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ON

THE PERIOD OF INCUBATION

OF

SCARLET FEVER

AND OF SOME OTHER DISEASES

BY

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Observations on the Period of Incubation of Scarlet Fever, and of some other diseases. By CHARLES MURCHISON, M.D. *Read May* 14, 1878.

BY 'period of incubation' I understand the time which elapses between the poison of an infectious disease entering the system, and the first manifestation of symptoms. This is the ordinary acceptation of the term, but I consider this definition necessary, because some authorities have calculated the period of incubation of the exanthemata from the time of exposure to the poison until the appearance of the cutaneous eruption, including therefore in the incubation-period that of the primary fever.

A knowledge of the incubation-period of the several infectious diseases is of great practical importance. Advantage is taken of this knowledge in the practice of vaccination as a preventive of small-pox. The development of the areola, which is necessary for the protective effect of vaccination, occupies about eight days; but, as the latent period of small-pox is usually about twelve days, it follows that, if a person exposed to the poison of small-pox be successfully vaccinated at once, he has time to escape altogether, or to have the disease in a modified form. And, in all of the acute contagious diseases, the knowledge in question determines the time during which it is necessary to keep in quarantine persons who have been exposed to the infection, and helps also in determining the mode of introduction of the poison, or the origin of an epidemic.

It is, however, not a little remarkable how vague and unsatisfactory our knowledge still is respecting the period of incubation of most of the infectious diseases. Dogmatic statements on the matter, the most widely different, are made by the authors of our standard works on medicine, founded too often upon deficient observation. The Clinical Society has recognised the practical importance of obtaining a more definite knowledge than we yet possess of the duration of the incubation-period of the several infectious diseases, by appointing a Committee to collect and collate well-authenticated facts bearing on the subject; and I now offer to the Society the results of my observations on the incubation-period of some of these diseases, and particularly of scarlet fever.

But, in the first place, I would observe that in none of the infectious diseases does the period during which the poison incubates appear to be fixed. Even in small-pox the latent period is not 'limited with precision,' as stated by Trousseau.*

Small-pox. — In this disease the incubation-period is usually assumed to be twelve days when the poison enters the system in the ordinary way, and only seven days when the poison is introduced by inoculation. In the three following cases which have come under my notice, in two it was thirteen days, and in one eleven days.

Case I.—On January 9, 1877, Miss L., aged 3, with three good vaccination marks, sat on the knee of her aunt, Miss S., who was then suffering from headache and febrile symptoms, and was in the first day of what proved to be a typical attack of varioloid. After this Miss L. went home, and did not visit the house of her aunt again; nor was she in any other known way exposed to the poison of small-pox. On January 22 she became cross, lost her appetite, and had fever; and on the 25th a few variolous papules appeared.

Here the period of incubation was thirteen days. Possibly, had the thermometer been used it might have been a day less.

Case II.—James A., aged 22, was admitted into the London Fever Hospital on February 20, 1868, ill two days. His attack turned out to be one of varioloid. On February 5 he had visited a friend in Whitechapel suffering from the small-pox, and on February 18 he was taken ill with fever, headache, and lumbar pain, but no vomiting. On February 21 the papules of small-pox appeared.

Here also the incubation-period was thirteen days.

Case III.—On September 10, 1864, Eliza P., aged 27, was admitted into the London Fever Hospital on the fifth day of an attack of variola hæmorrhagica, and died at 10 p.m., four hours after admission. There were no characteristic papules, and the case was mistaken for one of malignant scarlatina, and placed in the Scarlet Fever ward. On September 21, eleven days afterwards, Ruth C., aged 21, who was recovering from an attack of scarlet fever in the same ward, having been admitted on September 5, on the third day of the disease, was seized with the premonitory symptoms of variola, the eruption of which appeared on September 24. She was desquamating freely when the small-pox set in.

In this case the incubation-period was eleven days.

These cases confirm the ordinarily accepted view that the incubation-period of small-pox is about twelve days. But Curschmann, in his recent article on Variola,† remarks

* 'Clin. Méd.' 1861, tome i., 5.

† Ziemssen's 'Cyclop. of Medicine,' American ed., vol. ii., 1875, p. 341.

that the latent period of small-pox is not so constant as is always maintained. In cases where he had been able to fix it exactly, it had certainly been most often between ten and thirteen days, but in others it had been as long as fourteen days, or as short as from eight to ten days, while in one it was only five days. Zuelzer also found the period of incubation in certain (nine) cases of hæmorrhagic small-pox to be only from six to eight days.* Lastly, the fact that the incubation-period of small-pox is far from being fixed was demonstrated by the late Dr. Otto Obermeier, in a memoir containing the largest collection of observations on the latent period of small-pox with which I am acquainted.† Of eighteen cases in which the actual moment of infection was determined,

in	1	the incubation-period	was	5 days.
„	1	„	„	6 „
„	3	„	„	8 „
„	1	„	„	9 „
„	2	„	„	10 „
„	5	„	„	11 „
„	4	„	„	12 „
„	1	„	„	13 „

Total: 18 cases.

Varicella.—I can find among my notes only one case showing the duration of the incubation-period of varicella: in that case it was eleven days. Most authorities make it longer than this. Thus, according to Thomas, it is from thirteen to seventeen days‡; and, according to Trousseau, from fifteen to twenty-seven days. § The data, however, on which these statements are based are not given. On the other hand, Dr. W. Squire has collected ten cases in which the duration of the incubation-period corresponded with that of mine, being in all from ten to twelve days. ‖ When varicella is produced by inoculation, the incubation-period appears to be shorter than when the disease is contracted in the ordinary way, just as in the case of small-pox and measles. Thus, of ten cases in which Professor Steiner of Prague inoculated the contents of the vesicle of varicella,

* Ziemssen's 'Cyclop. of Medicine,' American ed., vol. ii., 1875, p. 341.

† 'Beiträge zur Kenntniss der Pocken,' Virchow's 'Archiv für path. Anatomie und Physiologie und für klin. Medicin,' Bd. liv.

‡ Ziemssen's 'Cyclop. of Pract. Med.,' American Trans., vol. ii., 1875, p. 16.

§ 'Clinique Méd.' 1861, tome i., p. 133.

‖ 'The Period of Infection of Epidemic Disease': London, 1874, p. 28.

eight were successful. Varicella, and not variola, was always produced: and previous vaccination had no influence whatever on the result. In all of the eight children, the period of incubation was eight days.*

Measles.—I am inclined to think that the incubation-period of measles, although subject to variations, is quite as definite as that of small-pox. There is, it is true, some discrepancy in the statements of different authors respecting it; but much of this discrepancy, I believe, is due to a difference in the method of calculation. In different works we find the incubation-period set down as between ten and sixteen days, and as being most commonly fourteen days; but when we turn to the facts upon which these statements are founded, it appears that, in the case of measles, the incubation-period has, in the majority of instances, been calculated from the date of exposure to the poison to that of the first appearance of the eruption, and that, therefore, the stage of primary fever, which lasts three or four days, has been included in the period of incubation. Making allowance for this source of fallacy, the incubation-period of measles is usually about ten or eleven days. It is worth noting, however, that, just as in the case of small-pox, when the poison is introduced by inoculation, the incubation-period is shorter, or only seven days.†

The best observations on the incubation-period of measles with which I am acquainted are those made by Panum in the epidemic which occurred in the Faröe Isles in 1846. There were seventeen of these islands inhabited. Prior to April 1846 not a single case of measles had been observed in these islands since 1781; but within six months more than 6,000 of the 7,782 inhabitants suffered from it. Panum was able to trace the importation of the disease from one island to another, and, in this way, he had an opportunity of determining the period of incubation in a very large

* 'Brit. Med. Journ.,' May 8, 1875, p. 610.

† Successful inoculation with the blood of measles was performed by Home of Edinburgh at the suggestion of Monro, in 1758; by Speranza of Milan in 1822; and by Michael of Katona in 1842. An account of Michael's experiments will be found in the 'Gazette Médicale de Paris' for 1843. In all he made 1122 inoculations; only 7 per cent. failed; the disease was mild; not one of the inoculated died, although a severe epidemic was prevalent at the time. The primary fever appeared on the seventh day, and the eruption on the ninth or tenth day after inoculation. The inoculations were made with a mixture of blood and serum from the miliary vesicles, or with tears. More recently measles has been successfully inoculated by several German physicians, of whom Jörg and Wendt assert that the disease from inoculation is not less severe than that contracted in the ordinary way.

number of instances under the most favourable circumstances. With scarcely an exception *the eruption of measles appeared* on the thirteenth or fourteenth day after exposure to the infection. In other words the incubation-period was about ten days.*

These results of Panum's are corroborated by the two following observations :—

Group I.—In February 1878, I was consulted in reference to an outbreak of measles in the Beaumont Catholic College, near Windsor, where I met in consultation Dr. Lowndes of Egham, to whom I am indebted for the following particulars : There were 160 boys in Beaumont; of these about forty were attacked with measles; 100 were known to have had the disease before, and of these only two were attacked. On January 7, one of the pupils was visited by his cousins, who were convalescent from measles. On January 20 (thirteen days) this pupil showed the rash of measles, and on the following day he was seen by Dr. Lowndes, and at once removed to the Sanitorium. There were no more cases until February 3 (thirteen or fourteen days), when a second boy, who had been sickening for at least three days before, showed the rash, and on February 4 twenty-three other boys showed the rash (fourteen or fifteen days). The last case occurred on February 19.

Making allowance for the primary stage, the incubation-period in these cases was about ten days.

Group II.—On March 5, 1878, a son of Dr. Lowndes, aged 16, who was supposed to have had measles years before in India, went to a theatrical entertainment in the great hall of Beaumont College. Several boys convalescent from measles were present. After the entertainment Dr. L.'s son returned to Egham, where, on March 16, he became ill, with loss of appetite, fever, &c., and on March 19, the rash of measles appeared. On March 29 three younger children, who never had measles before, became feverish, and coughed. On April 1 the youngest showed the rash of measles, which on the following day appeared also upon the two others.

Here, in the first case, the incubation-period was eleven days; and as the disease is believed to be most infectious just at the time of the appearance of the eruption, it was probably ten days in the three other cases.

In the two following groups of cases, the particulars of which have been furnished to me by Dr. Bristowe, the incubation-period appears to have been from twelve to fourteen days. But, inasmuch as the dates were not noted at the time, I quote the cases mainly as illustrating the extreme

* 'Archives Gén. de Méd.,' April 1851, p. 451 ; and 'Edin. Med. Journ.,' June 1851, p. 589.

contagiousness of measles, in its primary, or catarrhal, stage, and the possibility of its propagation by fomites.

Group III.—About four years ago there was a party of about twenty children at the house of Mr. D. One of the children was in what turned out to be the second day of the catarrhal stage of measles, the rash not appearing until a day or two later. About twelve days afterwards almost all of the remaining children who were at this party were attacked with measles. Two of these children, while suffering from catarrh, but two days before the appearance of the rash, were present at another juvenile party at the house of Mr. F.; and fourteen days afterwards several of the other children who attended this party sickened with measles, the rash of which appeared four days later.

Group IV.—In the spring of 1876, a little girl who had been away for the Easter holidays returned to school. She came about two in the afternoon, and was sent home about six on the same day, either because she had the rash of measles upon her, or because she was ill with symptoms which developed later into measles. At that time all Dr. B.'s children, excepting the three youngest, had had measles; and five of those who were not susceptible were attending the school. When dressed to come home at four o'clock, Dr. B.'s eldest daughter went and talked to the little girl referred to on the stairs; and on reaching home the eldest of the three susceptible children went into her bedroom and helped her to put away her clothes. That day fortnight this little girl sickened with measles, and on the same day several of the pupils at the school were also attacked. About a fortnight later Dr. B.'s two youngest children were taken ill with what was thought to be a very slight attack of measles.

Hooping cough.—Little is known as to the duration of the latent period of hooping cough. According to Squire it is usually about a week*; while, according to Bristowe, it is probably about a fortnight.† In the following three cases, for the particulars of which I am indebted to Dr. Bristowe, it was exactly a fortnight. One of the cases is further interesting as showing the possibility of hooping cough being transmitted by fomites, while all of them prove that the disease is contagious at its very commencement.

Cases.—In the winter of 1874-5 Dr. B's three youngest children, owing to having suffered from severe 'colds' in the previous autumn, were kept in the house in London from the early part of December until May, when the following occurrence took place: They were then in perfectly good health, and for several months had seen no children nor visitors of any sort. But at that time some nephews and nieces of Dr. B. were ill at Sydenham with hooping cough. On Saturday Dr. and Mrs. B. went to dine with his mother, who also resided at Sydenham

* 'The Period of Infection of Epidemic Disease': London, 1874, p. 34.

† 'Treatise on the Theory and Practice of Medicine,' 1876, p. 142.

Hill; and on arriving they found the eldest boy of the family referred to living with her. He had hitherto escaped the disease, and was living with his grandmother in the hope that he might escape it altogether. But on this very Saturday he had for the first time a constant troublesome cough. Mrs. B., being afraid on account of her own children, and believing that the boy was in the early stage of hooping cough, did all she could to avoid him; but he clung to her during the whole evening, climbing on her knee, and coughing and sneezing over her. When she got home at night she took off her dress and laid it over an ottoman under a window in the dressing room, intending next morning to have it hung out in the open air. Unfortunately, however, the eldest of the three children referred to came into the dressing room early next morning and began playing at the window over the dress. As soon as this was noticed she was sent away, and the dress was carried out of doors. Exactly thirteen days afterwards, on the Saturday, this little girl appeared to have caught a bad cold, and ten days later she began to hoop. The two youngest children caught the disease from her, and both sickened about a fortnight after she first showed signs of illness. The seven other children in the family escaped; but they had had hooping cough before.

Typhus Fever.—In this disease also there is no fixed period of incubation. In a paper published in the second volume of the 'St. Thomas's Hospital Reports,' * in which I collected 31 cases where I had been able to determine the period of incubation of typhus fever, I arrived at the following conclusions:—

1. The period of incubation of typhus varies in duration in different cases.

2. In a large proportion of cases it is about twelve days.

3. In exceptional cases it is longer than twelve days; but it rarely, if ever, exceeds three weeks.

4. In many cases (one third or more) it is less than twelve days, and occasionally there is scarcely any latent period, the symptoms commencing almost at the instant of exposure to the poison.

These results were confirmed by Virchow, and also by Obermeier in the Berlin epidemic of 1867–8 †; while of eight cases in which the incubation-period of typhus was determined by Obermeier in the Berlin epidemic of 1873, in two it was seven days, in two it was less than nine days, in one it

* 'On the Period of Incubation of Typhus, Relapsing Fever, and Enteric Fever,' 'St. Thomas's Hospital Reports,' vol. ii., 1872. See also second edition of my work on 'The Continued Fevers of Great Britain,' 1873, p. 90.

† Obermeier, *loc. cit.*

did not exceed ten days, in two it did not exceed twelve days, and in one it did not exceed fourteen days.*

The following case, communicated to me by Dr. T. J. Maclagan, of Dundee, since the publication of my essay referred to, is an additional illustration of an extremely short incubation-period in typhus :—

Case.—One of the Sisters of St. Mary's Sisterhood, in Dundee, paid a single visit to a patient in the Typhus ward of the Dundee Infirmary (in which were several other patients suffering from the same disease), on the afternoon of November 29, 1873. On returning home she said that she was sure that she had caught the disease ; and in the course of the same evening she complained of headache, chilliness, and general malaise. Being a highly nervous and susceptible person, her symptoms were attributed to fear rather than to the typhus poison. They increased in severity, however, and on the morning of December 5 a distinct typhus rash was perceived. The patient was severely ill, but ultimately recovered. The one occasion on which she visited the infirmary was the only one on which she was exposed to the disease. She saw that case only once, and for nearly three months before she had been in no locality where typhus was known to exist. The disease was not epidemic in Dundee at the time, there being only a few sporadic cases here and there about the town.

Enteric fever.—Several circumstances contribute to make it very difficult to obtain satisfactory evidence respecting the incubation-period of enteric fever :—1. The difficulty, in many cases, in deciding when an attack of enteric fever really commences. 2. The circumstance that in fever hospitals nurses and patients rarely take enteric fever. 3. The fact that, in private practice, when the disease has been imported into a healthy locality, according to my experience it very rarely spreads. 4. The difficulty there often is in determining, when a person is seized with enteric fever soon after changing his residence, whether he has brought the disease with him, or whether he has been merely predisposed to the disease by recent arrival in an infected locality. From the facts collected in my former essay, already quoted, I came to the following conclusions respecting the period of incubation of enteric fever :—

1. The period of incubation of enteric fever is most commonly about two weeks.

2. Instances of a longer duration appear to be more common than in typhus or relapsing fever; but it is very

* Obermeier : ' Die ersten Fälle und der Character der Berliner Flecktyphusepidemie von 1873,' ' Berliner Klin. Wochenschrift,' 1873, No. 30.

doubtful if the incubation-period ever much exceeds three weeks.

3. The period of incubation is often less than two weeks, and it may not exceed one or two days.

Some observers, including the late Dr. Parkes, have thought that the period of incubation of enteric fever was shorter when the poison was imbibed with the ingesta than when it was inhaled; but, in many instances of very short incubation which are on record, the poison was apparently inhaled.*

Since the publication of the second edition of my book on 'The Continued Fevers,' in 1873, I have met with the three following cases illustrating the incubation-period of enteric fever.

Case I.—Mrs. L., aged 30, sickened with enteric fever in London on March 20, 1876. Seven days before (March 13) she had returned from visiting a brother, ill with enteric fever at Brighton, and she had spent four days in his house.

In this case the period of incubation lay between seven and eleven days.

In the next two cases the incubation-period appears to have been as long as twenty-one and twenty-two days.

Cases II. and III.—On August 31, 1874, Master C. B. sickened with enteric fever at his home at Reigate, where there were local causes to account for the disease.

On August 17 his sister, Miss B., left Reigate for Scotland, where she began to be ill with the same disease on September 7, and from which she was suffering when I saw her in London on September 21.

On September 15 Master E. B., a brother, left Reigate with the other children, who had not been ill, for Eastbourne, and on October 7 he fell ill there with enteric fever. It was stated that there was no enteric fever in Eastbourne at the time, nor had there been in the neighbourhood of the house where the B.'s lived for at least a year before.

On the other hand there were cases of enteric fever at Blairgowrie, where Miss B. remained for a few days while in Scotland; but, while it is not very probable that three members of the same family should within two months contract enteric fever from three different sources, the supposition that all three contracted the disease at Reigate is confirmed by the period of incubation in Miss B. and in the brother being almost identical.

Lastly, I may refer to an outbreak of enteric fever at

* See my essay in the second volume of the 'St. Thomas's Hospital Reports'; also second edition of my work on 'The Continued Fevers,' 1873, pp. 469, 472.

Guildford, in 1867, investigated by Dr. Buchanan, which was of more than usual importance, inasmuch as the latent period, in a number of different persons exposed to the same cause, appeared to be exactly eleven days. The epidemic was restricted with almost absolute precision to the high levels of the town, attacking here the poor and rich alike, but it spared entirely the low-lying parts of the town. The only condition generally coincident with the outbreak was the high service of the town water supply; and it was found that, eleven days before the commencement of the outbreak, water polluted with sewage, which had been stored up for sixteen days, had, *on one day*, been distributed by this service to the 330 houses in which the fever appeared.*

Relapsing fever.—In the second edition of my work on 'The Continued Fevers' (p. 31), I collected 32 cases bearing upon the period of incubation of relapsing fever, which led me to the following conclusions:—

1. The period of incubation of relapsing fever is not fixed, and is even more variable than that of typhus.

2. It is, on the whole, shorter than that of typhus. In nine of the twelve cases in which it was accurately determined it did not exceed nine days; in none of the thirty-two cases was there reason to believe that it exceeded sixteen days; in only four did it certainly exceed twelve days, and in only four others was it possible for this period to have been exceeded; while in thirteen of the thirty-two cases it did not exceed five days.

3. Occasionally, as in typhus, there is no latent period at all: the symptoms commencing almost immediately after the first exposure to the poison.

Since these results were published, relapsing fever is said to have been successfully inoculated on healthy persons, who submitted voluntarily to the operation, by Dr. Motschutkoffsky, physician to the City Hospital of Odessa. The material employed was blood taken from patients in the stage of pyrexia. The period of incubation never lasted less than five, nor more than eight days.†

From the above remarks it is clear that in none of the infectious diseases referred to is there anything like a fixed period of incubation. Still for practical purposes it may be said that they may be divided into two groups, in one of which the incubation-period is long—from one to three

* 'Tenth Rep. of Med. Off. of Privy Council,' p. 34.

† 'British Medical Journal,' March 25, 1876, p. 383.

weeks, or most commonly, from ten to fourteen days*; and in the other it is short, or from one to three or four days, and rarely longer than a week. As examples of the former group, there are the diseases already referred to, viz., small-pox, chicken-pox, measles, hooping cough, typhus, enteric fever, and relapsing fever; to which may be added rötheln, or German measles,† and mumps‡; while, as examples of the second, we have erysipelas, diphtheria, dengue, and scarlatina.

Erysipelas.—With regard to erysipelas, although I cannot lay my hand upon any notes of the incubation-period in cases that have come under my care, my experience leads me to think that it never exceeds a week, and that, as a rule, it is from one to three or four days.

Diphtheria.—Most observers agree in assigning to diphtheria a very short period of incubation. According to Oertels, the latest and best writer upon the disease, it may be stated positively to occupy from two to five days. His own experiments also show that in 'from twelve to twenty-four hours after artificial inoculation upon the surface of wounds, we can detect a greyish white discoloration, a dirty greyish layer, and the other signs of infection.'§

Dengue.—In this disease the latent period has been variously estimated at from one to seven days. Many instances have been observed in which it has only been a few hours. Dr. Charles, in Calcutta, found it to be as a rule about five days.‖

Scarlet fever.—The period of incubation of scarlet fever has been variously estimated by different authorities as follows:—

Binns (quoted by R. Williams)[1]	2 days.
Withering (1779)[2]	3 or 4 ,,
Gendron (quoted by Noirot)[3]	not over 4 ,,
Bateman[4]	3 to 5 ,,

* I purposely exclude here malarious fevers, the morbific agent of which may lie dormant in the system for many months; and hydrophobia, in which it may not manifest itself for years.

† In this disease the incubation-period is said by Squire to be from ten to fourteen days; and by Thomas (Ziemssen's 'Cyclop.') from two to three weeks.

‡ In mumps the incubation-period has been estimated at from eight to twenty-two days. In several cases collected by Squire it varied from fourteen to twenty-two days ('Period of Infection of Epidemic Disease': London, 1874, p. 30).

§ Article 'Diphtheria:' Ziemssen's 'Cyclop. of Med.,' American Trans., vol. i., p. 594.

‖ 'Dengue: its History, Symptoms, and Treatment,' by T. E. Charles, M.D.: Calcutta, 1872.

[1] 'On Morbid Poisons': vol. i., 1836.

[2] 'Account of the Scarlet Fever and Sore Throat': London, 1779.

[3] 'Histoire de la Scarlatine': Paris, 1847, p. 78.

[4] 'Practical Synopsis of Cutaneous Diseases': London, 1813.

J. Frank (quoted by Noirot)[1]	5 days
Cazenave and Schedel (quoted by Noirot)[2]	3 to 6 „
Sir Thomas Watson[3]	not exceeding 5 or 6 „
Willan[4]	never more than 6 „
Guersant and Blache (quoted by Noirot)[5]	3 to 7 „
Thomas and Gerhardt[6]	4 to 7 „
Heberden (quoted by Noirot)[7]	7 „
Samuel Gee[8]	less than a week.
G. Gregory[9]	1 week.
Niemeyer[10]	8 or 9 days.
R. Williams[11] and W. Aitken	a few hours to 10 „
Reinhold[12]	11 „
Bathurst Woodman[13]	2 to 14 „
Böning[14]	14 „
Copland[15]	1 to 25 „
Maton[16]	26 „
Most[17]	1 month.

But hitherto the statements made upon the subject have been based, for the most part, on one or two isolated observations, and no attempt has been made to collect a large number of observations bearing upon the point. So much has this been the case that, in 1861, Trousseau declared that neither in measles nor in scarlet fever could the latent period 'be rigorously determined in the present state of our knowledge';* while, still later, Obermeier gave it as his opinion that the incubation-period of scarlet fever was unknown.† In the *Lancet* for August 13, 1864, I published 13 cases illustrating the incubation-period of scarlet fever; and I came to the conclusion that while in rare instances there was no incubation-period at all, this, in most cases,

[1] Noirot: *loc. cit.*
[2] *Ibid.*
[3] 'Lectures on Pract. of Med.,' 5th ed., 1871, ii., 973.
[4] 'On Cutaneous Diseases,' 1808.
[5] *Loc. cit.*
[6] Ziemssen's 'Cyclop. of Med.,' American Transl., vol. ii., 1875, p. 169.
[7] *Loc. cit.*
[8] Reynolds's 'Syst. of Med.' vol. i., 1866, p. 334.
[9] 'Lectures on the Eruptive Fevers,' 1843, p. 142.
[10] 'Text-Book of Pract. Med.,' American Transl., 1869, vol. ii., p. 533.
[11] 'On Morbid Poisons,' 1836.
[12] Ziemssen's 'Cyclop. of Med.' *loc. cit.*
[13] 'Lond. Med. Journ.,' February 1865, p. 76.
[14] Ziemssen, *loc. cit.*
[15] 'Med. Dict.,' Article 'Infection,' vol. ii., p. 354.
[16] 'Trans. College Phys.,' vol. v., p. 149. Dr. Maton's cases have been quoted by Copland and others as examples of scarlet fever, but after referring to the original paper I consider this very doubtful.
[17] 'Geschicte des Scharlachf.' ii, 178.

* 'Clinique Méd.,' 1861, tome i., p. 4.

† 'Beitrage zur Kenntniss der Pocken': Virchow's Archiv für path. Anat. und Physiol. und für klin. Med.,' Bd. liv.

varied from one to five days, and very rarely exceeded six days. I have now collected all the cases of scarlet fever, having any bearing on the period of incubation, that have come under my observation, or been communicated to me during the last twenty years. They are 75 in number, and are as follows:—

Case I.—A female, aged 22, was admitted into the London Fever Hospital on April 22, 1858, on the third day of an attack of scarlet fever, which proved fatal on the eighth day. On April 19 she had come from a part of Oxfordshire where scarlet fever did not exist, to see her sister, who was lying dangerously ill with it in London. She arrived in the afternoon, and on the following morning she was seized with rigors, headache, and sore-throat, and on the 21st a scarlet rash was observed on the skin.

Here the period of incubation did not exceed eighteen hours.

Case II.—Ann W., aged 18, a servant, was admitted into the London Fever Hospital, suffering from scarlet fever, on October 5, 1863. On September 28, a young lady had come from school to the house where Ann W. was in service, ill with scarlet fever, and was waited on by her on the same day. The next day Ann W. was seized with sore-throat, followed by the usual symptoms of scarlet fever.

In this case the period of incubation did not exceed twenty-four hours.

Case III.—For the details of this case I am indebted to the late Mr. Marson, of the Small Pox Hospital. About twenty years ago, a family residing in Gray's Inn Lane, gave a children's party. Before the day one of their own children fell ill with scarlet fever. Not wishing to put off the party, the child was removed to a garret. The party took place on a Monday, the children being at the house from about 4 to 9 p.m. On the Tuesday, between 11 and 12 p.m., a child, residing in a distant part of London, who had attended the party, but was not known to have been otherwise exposed to scarlet fever, was seized with the usual symptoms of scarlet fever, of which she died on the Friday morning.

In this case the period of incubation was somewhere between twenty-six and thirty hours.

Case IV.—On March 19, 1869, about 3 p.m., Mrs. T., aged 40, had a small tumour removed from behind her left ear, by the late Sir William Fergusson. On the evening of the 20th she was taken very ill with fever and vomiting. On the 21st her face and chest were covered with a punctated scarlet rash, which, on the 22nd, when I saw her, had extended to the legs, and had all the characters of scarlatina rash. The other symptoms of scarlatina were also present. On inquiry it was ascertained that the nurse who had come to attend on Mrs. T., shortly before the operation on the 19th, had just left off nursing a child ill with scarlet fever.

Here the period of incubation was less than thirty hours.

Case V.—Mary B., aged 21, was admitted into the London Fever Hospital on September 14, 1863, on the fourth day of an attack of scarlet fever. She had been in service, and on the evening of September 9 she had gone to a 'new place,' at a house at which some of the inmates were suffering from scarlet fever. On the morning of the 11th she had been seized with vomiting and sore-throat, followed by all the ordinary symptoms of scarlet fever.

In this case the period of incubation was less than thirty-six hours.

Case VI.—On March 4, 1863, about 4 p.m., W. F., aged 11, a school-boy, went with some of his school-fellows to a house in which there were cases of scarlet fever, and remained there about two hours. Early in the morning of March 6 he was seized with scarlet fever. which was followed by gastro-enteritis, terminating fatally on March 23.

Here also the period of incubation did not exceed thirty-six hours; but it could not have been much shorter.

Case VII.—On the evening of February 23, 1878, Mrs. M. went from Hampstead to a school at Wimbledon, to nurse her son who was ill with malignant scarlet fever, and on the morning of February 25 she awoke with sore-throat and other symptoms of scarlet fever, which ran a mild course.

Here also the period of incubation did not exceed thirty-six hours.

Case VIII.—On June 13, 1875, I was consulted in the case of Lady A., aged 70, who had a typical scarlatina rash, with sore-throat and redness of the fauces; pulse 96; temp. 101·5° Fahr. She had never had scarlet fever before; but her daughter had had it when over 50 years of age. On June 9 Lady A. had dined out at 8 p.m., returning home about 11 p.m. Of the sixteen persons who sat down to dinner, eight were attacked within five days with scarlet fever, which there were good reasons for attributing to infected cream. (See Dr. Buchanan's report: 'Reports of Medical Officers of Privy Council,' New Ser., No. vii. 1876, p. 72.)

In the forenoon of June 11, Lady A. began to have fever and sore-throat.

In this case the period of incubation seemed to be somewhere between thirty-four and forty hours.

Cases IX. and X.—The Hon. Mr. and Mrs. B., aged respectively about 50 and 40, both dined with the same party as Lady A., on June 9, 1875. Both were taken ill with scarlet fever early on June 11, and on June 19 I saw them both in consultation, with great enlargement of the cervical glands and secondary fever.

The latent period in both cases was probably somewhat between thirty-four and forty hours.

Case XI.—The following case was communicated to me by Dr. Alfred Wiltshire, after reading my paper in the *Lancet*, of August 13, 1864, on the latent period of scarlatina:—

On March 1, 1864, Mrs. M. took her two children, Robert, aged four and a half, and his brother, aged two and a half, to University College Hospital, the latter having rickety deformity of the legs. They were in the out-patient room from two to four p.m. While there Mrs.

M. sat next to a woman nursing a child who was very ill and had its throat wrapped up, and the woman told Mrs. M. that she had four other children at home ill with 'scarlatina and diphtheria.' Mrs. M. kept her younger child in her arms, but Robert stood at her side next to the woman with the sick child. Early in the morning of March 3 Robert was taken ill with shivering, sickness, and drowsiness; in the evening of the same day a scarlet eruption began to appear on the skin, which next morning was very copious and bright all over the body; and on March 8 the boy died. The younger child sickened with scarlatina on March 10, and died with pyæmic abscesses on April 7.

In Robert's case the period of incubation was not longer than forty hours, and not shorter than thirty-six hours.

Case XII.—Mrs. H., about 30 years of age, student of medicine, carefully examined the rash of a child suffering from scarlet fever at two p.m. on March 8, 1878. The examination did not last longer than ten minutes, and she only saw the child on that one occasion. On the morning of March 10 she awoke with sore-throat and fever, and next morning she had a copious and typical scarlatina rash.

Here the period of incubation did not exceed forty-one hours, and was probably not shorter than thirty-six hours.

Case XIII.—On June 10, 1876, a child, A, left Lincolnshire, and arrived in the evening on a visit to a family residing at Shooter's Hill, near Greenwich. She was then apparently in good health, and there was no illness in the house in Lincolnshire from which she came. But in the night of June 11-12, two children, B and C sickened with scarlatina in this house in Lincolnshire; and in the same night A, and D, aged 6, who occupied the same room as A, and had not been away from Shooter's Hill, nor otherwise exposed to scarlatina, fell ill with this disease.

If A fell ill first and D contracted the disease from her, there could have been scarcely any period of incubation; but if, as seemed more probable, the poison was in the clothes of A, or A gave off the poison during the incubating stage, the period of incubation in D may have been forty-eight hours, but not longer.

Case XIV.—Mary Jane G., aged 5, was admitted with scarlet fever into the London Fever Hospital in the afternoon of June 20, 1865. Her brother had been brought home convalescent from scarlet fever on the 18th, and in less than forty-eight hours afterwards Mary Jane was taken ill, and brought at once to the Hospital.

The period of incubation was less than forty-eight hours

Case XV.—On April 12, 1868, Caroline A., aged 21, was engaged as a nurse in the London Fever Hospital, and on the same day she began duty in one of the scarlet fever wards. On April 14 she was taken ill with what turned out to be a severe attack of scarlet fever.

The period of incubation did not exceed forty-eight hours.

Case XVI.—Alexander D., aged 6, arrived from a locality in Scotland where scarlet fever was then unknown, at an hotel near Piccadilly, late in the evening of March 22, 1873. There had been cases of scarlatina shortly before in this hotel. The exact particulars were

kept back; but it was ascertained that a servant, ill with scarlet fever, had been removed from the hotel to a Fever Hospital a fortnight before, and that some other of the inmates had had sore-throat. On the evening of March 24, A. D. was taken ill with sore-throat, and next morning, when I saw him, he had a scarlatina rash.

In this case the period of incubation did not exceed forty-eight hours.

Case XVII.—Charles D., aged 4, came with his brother, A. D., from Scotland to Piccadilly, on March 22, 1873. (*See last Case.*) C. D. awoke at 3 a.m., on March 27, with vomiting and pyrexia, which were the first symptoms of a typical attack of scarlatina.

Here the period of incubation could not in any case have exceeded four days and six hours; but, on the supposition that C. D. caught the disease from his brother, which was probable, as they occupied the same room, it did not exceed fifty-four hours.

Case XVIII.—Mary H., aged 24, a nurse at the Henrietta Street Nursing Institution, went to nurse a child badly ill with scarlet fever, on the evening of March 12, 1865. During the 13th and 14th she did not feel very well. On the morning of the 15th she had sore-throat and vomited, and in the afternoon the rash of scarlatina appeared. On March 16 she was admitted into the London Fever Hospital, suffering from scarlatina.

The period of incubation in this case could not have exceeded two and a half days.

Case XIX.—Miss B., aged 12, returned to school at Kensington on October 5, 1858. A girl at the school was ill at the time with scarlet fever. On October 8 Miss B. felt feverish and had a sore-throat; and on October 9 the rash of scarlet fever made its appearance. The disease ran its usual course and terminated favourably.

The period of incubation in this case could not have exceeded three days.

Case XX.—T. M., an officer in the Limerick Artillery, aged 22, arrived in London on September 2, 1858. On September 5, in the afternoon, he visited a friend, whose little girl had scarlet fever, but so slightly that she was not confined to bed. He took the girl on his knee and kissed her. On the morning of September 8 he was quite well; but towards evening he was attacked with headache, heaviness, and sore-throat, followed by a dusky, scarlet rash, ulcers on the tonsils, constant delirium, sleeplessness, and great prostration. He died on September 14 at 11 a.m.

In this case the period of incubation was not longer than three days, but neither was it shorter.

Case XXI.—Susan W., aged 16, was admitted into the London Fever Hospital on January 13, 1863, along with her sister, who was ill with typhus. Susan's febrile attack terminated on the seventh day (January 15), with an eruption of herpes on the lips. She never had any typhus eruption, and on January 16 her pulse was 60, and her appetite good. In the night of January 16 she began to complain of pains in the limbs and sore-throat; and next day the rash of scarlet

fever appeared, and the pulse was 108. Although this patient was admitted with her sister into a typhus ward, she was attended by a nurse from a ward devoted to scarlet fever.

The period of incubation in this case could not have exceeded three and a half days.

Case XXII.—Ellen N., aged 4, was admitted into the London Fever Hospital on May 2, 1863, on the fourth day of an attack of scarlet fever, which proved fatal from pneumonia on the eleventh day. This child had been living in a locality where scarlet fever was not known to exist; but on April 25 she had been taken to the workhouse of St. George's-in-the-East, and on the same day she had played there with a child, who was then sickening with scarlet fever, and who was admitted into the London Fever Hospital with this disease in a malignant form on April 27. Ellen N. was taken ill with headache and sore-throat on April 29, and the scarlet rash appeared on April 30.

Here the period of incubation could not have exceeded four days.

Case XXIII.—In the afternoon of May 14, 1863, while from home, I was myself seized with general pains, fever, sore-throat, and great prostration. I did not get home until eleven o'clock, and all next day I was very ill in bed with the same symptoms, but there was no rash. Suspecting that I had scarlatina, I sent for a medical friend to advise me as to sending away my only child; but, by the time that he arrived, late in the evening, I was so much better, that he gave a decided opinion that my attack was not scarlatina, and next morning as I was able to get up and attend to my duties I believed that he was right, and did not send my child away. I have no doubt now from the sequel, and from what I have seen in other cases, that my attack was scarlatina. I may add that at the time I was much exposed to the disease, that I never had scarlatina before, nor have I had it since, and that for many months after that attack I was very anæmic and out of health. On and after May 16 I saw my child as usual. On the morning of May 20 she was attacked with scarlatina in a malignant form, of which she died on the 27th.

The period of incubation in this case could not have exceeded four days.

Case XXIV.—On April 1, 1878, Master P. left school at Wimbledon on the fortieth day of an attack of scarlatina for his home at Brighton. Before leaving desquamation had to all appearances quite terminated, the feet having desquamated twice. Also he had had repeated carbolic acid baths, and he had left all his infected clothes behind. After reaching Brighton, his face and feet desquamated again; and four days after his arrival his mother fell ill with scarlet fever.

Here also the period of incubation did not exceed four days.

Cases XXV. to LIV.—The following remarkable history was communicated to me in 1865 by Dr. J. Hogarth Pringle, then at Parramatta, New South Wales, in reference to my papers on the Etiology of Scarlatina, which had appeared in the 'Lancet' of the previous year. I quote from his letter:—

'In the month of April, 1858, I was surgeon of one of the large steamships, plying between Australia and Suez, in the Royal Mail Service. We left Sydney in April, carrying 147 first-class passengers, of whom upwards of forty were children under ten years of age. We had no sickness on board until one day after leaving Aden, or forty-six days after leaving Sydney, when scarlatina made its appearance, and before reaching Suez (four days) thirty cases had occurred. Now, when we left Sydney there was no scarlet fever there, nor was there any at Melbourne, King George's Sound, Galle, or Aden, the only ports at which we touched. I was most careful to ascertain this on my return passage. But a family on board had up to nearly three weeks before their embarkation resided with friends in Queensland who had scarlatina. None of the family who were on board had at that time contracted the fever; but the light clothing they had worn in the semi-tropical heat of Queensland had been packed up there for the voyage, and the boxes had not been opened until after leaving Aden and reaching the terrible summer-heat of the Red Sea, when it was unpacked and again called into use. It was in this family that the two first cases occurred, after an interval of upwards of three months since they and their infected garments had left the house in Queensland where scarlet fever had raged. The rapidity with which the disease was developed in the vessel tends to prove what I think I have been frequently assured of, that the incubatory stage of scarlatina is very short.'

This is certainly a most remarkable and telling story bearing on the period of incubation of scarlatina. Presuming that most, if not all, of those attacked on board ship were children, out of rather more than forty exposed, thirty were attacked within four days. At all events, in none of the thirty cases could the period of incubation have exceeded four days; in many it was probably much shorter than this, as they may have contracted the disease from those who first sickened rather than from the originally infected clothes; while in two at least of those first attacked, the incubation-stage seems to have been less than twenty-four hours.

Case LV.—Robert W., aged 44, was admitted into the London Fever Hospital on September 17, 1858, on the fifth day of scarlet fever. On September 8 he went to act for a coachman, who, with his children, were laid up with the disease. He did not sleep in the house, and never entered the sick-room; but late in the afternoon of September 8 the coachman, though ill, came out to speak to him, and gave him a cup of tea out of his hand. On the morning of the 13th, Robert W. fell ill with scarlet fever, the rash appearing on the 14th.

The period of incubation in this case was four and a half days.

Case LVI.—Thomas B., aged 16, was admitted into the London Fever Hospital on October 15, 1858, on the fifth day of scarlet fever, and on the eleventh day he died. Four and a half days before his seizure he arrived from sea, and went to his mother's house where scarlet fever was. Three of the family had died of it, and a fourth was not expected to live.

Here the period of incubation could not have exceeded four and a half days.

Cases LVII. to LXXII.—Reference has already been made (see Case VIII.) to a dinner party which took place on June 9, 1875, and where eight of the sixteen persons who constituted the party were within five days attacked with scarlet fever, which was probably due to infected cream. But this was not the whole extent of the calamity. To quote from Dr. Buchanan's Report above referred to :—

'Within five days of June 9, twelve persons who were in the house on that day are attacked with scarlatina, and six others with sore-throat, or with sore-throat and other symptoms resembling scarlatina. Besides these there was a nineteenth attack in the person of K., a lady who was not in the house on June 9, but who lunched there on the 10th, and was taken ill with slight scarlatina (second attack) on the 14th' (p. 73).

I have already shown that in three at least of the nineteen cases the incubation-period was less than two days; and no doubt this was the case with others; but deducting these three cases, here in all of sixteen cases, occurring under like circumstances, the incubation-period was less than five days.

Cases LXXIII. and LXXIV.—On January 10, 1864, a girl returned to the Sailors' Home at Hampstead from visiting a house where scarlet fever was. She did not take the fever herself; but on the 15th another girl in the Home was attacked, and on the 16th a second case occurred. The only discoverable source of the poison was that now stated.

In these two cases the period of incubation may have been (though not necessarily) as long as five and six days respectively; but it could not have been longer.

Case LXXV.—On Tuesday in March, 1878, a young lady, A, sickened with scarlatina at a school at Putney. On the following Thursday, a second young lady, B, left the school for her own home where there was no scarlatina. On the Monday following B fell ill with scarlatina.

The period of incubation was somewhere between four (not less) and six (not more) days.

These are all the cases in which I have succeeded in tracing the latent period of scarlet fever. It will be seen that in some this period was less than twenty-four hours, and that in none did it exceed six days. The cases where the disease was contracted at a dinner party (Cases VIII., IX., X., and LVII. to LXXII.) and on board ship (Cases XXV. to LIV.) are of particular interest, as showing that when a large number of persons became infected from a common source the incubation period was in every instance short. In all of the 75 cases it was possible to fix the maximum limit of the latent period.

Thus:—

In	4	Cases it did not exceed	24 hours.	I., II., XXV., XXVI.
	2	„ „	30 „	III., IV.
	3	„ „	36 „	V., VI., VII.
	4	„ „	40 „	VIII., IX., X., XIII.
	1	„ „	41 „	XII.
	4	„ „	48 „	XI., XIV., XV., XVI.
	1	„ „	54 „	XVII.
	1	„ „	2½ days	XVIII.
	2	„ „	3 „	XIX., XX.
	1	„ „	3½ „	XXI.
	31*	„ „	4 „	XXII., XXIII., XXIV., XXVII. to LIV.
	2	„ „	4½ „	LV., LVI.
	17†	„ „	5 „	LVII. to LXXII., LXXIII.
	2	„ „	6 „	LXXIV., LXXV.
Total	75			

In only 10 of the cases was it possible to determine the shortest limit, as most of the patients remained within the sphere of the poison from the moment of their first exposure up to the date of their illness. This is a point often lost sight of in investigations of this sort. The minimum period of incubation in the 10 cases was as follows:—

In	1	Case it was	26 hours.	III.
	3	„	34 „	VIII., IX., X.
	3	„	36 „	VI., XI., XII.
	1	„	3 days	XX.
	1	„	4 „	LXXV.
	1	„	4½ „	LV.
Total	10			

In only 3 of the cases could the moment of infection be fixed with precision, viz., in Case VI. (thirty-six hours); Case XX. (three days); and Case LV. (four-and-a-half days).

It follows that, of the total 75 cases, in not one did the incubation-period exceed six days; in 73 cases it could not have exceeded five days; in 54 cases it could not have exceeded four days; in 20 cases it could not have exceeded three days; in 16 cases it could not have exceeded two days; and in 3 cases it could not have exceeded twenty-four hours. It also appears that the longest period of incubation made out in any of the cases was four-and-a-half days (Case LV.);

* There are good reasons for believing that in a large proportion of these cases the incubation-period was much under four days (See Cases XXV. to LIV.).

† Inasmuch as in only 3 of the 19 cases contracted at an evening party was the incubation-period made out with certainty, and as in all three it was less than two days (Cases VIII., IX., X.), in many of the remaining 16 cases it was probably much under five days.

and that in only 2 of the cases was it certainly as long as four days (Cases LV. and LXXV.).

The above cases lend no support to the opinion expressed by some writers to the effect that the latent period of scarlet fever is longer in adults than in children, nor to the statement of Thomas, in his recent article, that scarlet fever differs from all the other acute exanthemata in the great variation of its incubative stage.* Also the common argument that scarlatina has not been transmitted by a nurse, or the medical attendant, because of the short interval that has elapsed between their first communication with the patient and the appearance of the disease, is hereby shown to be untenable.

The following observations, recorded by other physicians, are additional illustrations of the short period of incubation in scarlatina. Dr. B. W. Richardson relates that once when he was attacked, the effect of the poison was instantaneous. He had applied his ear to the chest of a patieut suffering from scarlet fever, and was conscious of a peculiar odour emitted by the patient. He immediately felt nauseated and chilly, and from that moment he was able to date the commencement of his illness.† A remarkable case was observed by the late Professor Trousseau, in the beginning of 1859. A London merchant had spent the winter at Pau with one of his daughters, and on his way back to England he remained for a few days in Paris. Here he was joined by another daughter, who came direct from London. Scarlet fever was prevalent in London, but there was not a case of it at Pau. The daughter from London was seized with scarlet fever in crossing the Channel, and joined her relatives in Paris seven or eight hours‡ later. She there occupied the same room in the hotel as her sister, who was attacked within twenty-four hours.§ 'My bootmaker,' says Sir Thomas Watson, 'went down from London to Devonshire to see his wife and children. Arriving on a Sunday, at noon, he unexpectedly found that one of his children had scarlet fever. On Monday he took a gallop with some hounds, and in the evening felt unwell. On Tuesday he had sore-throat and sickness, which proved to be early symptoms of a thorough attack of scarlatina.‖ In Hanau, where there was no scarla-

* Ziemssen's 'Cyclop.' American Trans., ii., 170.
† 'Clinical Essays,' 1861, vol. i., p. 94.
‡ Not *days*, as rendered in Syd. Soc. Transl., vol. ii., 165.
§ 'Clinique Méd.,' 1861, vol. i., p. 5.
‖ 'Lectures on Medicine,' 5th ed., 1871, ii., 973.

tina, Rehn saw a child attacked two days after its grandmother had returned from nursing a scarlatinous patient in Stuttgart. Russegger saw a child who had visited a scarlatinous patient at noon, taken sick the same night. He gives another instance, where three children visited a sick friend in a neighbouring village: two of these children took scarlatina two days after, and the third was attacked on the day following. At Wangen, where previously no case of scarlatina had occurred, Zengerle reports that a girl, aged 10, was taken sick two days after her mother had visited a family sick with scarlatina in a neighbouring town. Löschner states that a boy, aged 4½ years, who entered the hospital for the treatment of a sarcoma, was attacked a day and a half after his admission, and that the hospital could have been the only source of infection. Fleischmann observed the infection with scarlatina of two variolous children who had been placed near the scarlatina ward, and in each case three days intervened between their admission into hospital, i.e. the earliest possible period of infection, and the beginning of the disease. Gerhardt reports that a man was attacked with scarlatina four days after an abscess from which he suffered had been opened with a knife, used for the same purpose in a scarlatinous patient a few hours before. Pons also calculated the period of incubation with certainty at four days, in a case to which he had himself brought the contagion.* Of 10 cases narrated by Dr. W. Squire, the period of incubation was one day in 1 case, under two days in 1 case, two days in 6 cases, under three days in 1 case, and under four days in 1 case.† Lastly, Rostan refers to cases where the *eruption of scarlet fever appeared* seven days after inoculation with the poison, the incubating period being therefore probably five or six days.‡ It may be added, however, that in Miquel's experiments with inoculation, the incubation-stage lasted only thirty hours.§

By a further appeal to medical literature it would not be difficult to multiply the instances in which the incubation

* I quote these German cases on the authority of Thomas. See his article on Scarlatina in Ziemssen's 'Cyclopædia of the Practice of Med.,' Eng. ed., 1875, vol. ii., p. 167.

† 'The Period of Infection in Epidemic Disease' (Reprint from 'Trans. of Epidem. Society of London,' 1874, p. 38).

‡ 'Clinique Méd.,' 2me éd., 1830, vol. ii., p. 186.

§ 'Lançette Française,' 1834, p. 202. An account of these and other experiments on inoculation of scarlatina will be found in the 'Lancet' for August 13, 1864. (See also Thomas, *loc. cit.* p. 162.)

period of scarlatina has not exceeded a few days; and although it would also be possible to adduce cases in which it is said to have exceeded one week, or to have been two, or three weeks, or even longer, the cases of this sort to which any value can be attached are remarkably few. For example, the cases quoted by Thomas from Paasch, Böning, and other observers, where certain children sickened twelve or fourteen days after other members of the same family had commenced to be ill, show only the possible *maximum* incubation period, and are therefore not to the point.* About the best instance of long incubation-period in scarlatina with which I am acquainted is one recorded by Dr. W. Squire, where a boy, 2½ years old, was removed from an infected house for quarantine, and his temperature carefully taken. On the morning of the eighth day after removal the temperature in the axilla was slightly above the normal standard; by night the temperature had risen considerably; and next day the rash of scarlatina appeared.† Notwithstanding this case, subsequent experience satisfied Dr. Squire that when children are removed from a source of infection by scarlet fever, if any take it they will most probably sicken within a week.‡ Some years ago it was stated by Gerhardt that very accurate observations made by his assistant, Reinhold, indicated an incubation-period of eleven days; but more recently, Gerhardt has come to the conclusion that the normal period does not exceed seven days.§ Among cases where the incubation-period has been said to extend over several weeks, reference may be made to those narrated many years ago by Most, in which it was believed to be a month;‖ and in particular to a case recorded in the *Lancet* for August 20, 1864, by Dr. Reginald Thompson. In October 1862, scarlet fever was epidemic at Betchworth. On October 4, the little daughter of the coachman of the late Sir Benjamin Brodie, who went to school at Betchworth, was seized with it. Sir Benjamin's grandchildren had had communication with this child, but on October 6 were sent off to Oxford. On October 28, or twenty-two days afterwards, the eldest girl, aged 13, sickened with scarlet fever at Oxford, where, it is stated, the disease did not exist, either then or for some time before. Now,

* Ziemssen's 'Cyclop.,' *loc. cit.*, vol. ii., p. 169.

† 'Infantile Temperatures in Health and Disease' ('Trans. Obstet. Soc. of London,' vol. x., p. 169).

‡ 'Period of Infection in Epidemic Disease': London, 1874, p. 35.

§ Ziemssen's 'Cyclop.,' *loc. cit.*, vol. ii., p. 169.

‖ Geschichte des Scharlachf. ii., 178.

without denying the possibility of such a lengthened incubation-period in scarlet fever, my experience would induce me to suspect that in these and such like cases there was some fallacy. There may have been other undiscovered sources of infection, or the poison may have been lurking in the clothes rather than in the bodies of the individuals who were secondarily attacked. For example, in the case which I have narrated, where scarlet fever broke out in a ship at sea, upwards of three months after those first attacked had been exposed to the poison, had no mention been made of the box of infected clothes it might have been contended that the incubation-period was over three months (see Cases XXV. to LIV.). So also in the case of Hildenbrand. He is said to have caught scarlet fever from his own cloak, which, after exposure to the poison, had been locked up for eighteen months; and it has been well remarked that had he put on this cloak at the end of one, instead of at the end of eighteen months, after visiting the patient who infected the cloak, and been then attacked, the case would have been quoted as one proving the possibility of the incubation-period extending over four weeks. In reference also to these cases of long incubation-period of scarlatina I may add that during many years it has been my practice to pronounce persons, who had been exposed to the infection of scarlet fever, safe after a quarantine of seven days, provided their clothing had been properly disinfected: and that so far I have seen no reason to alter this rule.

My observations and study of the incubation-period of scarlet fever have led me to the following conclusions:—

1. The duration of the incubation-stage may be only a few hours.

2. Probably in a large proportion of cases it does not exceed forty-eight hours.

3. It very rarely exceeds seven days.

4. Consequently, a person who has been exposed to scarlet fever, and does not sicken after a week's quarantine, may be pronounced safe.

Duration of Contagiousness in Infectious Diseases.

It is not my intention to discuss at length this question on the present occasion. With regard to measles, however, I may be permitted to observe that, while the cases in Group III. confirm the general impression that measles is very

infectious in the catarrhal stage, before the appearance of the eruption, and thus explains the difficulty or impossibility of preventing its spread in schools, Group II. shows that, contrary to the opinion expressed by Panum,* the poison continues to be given off during convalescence.

The cases given under the head of Hooping Cough show that this disease also is infectious from its very commencement, long before the development of the hoop.

In my work on 'The Continued Fevers'† I have discussed the question as to what stage of typhus is most contagious.

Many facts, such as that quoted above from Trousseau (*antea*, p. 23), show that scarlatina has an infecting power from the earliest stage of the malady, although the comparative facility of preventing its spread in a school, when the first case is promptly isolated, points to this power being much less during the first two or three days than in the case of measles. On the other hand scarlatina has the power of infecting over a period of many weeks. The ordinary practice of pronouncing a patient safe at the end of a month, or after the apparent cessation of desquamation is not always safe. This is proved by Case XXIV., where a patient convalescent from scarlatina imparted the disease after the fortieth day, and after desquamation had to all appearances quite terminated, and also by other cases which have come under my notice. It is a good rule, I believe, to regard no case as safe until the expiration of the eighth week.

A question of great interest in reference to the stage of contagiousness of infections, and bearing also upon the duration of their incubation-period, is, whether a person in whom a contagious disease is incubating, and who has no symptoms, can impart the disease to another? There are some facts which render this probable. Perhaps the most important is one related by Curschmann in regard to small-pox. In the Charité Hospital of Berlin, small pieces of skin were taken, for transplantation upon other individuals, from the amputated arm of a person who, before and at the time of the amputation, did not manifest the slightest symptom of general disease. Several hours after the amputation the patient was attacked with violent fever, followed two days later by

* Panum observes: 'It is generally believed that measles is peculiarly contagious during the desquamative stage. On what foundation does this opinion rest? I cannot tell: for my own part I have never seen a case to convince me that contagion took place at the desquamative stage' ('Edin. Monthly Journ. of Med. Sc.' June 1851, p. 591).

† Second ed., 1873, p. 92.

an eruption of small-pox. One of the individuals upon whom the skin had been transplanted was attacked by variola on the sixth day after the operation (about the duration of the incubation period in inoculated small-pox); the three others, who probably were protected, remained exempt.* There are also many observations on record showing that the bite of a dog infected with rabies may give hydrophobia, although the rabies is still in its incubating stage, and the animal to all appearance well. Thamhayn has collected nineteen cases of hydrophobia in the human subject, which originated in this way; eighteen of the nineteen patients died, and the dogs in every instance became subsequently rabid.† Thirdly, there are facts which make it probable that erysipelas may be communicated during the period of incubation. Thus, Doepp relates how vaccine lymph was taken from a child, who the day after was attacked by erysipelas. Nine other children were vaccinated with this lymph, every one of whom took erysipelas.‡

These observations suggest a line of investigation in connection with the acute specific diseases which has still to be worked out. I have already suggested that in one of the cases of scarlatina, which I have now placed on record, the disease might possibly have been contracted from another person in whom it existed only in the incubation-stage (Case XIII.). There were, however, in this case, other possible sources of infection. In all of the observations now referred to, the disease was communicated in the incubation-stage by inoculation; and, so far as my knowledge extends, there are, as yet, no facts on record which prove that acute specific disease can be transmitted during the incubation-stage, either by mere contact or through the atmosphere.

Appendix.

Since the above paper was written, I have received from Dr. J. Ford Anderson the particulars of the four following cases of scarlatina, one of which I saw in consultation. The children belonged to one family circle, and lived in a district where Dr. Anderson was practising, and where, so far as he

* Curschmann, Article on Small Pox in Ziemssen's 'Cyclop. of Med.' American Transl., vol. ii., 1875, p. 335.

† Quoted by Bollinger in his article on Hydrophobia, Ziemssen's 'Cyclop. of Med.' American Transl., vol. iii., p. 440, 474.

‡ Quoted by Zuelzer in his article on Erysipelas, *Ibid.* ii., 436, 437.

knew, there were no other cases of scarlet fever. Dr. Anderson is inclined to think that they illustrate a longer period of incubation in scarlatina than accords with my experience. I am not, however, altogether satisfied upon this point.

With regard to Case I., Dr. Anderson himself asks: Did incubation date from March 4 (known infection), twelve days; or from March 13 (no known infection), three days? Now, for my part, with my experience of the incubation-period of scarlatina before me, and with my knowledge of the risks of London cabs and London crowds, I would, if I had to choose between the two alternatives, be inclined to the latter. But I cannot help suspecting that there may have been a source of infection in the residence of H. M. A. which was not discovered. We must either admit this, or we must admit that H. M. A. gave scarlatina to the fourth case 'a few days before his own illness began.' From what I have stated in the above essay, this, of course, may have been possible; but it is a pathological possibility which has still to be demonstrated. In the present state of our knowledge, however, I think the case is worthy of being placed on record.

In Case II., where the period of incubation was, at the outside, not longer than seven days, there is, perhaps, nothing very remarkable; but, of course, the period might be reduced to five days, if there be any force in the exception taken to Case I., to say nothing of the possibility of the isolation of H. M. A. during the first two days not having been so complete as was believed.

With regard to Case III., Dr. Anderson notes: 'C. F. A's incubation-stage lasted either nine days or thirty-six hours.' Knowing, as I do, how readily scarlatina may be propagated by medical men and nurses, I have no hesitation in giving my opinion that the incubation in this case was, most probably, thirty-six hours: a period which would correspond very closely with that of many of my cases. Moreover, on the supposition that the latent period in this case was nine days, C. F. A. must have caught the disease from H. M. A., while it was still incubating in him.

Case I.—H. M. A., a boy, aged 12, on March 4, 1878, sat at school next to another boy, who had sore-throat and a rash, which on the evening of same day was pronounced to be that of scarlet fever. H. M. A. was withdrawn from school from that day, and spent his time

playing in private grounds at Hampstead. On one occasion only, viz. on March 13, he left home and went in a four-wheel cab to the Grosvener Picture Gallery in Bond Street. He was one of a large family, and there had been no other case of scarlatina in or about his residence. On March 16 he was attacked with scarlatina.

Case II.—M. C. H., a child, twelve months old, was playing in H. M. A.'s bed on the morning of March 16, 1878, before H. M. A. was discovered to have scarlatina. H. M. A. was isolated at once. M. C. H. remained in the house till March 18, but had no further communication with H. M. A., direct or indirect. On March 18, M. C. H. was removed to lodgings, known to be free from infection, but on March 23 was attacked with scarlatina.

Case III.—C. F. A., a boy aged six, played with H. M. A. on March 15, i.e. the day before H. M. A. was attacked with scarlatina, and then returned to his own home at some distance, where, on March 24, at 10 p.m., he was attacked with scarlatina. The only other known source of infection was that Dr. A., the father, in the capacity of medical attendant, saw M. C. H. for five minutes on the morning of March 23, not touching the patient much, but simply diagnosing the disease and giving a few directions. An hour after he went home to luncheon and C. F. A. was in the room.

Case IV.—Besides these three cases, a little girl in the same family circle took scarlatina, in whom the only known source of infection was that she played with H. M. A., 'a few days before his illness began' (on what particular day Dr. A. could not say).

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