish this case.

REFERENCES

- Carey, T. N. (1940). *Ann. intern. Med.*, **13**, 1740.
Friderichsen, E. Cited by Sacks.
MacLagan, P. W., and Cooke, W. E. (1916). *Lancet*, **2**, 1054.
Sacks, M. S. (1937). *Ann. intern. Med.*, **10**, 1105.
Waterhouse, R. (1911). *Lancet*, **1**, 577.

ELEVEN YEARS OF DIPHTHERIA IMMUNIZATION IN A RURAL DISTRICT

BY

G. NICHOLSON, M.D., F.R.C.S.Ed., D.P.H.

*Medical Officer of Health to the Borough and Rural Districts
of Tiverton*

AND

AUDREY Z. BAKER, B.Sc., M.R.C.S., L.R.C.P.

Many years have elapsed since Copeman (1921) suggested the desirability of investigating the advantages which might result from large-scale immunization of children against diphtheria, and it is felt that the following report of eleven years' experience of mass immunization as carried out in a scattered rural district may be useful, both on account of the results achieved and also as indicating some of the practical difficulties to be overcome.

Several reports have already appeared indicating that where systematic mass inoculation has been adopted in large towns there has been a subsequent fall in the incidence of the disease. The practice was instituted on a small scale in Birmingham in 1926, when over 400 school children were treated. The numbers have been increased in the years following, and Burn and Fellowes (1934) report that between 1901 and 1931 the case rate per 1,000 of population varied between 0.86 and 2.00, while in 1932 and 1933, after six years' systematic inoculation, it was 0.60 and 0.41

respectively. A similar fall in incidence has been reported in Montreal, where immunization was begun in 1928. Graham Forbes (1932) gives the incidence in 107 great towns of over 50,000 population each, in which the total protected at the end of 1930 was more than double the number protected at the end of 1928. There was a drop in 1931 of 30 per cent. in the number of notified cases.

Attention has been drawn by Seckel (1939) to the danger of attempting to assess the efficacy of immunization from data obtained over a short period of years, on account of the normal swing from trough to peak in the incidence of the disease. In New York City, for example, a cycle of six to seven years has been apparent since 1895. It is clear that, to be significant, any fall in incidence must be maintained over a period when a rise would be expected, and that the new level should remain at approximately that of the years which were previously "low level" ones.

Fall in Incidence following Inoculations

We have traced the annual incidence in this rural district and borough since 1912 and find that there were peaks in the years 1913, 1921, and 1929. These were sharp and definite, the notifications at the lowest peak being twice that of the highest number in the intervening years, and at the highest fifteen times as great. Although our numbers are small compared with those of the great towns, the cyclical occurrence of peak years appears to be regular, and from the data of the previous years the next peak was to be expected in 1937. Neither in that year nor in the two subsequent years did any increase occur.

Inoculations were begun during the 1929 epidemic and have been continued ever since, a few schools being treated each year. By the end of 1939 approximately 4,000 children under 15 had been inoculated. The population of the rural district and borough together has remained almost constant at about 24,000 during the period under consideration. For England and Wales 36.7 per cent. of the population are under 15 years (Registrar-General's Statistical Review, 1938). If we accept this figure as approximately correct for this district we find that some 45 per cent. of the child population have been protected. The Ministry of Health (1940) considers that if 75 per cent. of all children under 15 were immune the disease would be abolished. We feel justified, therefore, in concluding that the absence of a peak in 1937 is due to the protective measures taken and has not been merely a fortuitous occurrence. The annual notifications and numbers immunized per 1,000 of population are shown graphically in the chart.

Discussion has taken place recently concerning the advisability or otherwise of utilizing the Schick test and also on the best methods of securing the consent of parents and the co-operation of school authorities. In this connexion an account of our experiences may be of interest.

The Procedure in Cullompton

In the 1929 outbreak the town of Cullompton and the surrounding district were intensively involved and the public were naturally greatly alarmed. A public meeting was therefore held in the town to explain the value of inoculation, and it was well attended. Dr. W. A. Lethem of the Ministry of Health addressed the meeting and a film entitled "New Ways for Old" illustrated the value of inoculation. Response by parents was rather poor at first, only 35 per cent. of the total consenting to have their children protected. The material first used was T.A.M. supplied by Messrs. Burroughs Wellcome. Three injections were given at fortnightly intervals. Reactions were negligible, but there was a disposition among some of the children to avoid their third dose, although they were mostly quite good about the first two.

Procedure was made as informal as possible: the classrooms of the school were used, and one of the mistresses acted as second nurse, the first usually being a volunteer from the staff of the local general hospital. One of the local general practitioners, together with the medical officer of health, administered the injections. It was found that the inclusion

of a local doctor had a beneficial effect on the proportion of consents and also a reassuring effect on the children.

Before inoculation hypodermic needles were carefully examined and the points attended to, with the result that children often did not realize they had received the injection until it was over. Injections were given into the deltoid, as high as possible, after first cleansing with spirit and dabbing with tinct. iodi mit. Reactions were negligible, and it was seen that in the space of ten to twelve weeks the incidence of diphtheria in the locality definitely decreased, although it

The continuous line shows the annual notifications of diphtheria since 1912, with an eight-yearly peak. The dotted line shows the cumulative numbers protected by immunization from 1929 to 1939. It will be noted that the peak expected in 1937 did not occur.

had previously continued unabated for twelve months. It was decided that there would be no advantage in employing the Schick test, as it was very desirable at the time to establish a mass immunity as soon as possible, and a preliminary Schick test would have entailed a certain loss of time. In addition to this we felt that both children and parents desired that injections should be as few as possible. Children appeared to treat the first two injections as rather an adventure, but later they developed some resentment. One felt, therefore, that Schick-testing would add to their troubles unnecessarily and thus imperil the popularity of the whole procedure. It is to be noted that the Schick test was abandoned in Birmingham in 1930 for very similar reasons.

Procedure in Surrounding Villages

In other villages a similar procedure was adopted. The schoolmaster would send a note to each parent (usually copied from the blackboard by the children themselves) stating that the M.O.H. would address them on inoculation against diphtheria immediately after school hours on such and such a day. In spite of the fact that in many cases long distances had to be traversed these lectures were invariably well attended. Parents were encouraged to ask questions and an informal atmosphere was maintained. Response depended a great deal on the support of the local schoolmasters and mistresses, who were usually enthusiastic and very ready to help. Perhaps our greatest difficulty lay in finding time to get round our very widespread district in order to deal with the numerous small schools each containing about forty to fifty children. When one considers that the population of the district (rural) is only 24,000 and the area is over 85,000 acres, its lateral extent being twenty miles, one can form some idea of the difficulties. Parents were invited to bring their children under school age to be treated at the same time as those of school age. It was found a good plan to institute inoculation in a village immediately after a case of diphtheria had occurred, interest being then active. It was realized that there are certain objections to this course, but we felt that the advantage gained by the

public anxiety led to a larger number of consents. It was found that there were some villages in the area in which diphtheria had never been known to occur, and these were of course not dealt with at an early stage. As inoculation proceeded opposition diminished, and when the town of Cullompton was treated a second time—three years later—the percentage of consents rose to 65. Later still, in 1939, when the same town was dealt with a third time, it was only necessary to treat the junior school, and consents had risen to 90 per cent.

In 1934 alum-precipitated toxoid was being recommended by several authorities, administration then being by the "one-shot method" of 1 c.cm. This was used for a short time, but we finally adopted the method of administering 0.25 c.cm. and 0.5 c.cm. of A.P.T. at an interval of not less than one month between doses, which, we found, gave rise to no troublesome reactions. While carrying out these injections we were interested to note that at least 50 per cent. of the children showed no wheal from vaccination against small-pox, and we drew the conclusion that many parents who must have objected to vaccination against small-pox did not carry their objections to inoculation against diphtheria.

The village of Silvertown offers another example of the growth in popularity of the procedure. In 1930 the response here reached a bare 30 per cent., whereas in 1939, when the village was again dealt with, it was 85 per cent. One now often receives voluntary requests from village school authorities to have their school inoculated.

Random Observations

Three instances occurred in the district in which the only uninoculated child in a household contracted diphtheria, whereas the remaining children escaped. Four children in the village of Langford contracted severe faucial diphtheria about one month after inoculation, but no case of clinical diphtheria has occurred in the district in any child who had been inoculated for three months or more. Several examples could be quoted of outbreaks of diphtheria being terminated in various villages by means of inoculation, two of the most striking being the outbreaks at Oakford and Huntsham. Another phenomenon noted was that since inoculation one now sees an occasional sporadic case of diphtheria occurring in a village, sometimes in a visitor, with no cases following, whereas prior to inoculation cases usually occurred in groups. With regard to compulsion, we feel that it has yet to be shown that this is really necessary. The system of giving lectures to the parents should be worthy of a more extended trial, and should prove more efficacious than the mere issue of pamphlets, which are not always read.

In 1934, it may be remembered, the incidence of diphtheria in the country was high (68,634 cases, as against 47,388 in the previous year). This had the very desirable effect of inducing Tiverton borough to adopt inoculation. Conditions here were much easier to deal with, as the children were congregated in six schools only. In the elementary schools 800 children were dealt with in the first instance, and in addition Blundell's public school and all private and secondary schools in the borough were inoculated by their own medical officers. Since that date it has been our practice to carry out a follow-up campaign in the borough at intervals of two years, when it is necessary to deal only with the junior schools. Usually about 150 children are inoculated on each occasion.

With regard to cost, we find this averages 3s. 3d. per head, while the average cost of the treatment of a case of diphtheria in hospital is about £15.

Our thanks are due to H. New, former chairman of Tiverton R.D.C., and to F. Voysey, the present chairman, for giving the scheme their support in its early stages.

REFERENCES

- Burn, M., and Fellowes, V. (1934). *Lancet*, 2, 1181.
- Copeman, S. Monckton (1921). Ministry of Health Pub. Hlth. Rep. No. 10, London.
- Forbes, J. Graham (1932). *Bull. Hyg., Lond.*, 7, 669.
- Ministry of Health (1940). Memo. 170. Med., rev. ed., London.
- Registrar-General's Statistical Review, 1938; medical tables. London.
- Seckel, H. P. G. (1939). *Amer. J. Dis. Child.*, 58, 512.