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The Infectivity and Management of Scarlet Fever

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THE INFECTIVITY AND MANAGEMENT OF SCARLET FEVER.

Mr. President and Gentlemen,

I must, in the first place, express my keen appreciation of the honour you have done me in asking me to read a paper on this subject. I do so with the greater pleasure, since it affords me an opportunity of raising points of importance in the administration of fever hospitals, and of obtaining the views of an association of medical men in a position to pronounce an authoritative opinion.

Sources of Information.—Since bacteriology unfortunately does not afford us any real aid in deciding the question of the infectivity of scarlet fever, our ideas regarding this subject must rest rather upon analogy and surmise than upon direct and reliable evidence. It is especially in connection with return cases that attempts have been made to gather information, and the infectious convalescent will therefore figure largely in this paper. Some light is also thrown on this difficult question by a study of diphtheria, a disease in many ways analogous, the micro-organism of which is readily recognised, and concerning which our knowledge has greatly increased during the last few years. I may add that the conclusions I shall attempt to draw are in agreement with the opinions which I have formed during my experience of the disease.

Diphtheria as an Analogous Disease.—It may be disputed that diphtheria is an analogous disease, and, under any circumstances, it will be well to give reasons for so regarding it. As I shall show later, the infective agent in each has been definitely proved to be present in the throat, and there is strong evidence that in scarlet fever, as in diphtheria, it is not infrequently resident in the nasal cavities also. In both diseases the bacterial poisons exhibit selective action: in scarlet fever the kidneys, in diphtheria the peripheral nerves and heart muscle, are specifically affected. The death

of the superficial layers of the skin, resulting in desquamation, may also be due to a selective property of the scarlatinal toxin. In certain features, it is true, the two diseases appear on superficial examination to be not quite analogous; some of these I shall dwell upon later. The rash in scarlet fever, perhaps the most striking difference, may quite possibly be due to some bacterial product circulating in the blood, for it is closely simulated by the erythema, which results, for example, from the administration of certain drugs, or of a soap and water enema. Scarlet fever much more closely resembles diphtheria than it does smallpox, the distinctive skin lesions of which appear to be the direct result of the extrusion from the circulation of a virus, which recent researches suggest is possibly a protozoon. These lesions follow a continuous and characteristic course from papule to scab, and to them in the later stages of the disease infection would appear to be confined, while protraction of infectivity beyond the stage of separation of the scabs is said to be unknown.

Criteria of Infectivity.—Before discussing in detail the infectious convalescent, it is necessary to indicate briefly the general rules that have governed the time of detention. It was originally believed that the period of infectivity coincided with that of desquamation. Occasionally, however, patients leaving hospital after desquamation was completed, were found to be the apparent cause of fresh outbreaks in their homes. It was then noticed that a large proportion of such patients had suffered, either before or after leaving hospital, from discharges from the nasal or aural passages, or from unhealthy conditions of the nasal mucous membrane with or without visible discharge. Rhinitis and otorrhœa, therefore, became additional criteria of infectivity. It was at the same time generally accepted that the secondary desquamation of hands and feet, which sometimes occurred, was not infectious. The practice of discharging patients during the primary desquamation had not made much headway at the time of the investigations which I shall quote; and, except when specially stated, it may be assumed that six weeks was adopted as the minimum period of isolation, and primary desquamation, rhinitis, and ear discharge regarded as reasons for further detention.

Certain Features of Diphtheria.—For the better appreciation of the results, it will be well to recall, also, certain of the known features of diphtheria. (1) In the first place, the Klebs-Loeffler bacillus occasionally persists for long periods. In some of these patients the throat does not quite

recover its normal appearance; there is slight congestion of the tonsils or excess of mucus in the naso-pharynx. But this is not always so; in some of the most intractable cases the nose and throat appear clinically quite normal. (2) Another point is that the persistence of the bacillus does not depend on the original severity of the disease; mild cases, in spite of continued treatment, often retain infectivity for a very long time. (3) A third point is the fact that the number of patients who give rise to return cases cannot be regarded as a full measure of those who are released from isolation still carrying the virulent germ in throat and nose. This circumstance may be attributed partly to the non-susceptibility of the other inmates of the house, and partly to the absence of discharges by which the micro-organism may be transferred. (4) Finally, one may definitely say that in the case of diphtheria it is impossible, without bacteriological aid, to decide when a convalescent becomes free from infection. There is evidence that these features are also exhibited by scarlet fever.

Statistical Investigations.—From the hospitals of the Metropolitan Asylums Board, during six months, October, 1898, to March, 1899, 6,507 recovered scarlet fever patients were discharged, and association with return cases occurred in 2·9 per cent. of these. The infecting cases formed the subject of careful investigation by Professor Simpson,* who visited each of these patients at his own home within a short time of the occurrence of the fresh outbreak, and made observations on his condition at that time. The condition of infecting cases on the day of discharge from hospital, which for obvious reasons is not of quite the same value, has been published by several observers, for example, Dr. Boobbyer,† of the Nottingham Fever Hospital, and Dr. Millard,‡ of the Birmingham City Hospital. Dr. Knyvett Gordon,§ of Manchester, has also made interesting observations. I propose to take *seriatim* the throat, nose, ear, and skin as sources of infection, and regard them in the light of these statistics.

The Throat.—It was incidentally shown by a research, published in the Medical Record for September, 1899, that the mucus of the throat in the early stages of the disease definitely contained the contagium of scarlet fever. The manuscript had been found among the papers of the late Dr. Stickler,

* Report on return cases of scarlet fever and diphtheria, Metropolitan Asylums Board, 1901.
† *Brit. Med. Jour.*, Aug. 31, 1895, p. 523. ‡ *Brit. Med. Jour.*, Sept. 3, 1898, p. 614.
§ Reports on the Health of the City of Manchester, 1902 and 1903.

and it detailed certain experiments which he had performed with a view to conferring immunity against scarlet fever. He had taken mucus from the throat of a mild case of this disease, and, mixing it with carbolic acid (1-600), had injected it subcutaneously into ten children. In all cases, after an incubation period of 12 to 72 hours, scarlatina of undiminished severity followed, and Dr. Stickler therefore abandoned his experiments.

The part the throat plays in the diffusion of infection in the late stages of the disease is uncertain. Dr. Mervyn Gordon* suggests that it is a more frequent cause of return cases than has been generally imagined. He believes that, in addition to infective material being transmitted directly by kissing, or indirectly by being deposited on cups, towels, &c., there is a possibility of airborne infection occurring indoors from the dissemination of droplets of moisture from the mouth in talking, sneezing, and coughing.

That mucus from the throat may be disseminated in coughing and sneezing cannot be doubted, and it is interesting to note that Professor Simpson found, among 90 probable infecting cases, 15 with colds in the head, and 5 with colds in the chest, a fact which emphasises the importance of preventing chills after release from isolation, and of dispensing with the hot bath immediately before discharge. But I should regard it as unlikely that in the convalescent stage there is much danger of distribution by talking of those pathogenic organisms whose habitat is the throat. Any fluid which may be sprayed in the act of talking, comes from the neighbourhood of the incisor teeth, and, as there is a constant flow of saliva backwards to the pharynx, it must be only occasionally that in this stage such fluid contains bacteria derived from the fauces.

The Nose.—Rhinitis is a common and very important complication. The great facility this affection offers in young children for a widespread diffusion of infection, when the discharge contains the infective agent, is sufficiently apparent. It is often most intractable to treatment, and the knowledge that it is frequently associated with return cases leads to its being the main cause of prolonged detention of patients in hospital. Every endeavour is made that a patient shall leave free from nasal affection, though there can be no doubt that the condition often relapses within a short time of the child reaching home. It not infrequently is first noticed after the patient has been discharged.

* *Brit. Med. Jour.*, Aug. 16, 1902, p. 445.

At Birmingham, while only 6 per cent. of all cases had an abnormal condition of the nose at the time of discharge, no fewer than 22·9 per cent. of the infecting cases had been noted as leaving with such abnormality.

Dr. Knyvett Gordon relates that rhinorrhœa was associated with 39 out of the 174 alleged infecting cases which occurred in Manchester in the years 1902 and 1903 ; in 8 cases it had been present at the time of leaving hospital ; in 31 it appeared later.

Professor Simpson found that of 90 discharged patients whom he regarded as probably the cause of fresh outbreaks, 49 had nasal discharge, 5 a sore nose, and 15 a cold in the head with running at the nose.

But it must be noticed that rhinorrhœa does not necessarily prove infectious in the family. It may be calculated from the Birmingham statistics that less than one-eighth of the cases discharged with a morbid condition of nose became associated with return cases. This may be due to one of the following causes : The exposed children may not be susceptible ; the discharge may never actually be conveyed to them ; or the discharge may not in all cases carry with it the infecting virus. It is probable that the last is most frequently the correct explanation, for in diphtheria the rhinorrhœa which sometimes occurs in convalescence is often found not to be associated with the presence of the Klebs-Loeffler bacillus. In other words, the risk attached to rhinorrhœa would appear to be that, if the infecting agent is still present on the mucous membrane of the nose, the discharge will act as a vehicle for its distribution. From many observations it seems likely that in both scarlet fever and diphtheria persons may be released from isolation, still carrying the contagium on their mucous membranes, and yet prove harmless, unless catarrh is set up and the resulting discharges act as carriers of infection.

The Ears.—Otitis is also a common complication of scarlet fever. Among nearly 11,000 patients treated in the Board's hospitals during 1903, 15 per cent. suffered while in hospital from otorrhœa. Even this does not include all, for, not rarely, it occurs for the first time after the patient has left hospital. Otorrhœa, which has ceased for weeks, is apt to recur when the child comes again under home conditions.

The frequency of this complication being admitted, what is its potentiality for transmitting infection ? Dr. Millard states that otorrhœa was present on discharge in 2·2 per cent. of alleged infecting cases, as compared with 1·5 per cent. of all cases. The inquiry is to some extent obscured by

the fact that rhinitis often co-exists with the otitis (*vide* Professor Simpson's table), and the difference is not sufficiently great to enable one to say that otorrhœa plays a very important part in the causation of return cases. Since otorrhœa, for anatomical and pathological reasons, frequently persists for a long time after the original infective process, with which it was associated, has disappeared, this observation is of considerable interest. It may be debated whether the fact that otorrhœa is less infectious than rhinorrhœa results from the specific contagium being frequently wanting in the secretion, or because with ordinary precautions there is less risk of the discharge being brought in contact with the mucous membranes of other children.

Desquamation. — Against the infectiousness of secondary peeling and late desquamation of the feet, there has been accumulated a considerable amount of evidence; for example, at Birmingham, during 1896-98, while 8·2 per cent. of all patients left with some late peeling of the feet, only 7 per cent. of alleged infecting cases had exhibited this condition on discharge.

The impression that even earlier desquamation is not infectious has been gaining ground for several years, but definite information on this point is not yet very extensive. In 1895 Dr. Boobbyer* stated that his experience as medical officer of health led him to believe that too much importance had been attached to risk of infection from desquamation. He pointed out that the disease frequently failed to spread from an actively desquamating patient (though surrounded by susceptible persons), if the mucous surfaces had been only slightly invaded. Dr. Meredith Richards,† then superintendent of the Birmingham Fever Hospital, also expressed the opinion that desquamation was simply concomitant and not the essential cause of infection. Dr. Gilbert,‡ of Tunbridge Wells, remarked that for twenty years he had acted with success on the conviction that in a desquamating skin after scarlet fever there was no danger to others, and that if throat and nose were quite sound, isolation of the patient was not necessary for more than a month. Dr. Priestley,§ in the same year, recorded that at Leicester, at the time of an outbreak of smallpox, about 120 children in various stages of desquamation after scarlet fever were sent to their homes, and no secondary cases occurred at any of

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* *Loc. cit.*
‡ *Brit. Med. Jour.*, Sept. 14, 1895.
† *Brit. Med. Jour.*, Aug. 31, 1895, p. 524.
§ Trans. Epidem. Soc., Vol. XIV., 1894-95.

these houses. In 1902 Dr. Millard,* of the Leicester Fever Hospital, reported that he had adopted four weeks as the minimum period of isolation, and had discharged during three months 190 patients, after an average period of detention of 35·3 days. The exact number was not given, but it was stated that many of these were still desquamating. Of the 5 cases, which gave rise to fresh outbreaks in their own homes, only one had been noted as having desquamation present on discharge, and in this patient the peeling was confined to the feet, and the nose was found to be unhealthy. From several of the Board's hospitals during the past two or three years a number of patients who had not suffered from complication have been discharged desquamating, at the end of four weeks' detention, but no statistics as to results have yet been published. At Southampton, during 1903, Mr. Lauder† also put the matter to the test, and ignored desquamation as a reason for further isolation. He reports that 325 convalescents left hospital during the year. Of these, 204 patients who had not suffered from complications during their stay in hospital were discharged peeling, after an average detention of 28 days ; there were only 2 return cases. Thirty-three were discharged without desquamation or complication, after an average stay of 33 days ; there were no return cases. The remaining 88 patients, in whom complications of various kinds had occurred, left after an average stay of 50 days, and there were 5 return cases. Mr. Lauder remarks : "If peeling *per se* were infectious, then it is almost impossible to conceive how 204 patients discharged from the hospital in a peeling condition failed to be responsible for more than two return cases."

No Morbid Condition.—It is not uncommon for patients discharged apparently free from all abnormality to give rise to return cases. Dr. Boobbyer stated that 11 out of 29 infecting cases, which were discharged from the Nottingham borough hospital in 1893, were normal on discharge. Dr. Millard recorded that 58 per cent, of the infecting cases at Birmingham were quite clear in every way at the time of leaving hospital. It must be recognised, however, as I have already related, that a morbid condition not infrequently develops, or recurs, after the child has been sent home, and that this is apt to be followed by the occurrence of return cases.

Conclusions.—To sum up the results of these investigations, the evidence that infectivity lies, not in the

* *Lancet*, April 5, 1902, p. 959. † *Lancet*, March 12, 1904, p. 712.

desquamating cuticle, but in the throat and nasal cavities, is decidedly strong. In scarlet fever therefore, as in diphtheria, it is impossible to ascertain definitely by clinical means when the patient has been freed from infection.

It must not be assumed, however, that prolonged infectivity is the rule; it is probable that the majority of patients are free from infection at the end of the minimum periods of isolation usually prescribed—the six weeks for scarlet fever and the four weeks for diphtheria. It would seem impossible to discover by clinical means the minority who retain infection longer, and difficult even to differentiate those by whom transmission of infection is likely. The impression derived from experience has been that such transmission is especially liable to occur from those who suffer from rhinitis at the time of their discharge, or have suffered from this complication during their period of isolation, and this impression has been supported by statistics whenever subjected to that test. A nasal discharge, therefore, while not to be regarded as proof that the patient continues infectious, is a symptom to be viewed with considerable suspicion, for if the contagium is still resident on the mucous membrane of the nose, it will unfailingly act as a vehicle for its distribution.

Review of Suggested Methods of Indirect Infection.—Having acquired, from a study of the convalescent, more or less definite ideas regarding the infectivity of scarlet fever, one is now in a position to consider critically the various ways which have been suggested for indirectly acquiring the disease.

Milk.—I shall deal very briefly with milk as a vehicle of infection. Several outbreaks* of scarlet fever have been proved to the satisfaction of the medical officers concerned to be due to the consumption of contaminated milk. It is possible that this occurs more frequently than is known, for the milk supplied in towns often comes from various sources, passes through several hands, and suffers much blending before it reaches the consumer, and it is thus difficult to trace the career of any given sample.

Unrecognised Cases.—I next come to the influence of unrecognised cases, which there is reason to believe is one of the chief causes of the failure of isolation to eradicate the disease. It is now widely appreciated that scarlet fever, like diphtheria, may exist in an extremely mild form, so mild that a considerable number of cases do not come under medical

* *Vide* "Bacteriology of Milk," by Swithinbank and Newman.

observation at all, and so are never isolated. There are patients also with marked throat affection, in whom the rash either does not occur, or has such a brief existence as to escape notice. It is not at all unusual for such cases to be admitted into hospital under certificate of diphtheria ; cultures prove negative and desquamation, suggestive of scarlet fever, ensues, in spite of the fact that no rash has been observed before or after admission.

Scarlatinal Sore Throat.—Again, it is within the experience of every one that throat inflammation is apt to arise in households in which scarlet fever has been notified, and I think we are justified in considering it probable that many of these cases are scarlatinal in nature. Murchison wrote many years ago : " I have frequently found that when one or two children in a house have had scarlatina every adult in the same dwelling has suffered from a severe angina." In cases of this kind which have come under my observation, although the throat affection has been severe, no rash has been observed, nor has desquamation followed.

Healthy Infection Carriers.—The part played by the healthy infection-carrier comes next under consideration. The virulent diphtheria bacillus, it is known, may exist in the throats of healthy persons, who have been intimately exposed to infection, and under a variety of circumstances, it is believed, may be communicated to others who develop the disease. It is possible that in scarlet fever healthy persons may similarly carry the infective agent in their throats, but in the absence of bacteriological evidence this must remain uncertain. Even in diphtheria we have no means of estimating the magnitude of the part the bacillus-carrier takes in the spread of infection. I may mention, however, that it is very rarely that one hears of either disease occurring in the homes of any of the staff of a fever hospital, or among their friends. This is in spite of the fact that 10 per cent. of the nurses who have been examined while on duty in the diphtheria wards of the North-Eastern Hospital have been found to harbour the bacillus in their throats.

Temporary Immunity.—This, incidentally, leads me to raise rather an interesting point. Nurses and medical officers, not infrequently, do not develop scarlet fever until they have worked for many weeks, or even months, in the scarlet fever wards. Patients, admitted under an erroneous diagnosis, may be in these wards for a fortnight or three weeks before they acquire the disease. The explanation usually given is that the susceptibility of an individual varies from

time to time, but another interpretation is at least possible. In a well-conducted scarlet fever ward, as in a diphtheria ward, there is no reason why a person should not work, or live, for a considerable time without actually acquiring in the throat or nose infective secretions derived from patients, and it seems to me that this may well be the explanation of the apparently temporary immunity. The fact, therefore, may be regarded as further evidence of similarity in the mode of infection of diphtheria and scarlet fever.

Air, Clothes, etc.—The question of the extension of infectious diseases by fomites and air has been recently discussed by Dr. Chapin,* of Providence, and he arrives at the conclusion that the importance usually attached to these methods of transmission is based on very slight evidence. At a time when the desquamating cuticle was regarded as the sole source of infection in scarlet fever, it was natural that a somewhat exaggerated importance should have been attached to the risk of conveyance by clothes, and that the carpets and curtains, even the walls and ceiling, should have had dangerous properties attributed to them; it has thus come about that, to disinfection of the room, furniture, bedding, and clothes, the sanitary authorities especially devote their attention. But, although many cases have been recorded where it was possible that diseases were transmitted by fomites, this is very different from proving that they were so carried. Much of the evidence was accumulated at a time when the possibility of danger from the convalescent, the infected yet healthy contact and the unrecognised case was not yet fully appreciated, and, when allowance is made for coincidence also, one may fairly question, with Dr. Chapin, whether the generally received doctrine rests on a really sound basis. That articles, such as cups, handkerchiefs, pillows, sheets, blankets, sofa-cushions, towels, toys, and the like, liable to come in contact with the mouth or nose of other persons, may transmit the disease if smeared with infective secretions, no one can doubt. But secretion deposited elsewhere, speaking generally, cannot come into action until dry and pulverised, and when due allowance is made for the influence of light, desiccation, and starvation upon the virulence and vitality of all pathogenic organisms, it must certainly be seldom that germs in the form of dust are received in sufficiently potent dose to cause the disease. These observations are important in that they indicate the

* Annual Report of the Superintendent of Health of the City of Providence, for the year ending Dec. 31, 1903.

direction which rational disinfection should take, and the need for promptness and discrimination in dealing with this matter.

Conditions Necessary for Transmission.—In conclusion of this section I shall enumerate the conditions which appear to be necessary for the transmission of scarlet fever and similar diseases from a potentially infectious person. The contagium must be present in a form capable of being carried ; there must be a vehicle for its conveyance ; it must be actually conveyed to a mucous membrane ; the germ must be still virulent when received ; the dose must be sufficiently large, and the receiver must be susceptible to infection.

In measles all these conditions are usually fulfilled in marked degree. There is abundant secretion, distribution of which takes place by sneezing and coughing, by the contaminated hands of the attendant, and by articles smeared with the infective discharges. Susceptibility is almost universal, and the disease would appear, from an epidemic in the Faroe Islands, to affect all ages alike.

In scarlet fever the mucous discharges are common during the acute illness, and not infrequent in the later stages ; distribution occurs as in measles. The average susceptibility is much less, however, and varies according to age, being estimated from the records of an outbreak* among a totally unprotected population at Thorshavn, the capital of the Faroe Islands, at 67 per cent. for persons under twenty, and 13 per cent. for those above that age.

In diphtheria the discharges are also frequent during the acute illness, but much rarer in the convalescent stage ; return cases thus occur in diphtheria less commonly than in scarlet fever. Transmission takes place as in that disease, but the average susceptibility is less.

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* *Vide* Nothnagel's Encyclopædia of Practical Medicine.

THE MANAGEMENT OF SCARLET FEVER.

It is now generally recognised that, owing to the several sources of infection with which I have dealt in the first section of this paper, eradication of the disease from large centres of population will not result from isolation of the notified cases. But this is no reason why every endeavour should not be made to limit the spread of infection. Though the case death-rate was only 3·1 per cent. among the patients treated in the Board's hospitals during 1903, nephritis occurred in 5·3 per cent., endocarditis or pericarditis in ·8 per cent., middle ear disease in 15·6 per cent., and mastoid abscess in ·8 per cent. Scarlet fever, therefore, cannot be regarded, even now, as other than a serious illness. The methods of management, which are being adopted with a view to the limiting of infection, I shall now proceed to discuss, giving statistics illustrating the results of each.

Scarlet fever may be treated at home or in hospital, and there are drawbacks to each system. Home isolation tends to become a farce when the entire family occupies but two or three rooms, and, generally speaking, such isolation is not practicable among the poorer classes. When the patient is retained at home the wage-earner, by reason of popular feeling, often finds himself unable to continue at work, There is absence of skilled nursing; syringing of the throat, and feeding by artificial means, often needed in septic cases, are of course not available. Even among the more well-to-do home treatment is not without its drawbacks. The isolation is frequently defective, and secondary cases are apt to arise, while the patient has to pass the whole period of convalescence indoors, confined to the tedium of an often ill-ventilated bedroom.

Home Treatment—First Method.—There are two methods of home treatment. In the one more commonly adopted the patient is isolated from the other susceptible inmates by being kept to a single room. In Manchester, during 1901, roughly one-fifth of the notified cases were treated at home. Dr. Niven,* the medical officer of health, using the rent to determine the circumstances of households,

* Report on the Health of the City of Manchester, 1901.

ascertained that the persons who were removed to hospital were of a much poorer class; he noted, also, that on the average there was considerably less susceptible material at home, when the patient was not so removed. Since these home-treated cases differed from the hospital patients in these all-important respects, it is obviously impossible to come to any reliable conclusion from Dr. Niven's statistics as to what would have had happened had all the cases been treated at home. In the year mentioned 358 primary cases were treated at their own homes; there were 351 other unprotected persons *under fifteen* in these households, and 69 (19·6 per cent.) subsequent cases occurred.

More unsatisfactory are the results when home isolation is uniformly adopted for all classes. During the last few years interesting and instructive reports have been kindly sent me by Dr. Chapin,* Superintendent of Health of the City of Providence, U.S.A., and I shall quote from his statistics. Providence has a population which has risen from 132,000 in 1890 to 193,000 in 1904, and home treatment had until recently been practically the only method employed. During eight years, up to and including 1903, scarlet fever was acquired by no fewer than 26·1 per cent. of the 4,412 persons in infected families *under twenty-one*, other than the primary cases. (During this period 3,023 patients, out of a total of 3,315 cases, had been treated at home.)

This high percentage of secondary cases forms a drawback to home isolation, which is clearly a serious one, serious not only to the individuals, but also to the community. In the previous section it was shown that in a not inconsiderable proportion of the convalescents from both diphtheria and scarlet fever infectivity was protracted beyond the period of isolation. The multiplication of cases in the infected homes may thus have an effect not to be estimated merely by the number of secondary cases. Scarlatinal sore throats, also, to which I have referred as occurring in homes infected with scarlet fever are, of course, not included among the secondary cases, yet they are quite possibly highly infectious.

Second Method.—The second form of home isolation consists in effectually separating the susceptible children by sending them away. This, so far as the children are concerned, is much superior to the other method, but it is obviously of limited application, and there is some risk of infecting fresh households. In Providence, during the last seventeen years, from 652 families infected with scarlet fever

* *Loc. cit.*

there were thus removed 1,051 persons, mostly children, none of whom had had the disease. Fifty-two (5 per cent.) were attacked while away from home.

Dr. Chapin informs me that scarlet fever patients are isolated at Providence until desquamation has ceased, and five weeks was, until March, 1902, the time laid down as the minimum period of isolation. It is interesting to find that nineteen of the above persons who had been thus sent away from the infected houses were attacked on their return home, a percentage on the infected families of 2·9. These cases correspond closely to the return cases of fever hospitals, described by some writers as purely a "hospital phenomenon." That similar instances of late infection are rarer when the other method* of home isolation is adopted may possibly be due to the more susceptible material being to a great extent used up in the secondary cases.

Segregation Hospitals.—Hospital treatment also is of two kinds. The first is the segregation hospital, where wards of from 12 to 20, or more, beds are provided for scarlet fever patients, smaller wards for combined diseases, and single-bedded rooms, usually quite inadequate in number, for doubtful or complicated cases requiring complete isolation.

Drawbacks.—It is needless for me to indicate the advantages of hospital treatment for the poorer classes, and I shall confine myself to pointing out the drawbacks attaching to segregation.

(1) There is the risk, a small risk as a rule, which erroneously certified patients run of acquiring the disease in hospital. Scarlatina often assumes a mild type, and there is sometimes difficulty, by the time the patient has arrived at the hospital, in deciding whether or not the diagnosis is correct.

(2) Then there is the possibility of infection by some secondary disease. This danger is not confined to fever hospitals, but attaches to all institutions where sick children are collected together. A child admitted with scarlet fever may be at the same time incubating a second infectious disease which he transmits to some of his fellow patients.

(3) Again, the period of isolation is on an average longer than when the patient is treated at home. This, however, may be due to the fact that, while many practitioners still

* Extract from Dr. Chapin's report: "Since 1895, there must have been at least 1,300 families in which susceptible children remained after the removal of the warning sign. . . . The disease recurred in thirty families after removal of the placard (in twenty witnin a month); . . . and in seven other families living in the same house (in five within a month)."

regard desquamation as the sole criterion of infectivity, the hospital authorities attach much importance, perhaps too much, to the mucous discharges.

(4) The fourth point is that there may be in a ward patients suffering from the same disease in different degrees of virulence—a state of affairs which may possibly act to the detriment of those admitted with a mild variety.

(5) Again, rhinitis, which so frequently leads to prolonged detention, is regarded by some as transmissible. Both these drawbacks may be to some extent diminished by a classification of cases.

(6) It is suggested, also, that the congregation of cases in wards affords facilities for a patient, who under other circumstances would be free from infection, to become re-infected.

(7) Lastly, there is the fact that in a small percentage of cases the treatment has apparently failed, and return cases arise as a consequence of the patient's discharge.

Protracted Infectivity.—There has been considerable discussion as to the exact reason for this occasional persistence of infection. Professor Simpson raised the question as to how far segregation was responsible for it. As Dr. Newsholme* expresses it, does the mucous membrane with its crypts act as a continuing incubator of scarlatinal germs originating from those which caused the patient's illness, or does it act merely as a suitable storehouse for germs derived from other patients, a storehouse which can only be emptied by one or more week's separation from these patients? Professor Simpson inclined to the second view, and suggested that protracted infection might cease if convalescents were completely isolated for a fortnight, and treated antiseptically. In diphtheria we are able to test this, and there can be no doubt that in this disease, at any rate, the first explanation is the correct one in many cases of protracted infection,—the germs which are present are descended from those which originally caused the patient's illness.

Disappearance of Infectivity.—It may be added that antiseptic treatment in prolonged infection in diphtheria is disappointing. In a proportion of our cases, a small proportion it is true, although the nose is douched, the throat syringed or painted with antiseptic lotion every four hours, and the patient kept isolated in a single room, yet the bacilli persist for weeks and even months. Indeed, it would seem as if the disappearance of the bacilli was not entirely due to

* *Public Health*, Aug., 1904, p. 713.

their mechanical removal, but in some degree to a specific bactericidal action on the part of the mucous membrane or its secretion, the development of which property was in some cases considerably delayed. The question as to how persons suffering from these infectious diseases lose the contagium, and cease to be infectious, seems to me both an interesting and an important one, which has not yet been sufficiently discussed. If it does depend on a specific property which the tissues develop in the course of the illness, there is hope that measures may be devised for hastening the onset of this action. The provision of a method of effectually and speedily removing infection is as important to the public health as the discovery of an antitoxin.

To return to the relation between segregation and prolonged infectivity, it is probable, from analogy, and from the fact that infection is sometimes prolonged in cases treated by home isolation, that segregation is not wholly responsible. But I should regard it as possible that it has some effect. To express it in the terms of the theory to which I have just referred, I see no reason why a specific bactericidal action, if one exists, should not in some cases be shortlived, just as in diphtheria the antitoxic property is. Under these circumstances the patient might re-acquire infectivity from his neighbours without the necessity of re-acquiring the disease.

Results.—What is the influence of the segregation hospital on the occurrence of cases in the households attacked ? Dr. Niven* reports that in Manchester, during the year 1901, there were 1,534 cases removed to hospital. There were 2,937 unprotected persons under fifteen left, and 356 subsequent cases† occurred, a percentage of 12·1. In addition, 3·6 per cent. of these children acquired scarlet fever after the discharge of the primary case from hospital. Thus, in all, 15·7 per cent. of the unprotected children in these households acquired the disease. Comparison with the results at Providence of the treatment of all classes at home would suggest that the removal to a segregation hospital had very considerably reduced the risk to susceptible persons in the infected households, quite apart from the undeterminable influence on the health of the community. One would not be justified in saying how much, for all the conditions may not be the same in the two instances.

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* *Loc. cit.*

† In both Providence and Manchester, when cases have occurred nearly simultaneously in one house they have been treated in these statistics as primary and subsequent.

To Improve Results. — The question arises as to whether these results could be improved. I shall pass over the *secondary cases*, which, however, form the majority of the subsequent cases, merely remarking on the importance of prompt removal of the primary case, on the danger of infection being spread by the soiled hands of the parent, and on the necessity for immediate disinfection of articles likely to be smeared with infective secretions, cups, spoons, handkerchiefs, sheets, pillows, towels, toys, &c., all matters which are very much in the hands of the medical attendant.

It is probable that the number of *return cases* might be reduced, were the attention of parents more generally called to the fact that freedom from infection cannot be definitely ascertained. For some time after the return home of the patient, precautions should be taken with regard to such articles as those indicated above, and if possible he should not sleep with children unprotected by previous attack. In many households such precautions are possible, but are not taken because the parents are under the impression that the child is, so to speak, guaranteed free from infection. The general incidence might also be influenced if convalescents were prevented from attending school for at least a month after their release from isolation. These remarks apply to home-treated, as well as hospital-treated, patients. Is it possible by any modification of hospital treatment to reduce still further the number of return cases? I have already indicated that segregation may conceivably have a delaying influence on the freeing of patients from infection, and it would be well to remove this possibility. A separation of acute from convalescent patients and of complicated from uncomplicated cases has been a step in this direction. But the gathering together of the complicated cases is not free from objection, and two of the principal drawbacks to the segregation hospital, the occasional occurrence of secondary disease and the risk to wrongly certified patients, still remain. Under these circumstances attention is naturally being directed to the possibility of securing isolation, rather than segregation, for hospital patients.

True Isolation Hospitals. — This brings me to the second form of hospital treatment, the true isolation hospital. In hospitals of this type, the patients are treated in wards built on the cubicle system. In each ward is a central passage with single-bedded cubicles opening into it, separated from one another by partitions, composed in great part of glass. Each room is well ventilated, and provided with its

own hot and cold water fittings for hand-basin and movable bath. All articles used by the patient, such as cups, plates, spoons, &c., are sterilised after use, and the nurses wash their hands and change overalls on going from one cubicle to another. In this way it has been found possible to treat different diseases in adjacent cubicles without interchange of infection.

There are drawbacks to this system, of course. From the patient's point of view the curtailment of outdoor exercise and the confinement to one room are objectionable ; the glass partition, however, relieves him from a sense of complete isolation. From the administrative aspect the wards are more expensive to build, the nursing is not so convenient—a matter of some importance when over one-third of the patients are under five years of age—and there may arise difficulty in securing adequate disinfection of the attendants' hands. The drawbacks, however, are not insurmountable, and hospitals of this construction have been found to work satisfactorily in France and the United States.

Many of the wards of a segregation hospital could be readily converted into cubicle wards by glass partitions. If a suitable classification of cases were adopted, the common bathroom and lavatory might still be used. Unless there were special indications, the overalls might be dispensed with, and the nurse need disinfect the hands only before and after attending to mouth and nose. In wards, where miscellaneous diseases, acute cases, or cases complicated with chronic mucous discharges were treated, the wearing of rubber operation gloves would facilitate the frequent washing and disinfection of the hands which would be required. (These gloves are worn by nurses in the septic wards and isolation rooms of the North-Eastern Hospital, and prove satisfactory.) Sterilisation of the food utensils is indispensable, and this might be done centrally. The provision of several fixed hand-basins is an almost essential convenience, but might in many cases prove the chief difficulty in the conversion of wards from the one system to the other.

Since transfer of infection depends almost entirely on the conveyance of infective secretions by the soiled hands of the nurse, on the playing together of the children, and the use of the same toys, and on the imperfect cleansing of eating and drinking utensils, wards modified as suggested would in all probability meet the occasion.

This method of treatment is said to be efficient in the

case of scarlet fever, but I am not able to bring before you statistics dealing with sufficient numbers to allow of reliable conclusions being drawn from them. One would anticipate that the danger of acquiring disease in hospital would diminish almost to vanishing point, that the period of isolation would be shortened, and that the number of patients discharged while still infectious would be lessened. It is unlikely that return cases would be altogether prevented, but owing to the special attention which would be paid to the throat and nasal cavities, the results would probably be better even than those of home treatment by the second method, which in effect this system of isolation closely resembles.

In conclusion, Gentlemen, the beneficial influence of hospital treatment on the incidence of scarlet fever cannot be realised to the full without co-operation on the part of parents, medical attendants and sanitary authorities, and I have endeavoured in this paper to indicate in some particulars the direction which such co-operation should take. It is of prime importance, also, that the micro-organism of scarlet fever should be isolated and identified. It would probably lead to a saving of public money were an organised research made into this subject, for there can be little doubt that under the present system, while some are discharged who are still infectious, many are isolated for an unnecessarily long period.

APPENDIX.

The following Table, in which the condition, *at the time of discharge*, of alleged infecting cases and all cases is compared, is compiled from Dr. Millard's valuable paper, published in *British Medical Journal*, September 3, 1898.

	Enlarged tonsils, or congested mucous membrane	Enlarged cervical glands.	Morbid condition of nose.	Otorrhœa.	Desquamation.	Sores and excoriations.	Skin eruptions.	Albuminuria.	Quite clear in every way.
Alleged infecting cases (158)									
percentages	*3·1*	*2·1*	*22·9*	*2·2*	*7·0*	*3·1*	*3·1*	*0·6*	*58·2*
All cases									
percentages	*5·4*	*2·3*	*6 0*	*1·5*	*8·2*	*2·2*	*1·0*	*0·5*	*72·6*

The next Table is from Professor Simpson's report to the Metropolitan Asylums Board, 1901, and deals with the condition of ninety probable infecting cases *at the time of his visit.*

	Unhealthy throats and enlarged cervical glands.	Colds in chest.	Colds in head.	Discharge from nose.	Sore nose.	Discharge from nose and ears.	Desquamation and eczema.	Various.	Healthy.
Cases (90) ...	7	5	15	36	5	13	3	3	3
percentages	*7·7*	*5·5*	*16·6*	40	*5·5*	*14·4*	*3·3*	*3·3*	*3·3*

APPENDIX.

The statistics, which have been quoted as to the results in infected families of different methods of management, are presented below in tabular form.

	Unprotected persons exposed.	Subsequent cases among these.
Home treatment.		
Providence (1896-1903)*	4,412 (under 21)	1,154 = *26·12*
Manchester (1901)† ...	351 (under 15)	69 = *19·62*
Home isolation by second method.		
Providence (1887-1903)	1,051 (mostly children)	52 (secondary) = *5·02* 19 ("return") = *1·82*
Hospital segregation.		
Manchester (1901) ...	2,937 (under 15)	356 (secondary) = *12·12* 106 ("return") = *3·62*

* All classes. (Only 292 patients, out of 3,315, were sent to hospital, and these are not separated in the calculations.)

† To some extent selected cases.

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