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Scarlet Fever from the Preventive Medicine standpoint with special reference to the position of Hospital Isolation in controlling its spread.

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This subject has within the last three or four years been very prominently before the consideration of the profession, and particularly of that branch engaged in public health work. Many papers have been written, and many discussions have taken place; and at the present moment great uncertainty exists in the minds of many of us as to the best methods of controlling the spread of the disease; as to how much value we should attach to the provision of hospital accommodation; as to what exactly is the type of hospital best suited to the management of the disease, and on what points we should rely in determining the length of isolation necessary in each individual case.

Until within a very recent period practically no doubt existed on any of these points. It was held that hospital isolation of every case was the ideal to be aimed at; the type of hospital (pavilions standing some distance from each other and each comprising two large wards with an intervening duty room and offices) had become stereotyped; and the period of isolation was governed by the duration of the stage of desquamation of the skin with usually a minimum of six weeks.

The theory on which this practice was founded would appear to be twofold, (a) that the infection of scarlet fever is conveyed almost invariably directly from person to person; (b) that the infecting principle is contained in the desquamating cuticle. It was held that the utility of the hospital system, and the general reliability of the principles mentioned were clearly shown by the great diminution of the disease and the reduction of the death-rate therefrom during the past thirty years or so. The fall in the death-rate in England and Wales is shown in the following table:-

Quinquennium	Average annual death-rate
1866 - 1870	.959 per 1,000
1871 - 1875	.758 " "
1876 - 1880	.679 " "
1881 - 1885	.435 " "
1886 - 1890	.240 " "
1891 - 1895	.182 " "
1896 - 1900	.134 " "

It has however been pointed out by many writers that the decline in the death-rate commenced considerably before the adoption of hospital isolation on a large scale; and recently, particularly by Dr Millard of Leicester,("Public Health" April 1901) that the decline of this disease has been equally great, if not greater, in towns not practising hospital isolation, as in those where it is carried out. The occurrence of "return" cases,(by which term is understood cases occurring in a house to which a patient from hospital has been discharged within four weeks) on the one hand, and the apparent absence of any bad results following the discharge of desquamating convalescents on the other, has caused a revolution in our conception of the channels by which this disease is spread. In the great proportion of "return" cases which have been investigated there has been no evidence of desquamation present in the primary case after his discharge from hospital, whilst a large proportion of such primary cases have been shown to have been discharged with, or to have afterwards developed, otorrhea, rhinorrhea, sores about lips or nostrils or abnormal conditions of the pharynx and tonsils.

The evils of aggregation in the large wards of a fever hospital in producing such complications and in aggravating the type of the disease have been dwelt upon; and certain observers even go as far as to maintain that the effect of the present type of fever hospitals is not only to increase the severity of the disease in the individual after admission, but also to manu-

-facture a more virulent poison and to spread this far and wide by means of convalescents discharged in an infectious state. They maintain that the "return" cases as at present defined represent only a small proportion of those who derive their infection from hospital convalescents, such convalescents infecting many outside their own households. They also maintain that the cases so infected are particularly apt to be of a severe type. These views have been supported by reference to the high death-rates and high case mortality in certain towns which isolated a large proportion, over 70 per cent., of their cases; and to the favourable position in these respects of other towns isolating few or none; and also by the observation made by several writers that known "return" cases were of a more severe type than the average.

The exceeding prevalence of this disease in almost all parts of the country, and the heavy expenditure which is entailed by the present methods of dealing with it, combine to make the consideration of the subject of very great importance. I do not think that the arguments so far brought forward in favour of abandoning the principle of hospital isolation are at all conclusive. The value of comparison of different towns in this respect though useful to some extent, is apt to be fallacious. Not only do the towns differ in respect of age and sex constitution, occupations, natural situation, meteorology, etc., but hospital isolation in one town may be far less effectively carried out than in another.

One of the towns cited as a good isolator in Dr Millard's paper is said to have had its hospital constantly overcrowded, and to have kept patients waiting some days before admission. Failure to control the disease by means of hospital isolation of this kind is really no disproof of the value of hospital isolation properly carried out. The comparison must be made between an efficient system of hospital isolation on the one hand, and the best possible home isolation that circumstances permit on the

other.

However carefully comparisons are made between differeht towns, it appears to me that disturbing factors will still largely invalidate the results; and further, hospital isolation may be useful and necessary in a certain class of town, though not in all. In many respects a study of the history of the disease in a single town and its distribution in the various districts thereof, appears more likely to throw more light on the question.

By the study of the course and distribution of the disease in one town (South Shields) I have endeavoured to contribute, in however slight a degree, to the elucidation, primarily, of this question of hospital isolation, and incidentally to, that of the method of spread of the disease.

South Shields is a seaport town with a population in 1903 of approximately 106,000. It is situated on a miniature peninsula as shown in the accompanying map, and has the river Tyne on the west and north, and the German Ocean on the east. The subsoil varies in different parts of the borough, sand, alluvial clay, sandstone and "made" ground being the chief varieties.

For the last thirty years certainly, and no doubt for a considerable period prior to this, this town has suffered in an exceptional degree from the ravages of scarlet fever. Unfortunately the Notification Act was not adopted until the middle of the year 1891, so that previous to the year 1892 the prevalence of the disease can only be judged from the death-rates. The two charts A and B show respectively the annual death-rates from 1871 to 1903; and the notifications month by month from January 1892 to December 1903, the latter calculated on a population of 100,000. These charts show a marked endemicity of the disease in the borough, to which is occasionally added an epidemic wave. Chart B shows that in only three out of 144 months recorded did the number of notifications fall below 20 per 100,000 of population, whilst in 58 of the total months over 60 cases were notified per 100,000.

In the year 1873 the disease was so prevalent in the Borough

Chart A.- annual Scarlet Fever Deathrates.

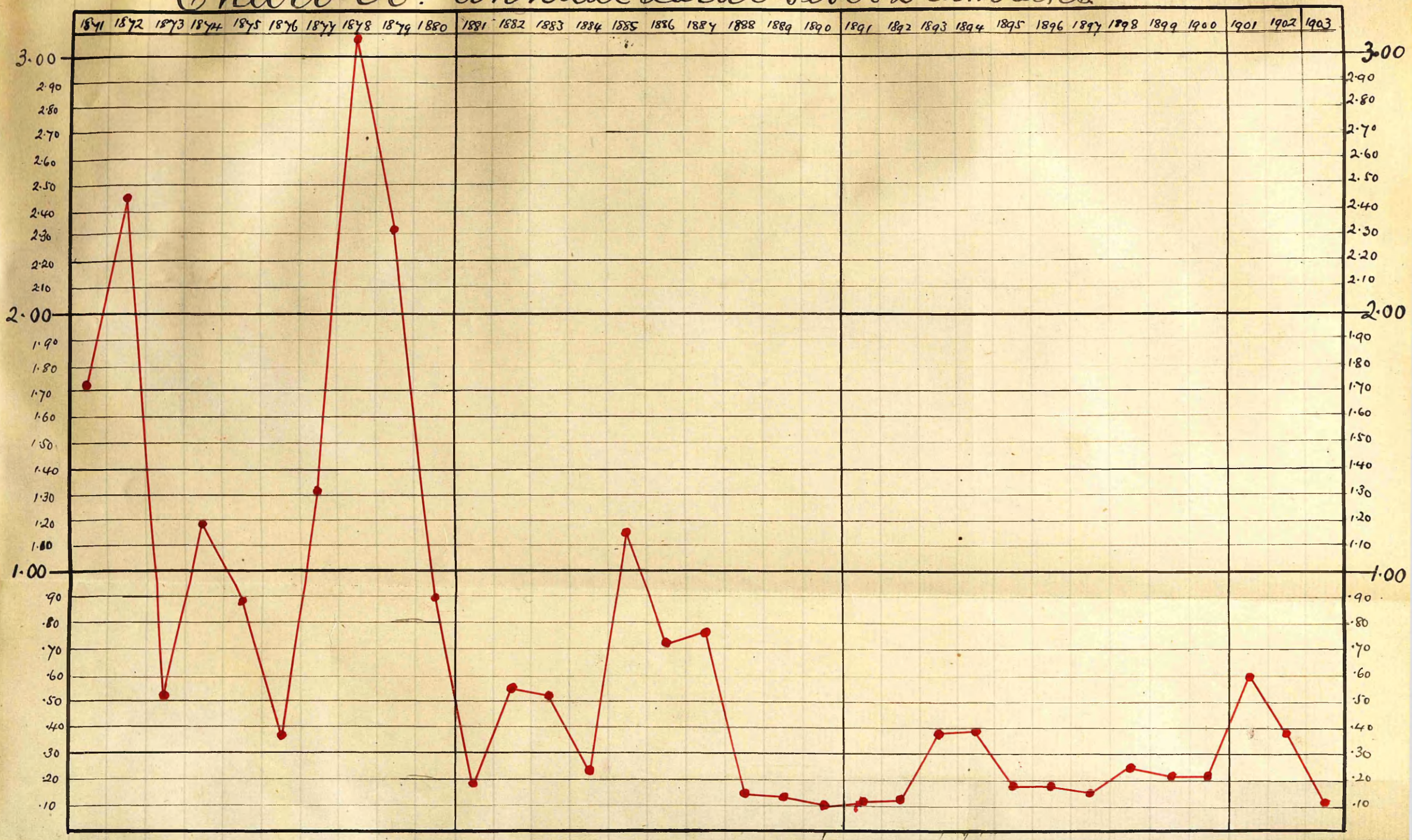
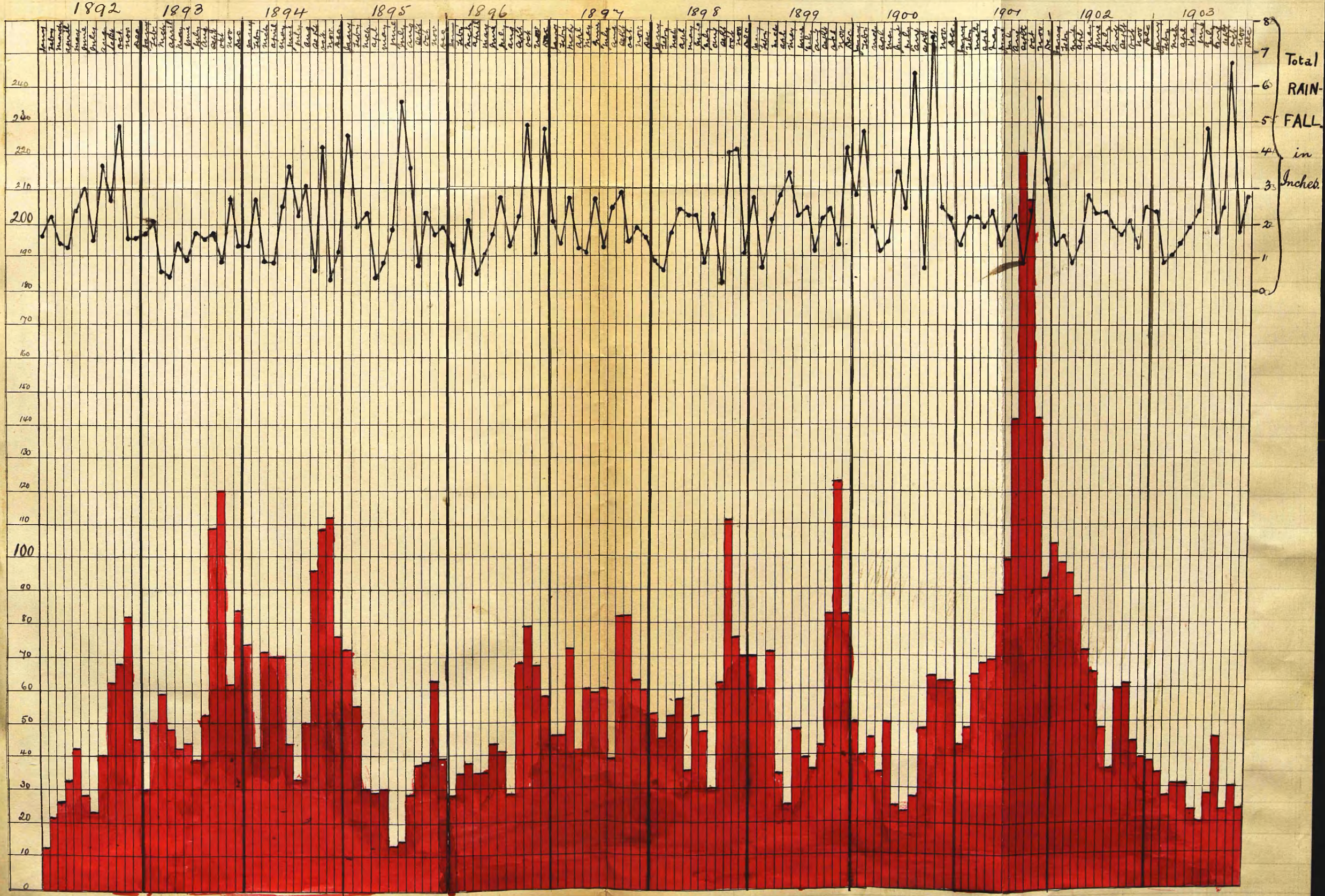


Chart B.

Monthly Scarlet Fever Attack-Rate per 100,000.



that the attention of the Local Government Board was called to it, and one of their Inspectors was sent to South Shields to investigate the question. This gentlemen, unfortunately, himself contracted the disease, and died from it. Since then two of the Medical Officers of Health have suffered from the disease. In many of the annual reports of my predecessors in office the endemicity of this disease in the borough is emphasised. Whatever may be the explanation of this endemicity it is a fact which must be borne in mind in considering the results obtained by methods of isolation.

Influence of season and meteorology. Another fact which is clearly shown by chart B is the constant rise and fall in the prevalence of the disease produced by the changes of season. The months of least prevalence are June, July, and August, whilst those of greatest prevalence are September, October, and November, and to a less extent December. The most constant feature in the yearly curve of the disease is the rise which takes place in September, and culminates in October or November. This rise is usually abrupt, there being a marked difference between the number of notifications in August and September respectively. The fall towards the end of the year is more gradual. A slight rise also appears to occur in the Spring (March and April) which is followed by a very regular fall in June. The lowest point in the year is generally reached in July, and it is worthy of note that the number of cases recorded in this month of any year bears a more or less constant proportion to the number recorded in the month of greatest prevalence. The Autumn rise has occurred every year (since notification was adopted) without exception, and the Summer fall every year except in 1901, in which year the disease assumed epidemic proportions. The following table shows for each year the lowest point reached in the Summer fall, and the highest point in the Autumn rise.

Year	Summer Fall		Autumn Rise		
	No. of cases	Month	No. of cases	Month	Proportion Minimum to Maximum.
1892	23	July	82	Nov.	3.5
1893	39	"	120	Oct.	3.0
1894	33	"	112	Nov.	3.4
1895	13	June	62	"	4.8
1896	28	Aug.	79	Oct.	2.8

Year	Summer Fall No.of cases	Month	Autumn Rise No.ofcases	Month	Proportion Minimum to Maximum
1897	38	Aug.	82	Sept.	2.2
1898	30	"	111	Oct.	3.7
1899	36	"	122	Nov.	3.4
1900	23	July	64	Oct.	2.8
1901	99	"	220	Sept.	2.2
1902	36	Aug.	61	Oct.	1.7
1903	20	July	45	Sept.	2.2

Meteorological factors have evidently therefore a marked influence in the spread of the disease, and this influence must be taken into account when the results of different methods of isolation are being compared. Such factors occasion increase or decrease in the number of notifications quite independently of any form of isolation adopted.

It is difficult to determine what precisely are the meteorological factors which are concerned in the production of this seasonal wave, but it would appear that the influence acts by favouring the spread of the disease from person to person rather than by exciting afresh the extra-corporeal germs of the disease which may be lying dormant in fomites or in infected houses. I am led to take this view by the following facts: (1) that although this seasonal wave is well marked when the town is taken as a whole, if small districts be taken it is frequently not so, the explanation being that the disease had not spread to such districts until after the month of maximum prevalence: and (2) that re-appearances of the disease in a house are not more common in September, October and November in proportion to the total number of cases for the month. than they are at other times of the year. An exaggeration of the autumnal meteorological conditions which favour the spread of the disease is probably one of the causes of an epidemic wave. Dry warm weather appears to favour the spread, whilst heavy rains occurring in the early Autumn retard and minimise the rise of the seasonal wave.

Apart from the purely general causes which may account for the great fall in the prevalence and fatality of the disease

in the Borough between the decade 1871-1880 and the decade 1891-1900 two forces specially directed against it came into play, viz., the opening of the fever hospital in 1882, and the adoption of the Notification Act, in 1891. Whilst the average annual death-rate in the decade 1871-1880 was 1.44 per 1,000, in the decade 1881-1890 it stood at .45 per 1,000, and in the decade 1891-1900 it was .21 per 1,000. In this Borough there is no evidence whatever that any steady fall in the prevalence of the disease commenced prior to the institution of hospital isolation. With the introduction of hospital isolation and prior to any system of notification we see a rapid and marked reduction. This is perhaps best shown by a comparison of 5 year periods.

Period	Average Annual death-rate -per 1,000	Hospital isolation	Notification.
1871-1875	1.35	No	No
1876-1880	1.59	No	No
1881-1885	.53	Yes from 1882	No
1886-1890	.37	Yes	No
1891-1895	.25	Yes	Yes
1896-1900	.20	Yes	Yes

In addition to the general decline of the disease there appears to have been a very marked change in the nature of the districts and of the classes of the community who suffer most from its ravages.

I have no exact records of the death-rates in different districts in the years prior to notification, but whenever in the annual reports any comment is made as to the distribution of the disease it is pointed out that it chiefly affects the poorest and most insanitary quarters and those with the largest general death-rates. The Local Government Board inspector attributed its prevalence "to the filthy condition of the back-streets." Dr Spear in his report for 1875 says that,"Such conditions,"(viz, those cited by the inspector) "greatly favour the spread of the disease.": In 1877 the same authority remarks that," the disease is specially prevalent in insanitary areas particularly new, jerry-built parts." The same remark is made in the 1878 report. In 1885 Dr Campbell Munro remarks that "the disease was very prevalent and fatal in the most insanitary areas, and those having the highest general death-rates." The streets

mentioned certainly deserve the description.

At the present time we find that a more or less opposite distribution exists. Comparing the attack rates in different wards for the years 1901 and 1902 I remark, "What will strike anyone well acquainted with the town is that the wards which contain the slums come out best in this comparison. This is even more apparent when smaller areas are taken." The alteration may be less than it appears. It may be that though in the seventies and eighties the death-rates were highest in insanitary areas, yet the attack-rates were not any greater or were possibly even less than in the more salubrious quarters. But that a change of very considerable magnitude has taken place in this matter of distribution there can be no doubt, for even the death-rates in the slum districts are now comparatively low. It is not until the year 1892 that the notification returns provide data by which the different quarters of the town can be accurately compared with one another with respect to the prevalence of this disease. I have tabulated these returns in a street index, and from this have allocated them to the different districts of the Borough. At the census at 1901 the Borough was divided into 80 enumeration districts, and I am furnished with the populations of each of these, the age constitution of such populations and the number and size of the houses. In comparing different districts I think it best to consider only the primary cases, and to make the comparison with respect to the percentage of houses invaded. The question of the spread of the disease in invaded houses from one member of the household to another I deal with separately. The fact that scarlet fever is so largely a childrens disease has an important bearing on the endeavour to trace out the sources of infection of individual cases and to guard against further spread. In both points it offers a marked contrast to small-pox, which is nowadays principally a disease of adults. The youthful age of those affected renders the effort to trace the origin of the infection extremely difficult and too often unsuccessful. The patient can give no information in most cases, either respecting his movements or regarding the names of his playmates.

The enquirer has usually to fall back upon circumstantial evidence, such as association in the same class at school with a preceding case or proximity to a house in which a case of similar age has recently occurred. This evidence, though helpful, is not absolutely reliable, and in many cases the facts may simply be coincidences. This is a strong reason for having recourse to statistical methods in endeavouring to determine the causes which favour and those which retard the spread of the disease. on the other hand the youth of those affected has in itself a tendancy to limit the spread of the disease. Children at the ages chiefly affected pass their days for the most part, in a comparativly restricted area; they are rarely out of the district in which their homes lie, except in going and coming from school, which is usually also in the same neighbourhood. Still more rarely are they out of the town. If an epidemic of a children's disease is watched by means of a spot map or in some similar fashion it will be found that it is for a considerable time, weeks or even months, restricted to a certain quarter or quarters of the town. It is then introduced into a fresh quarter (frequently by the agency of a school) takes root and spreads there and is then similarly passed on to another quarter. An epidemic of measles, scarlet fever or whooping-cough may be raging in one town and hardly present at all in a town a few miles off, or perhaps on the opposite banks of a river, and to a less degree this holds good with respect to different districts of the same town. The following comparisons are interesting in this respect:-

Year	1901.								1902.								1903.							
Town	South Shields		Sunder-land		Tyne-mouth		Jarrow		South Shields		Sunder-land		Tyne-mouth		Jarrow		South Shields		Sunder-land		Tyne-mouth		Jarrow	
* Rate per 1000 of the Population	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
Measles	·	·68	·	·43	·	24	·	·52	·	·92	·	·55	·	·32	·	1·0	·	·14	·	·81	·	·13	·	·00
Whooping Cough	·	·10	·	·71	·	·02	·	·58	·	1·01	·	·32	·	·78	·	1·0	·	·03	·	·32	·	·20	·	·34
Scarlet Fever	12·5	·6	5	·3	5·2	·23	14·1	·34	8	·38	5·5	·16	6·4	·15	8	·26	3·6	·11	5	·24	7·8	·20	3·6	·17
Smallpox	·00	·00	·00	·00	·08	·00	·00	·00	·68	·039	·06	·006	1·7	·06	·08	·029	·33	·009	·21	·012	2·1	·08	·49	·058

* { A = Attack Rate / D = Death Rate } per 1,000 popn.

In small-pox,on the other hand, whilst one is frequently able to trace the exact source of infection, one is also familiar with the ease with which the infection is conveyed from,one quarter of the town to another, or from town to town. This comparative restriction of the movements of that part of the population specially susceptible to scarlet fever infection, namely,those under 16 years, justifies one, I consider, in comparing different districts in the same town as regards the prevalence of the disease and as regards the effects of hospital isolation, which is probably employed to a very varying degree in the several districts.

The spread of the disease in Invaded Houses.-Secondary cases in a house are not very common, and the total number of such cases in any year bears a small proportion to the number of primary cases. By the term "secondary" I understand cases occurring during the illness of the first case, or within a month from his release from isolation. In this Borough the following are the numbers of primary and secondary cases respectively in each of the years 1901 to 1903.

Year	Total cases	Houses invaded	Secondary cases	Proportion of secondary to primary.
1901	1,263	907	356	38.1%
1902	834	589	245	41.6%
1903	376	279	97	34.8%

These secondary cases are divisible into various classes (a) those which are notified at the same time as the primary, (b) those which occur after the removal to hospital of the primary, (c) those which occur during the home isolation of the primary, (d) those which occur within a month of the release of the primary from isolation, including those which are known as"return"cases. The first class constitutes a large proportion of the total secondary cases, 129 out of 356 in 1901, 87 out of 245 in 1902, 38 out of 97 in 1903. The number of the first class of secondaries is evidently not affected by any methods of isolation adopted at the instance of the Public

Health authority, and can only be reduced by earlier diagnosis, and by the use of precautionary isolation in cases of illness, the nature of which is still in doubt. It is the other three divisions of secondaries comprising all those occurrring after the notification of the primary that are chiefly important from the point of view of preventive medicine. The number of these can unquestionably be largely reduced by efficient means of isolation and disinfection. A certain proportion of this class should really come under the same heading as the secondaries notified simultaneously with the primary, for although not yet showing the symptoms of the disease, they are already affected when notification brings our methods of prevention into play, and they develop the symptoms within a few days of the primary notification.

Cases Notified within a Week of the Primary Notification should probably be placed under this heading. The following table shows the numbers of the secondary cases of the different classes during the years 1901-1903:-

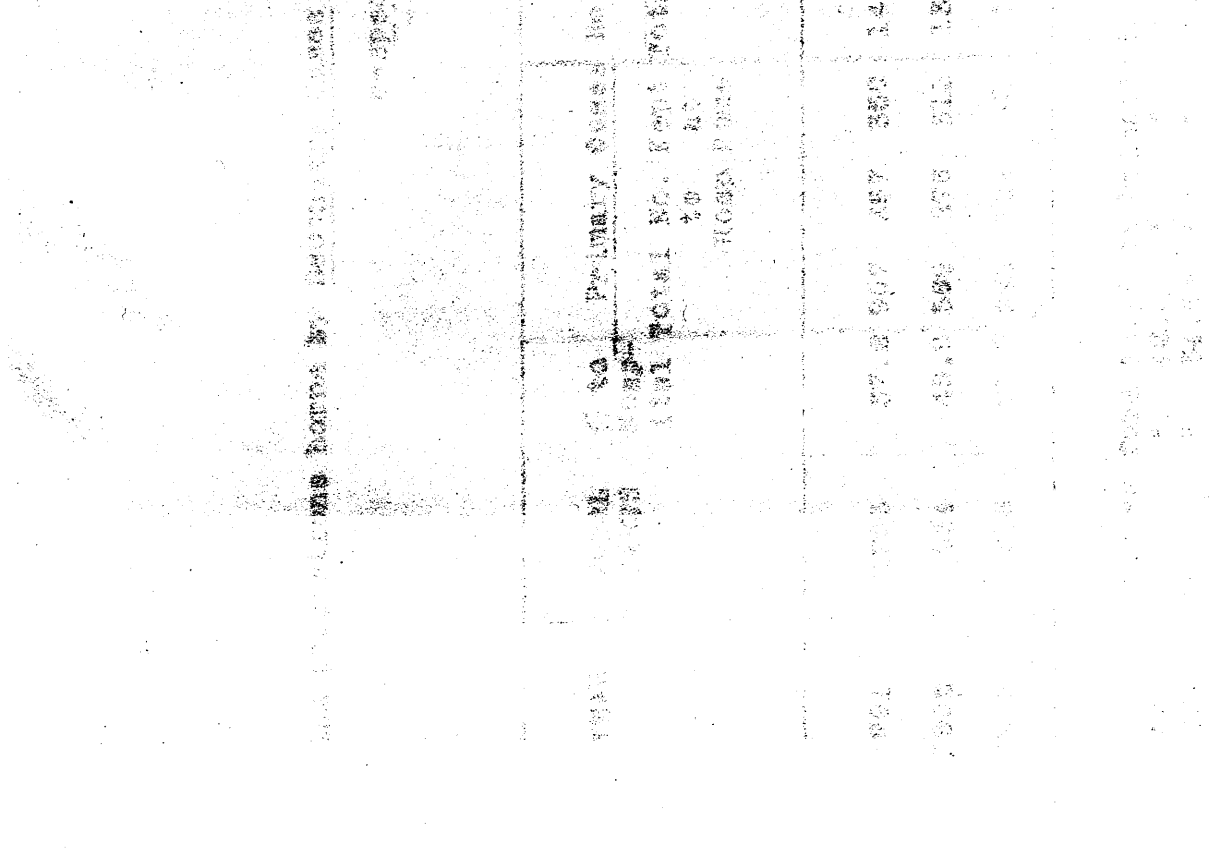


TABLE C,

Showing proportions borne by Secondary Cases to Primary Cases where primary case is kept at Home or removed to Hospital respectively, in the years 1901, 1902 and 1903.

YEAR	TOTAL CASES	% to Hospital	Primary Cases			Return & Secondary Cases when Primary sent to Hospital.								Return & Secondary Cases when Primary kept at home.					
			Total	No. to Hosp.	Kept at Home	Total	Forming %P to Hosp.	Occur on Notif of P	Forming %P to Hosp	Occur in 7 days	Forming %P to Hosp	Occur Later	Forming %P to Hosp	Total	Forming %P Left at home	Occur on Notif of P	Forming %P left at home	Occur in 7 days	Forming %P left at home	Occur Later	Forming %P left at home
1901	1263	37.2	907	357	550	141	39.4	43	12	35	9.8	63	17.6	215	38.6	83	14.9	45	8	87	15.6
1902	834	48.9	589	276	313	133	48.2	34	12.3	39	14.1	60	21.7	112	35.7	51	16.2	12	3.8	46	14.6
1903	376	71.0	279	194	85	78	40.2	29	14.9	19	9.7	31	15.9	19	20.3	9	10.5	4	4.6	6	7

1901 Secondaries form 38.9% of Primaries: the Secondaries notified more than a week after the Primary form 16.4%
1902 " " 40.6% " " : " " " " " " " " " " 17.9%
1903 " " 34.6% " " : " " " " " " " " " " 13.2%

The Secondaries under each year include those which were actually notified in the year following, that in which the primary was notified.

As regards the secondaries to hospital treated primaries, the table shows that the proportions borne by secondaries to primaries in the years 1901 and 1903 was very nearly the same; but that in 1902 the secondaries formed a considerably larger proportion. Taking only the secondaries which occur more than 7 days after the primary, which as already mentioned are really the only portion which are affected by the action of the public health officials, we see that the proportion rose markedly in 1902 and fell in an even more marked way in 1903. The high figure for 1902 is largely accounted for by the great number of 'return' cases belonging to this year, the word being used in its widest sense to include all cases arising within six weeks of discharge of a convalescent.

As regards the secondaries to home treated primaries, we see a steady diminution in the proportion borne by secondaries to primaries: this diminution is visible in all the classes of secondaries, but is most marked in the secondaries belonging to the late group. The explanation of this reduction is simply that with an increasingly high proportion of primary cases sent to hospital, it has been possible to select for home isolation only those cases where the number of susceptible children is small and where the accommodation is good. The improvement is in no way due to improved methods of home isolation.

When the proportions borne by secondaries to primaries in the hospital isolated and in the home isolated respectively, are compared, all the years and all the classes show a smaller proportion in the home isolated. The difference between hospital and home groups is small in 1901, but in 1903 there is a difference of nearly 100%. These figures, however, form no real clue to the respective merits of home and hospital isolation. It is evident that whichever method is adopted the number of secondaries will largely depend on the number of susceptible children in the invaded houses, and unless we know these numbers in the two groups for any year, a true comparison is impossible.

It would appear, however, that if we compare one year with another as regards the proportion borne by the total secondaries

to the total primaries, that some reliable evidence as to the value of hospital isolation might be obtained. The proportion of susceptibles in the total number of houses invaded in any year, does not probably vary very much from that of other years. The figures given in the table show that whereas the proportion of total secondaries to primaries was nearly the same in the years 1901 and 1902, it fell considerably in 1903, and that the fall in that year in the proportion of late secondaries was even more marked.

This fall in the proportion of secondaries is then coincident with a large increase in the hospital isolation.

Putting aside 'return' cases, which I shall discuss later, and those unavoidable secondary cases which are either notified along with the primary case or within 7 days of its notification; we may compare the relative proportions of late secondaries in invaded houses where hospital isolation or home isolation are resorted to respectively. In 1901 the late secondaries form 10% of the total primaries, in 1902 they form 11.8%, and in 1903 they form only 6%. The proportion borne by this class of secondaries to the home treated primaries is markedly greater than it is in the case of the hospital treated primaries in the years 1901 and 1902, but the position is reversed in 1903. In 1901 the proportions are 12.4% and 6.4% respectively, in 1902 13.7% and 9.7%, and in 1903 3% and 7.2%.

The figures for the last year are explained as already stated by the fact that the cases left at home were selected on account of the absence of susceptibles or the large size of the houses.

In the previous years such selection was impossible owing to the absence of sufficient hospital accommodation, and the admission of cases was governed more by the wishes of parents, or desire to protect a certain district, etc. There appears to me to be no doubt whatever that this class of secondaries can be greatly reduced in number or even entirely got rid of by the use of hospital isolation.

A more definite indication of the relative success of home isolation or hospital isolation is obtained by comparing the attack-

rates among susceptible children in the houses from which the primary case is removed, on the one hand, and in the houses where the primary case is left at home, on the other.

During the year 1903 it was ascertained, at the time of the notification of any case or cases, how many children were living in the invaded house under 16 years of age, and not protected by a previous attack of the disease. The total number of these 'susceptibles' in the houses invaded during the year was 516. Of these 54 afterwards developed the disease, being 10.4% of the total. In those instances where the cases first notified were left at home, out of 77 'susceptibles' 10 developed scarlet fever, being a percentage of 13; whereas of 439 susceptible children in houses where the first case or cases were removed to hospital, only 10% developed the disease (including "return" cases). These figures show a distinct advantage in the adoption of hospital isolation over home isolation. This advantage is further accentuated when we take into consideration the relative accommodation in the houses from which cases were removed to hospital and in those where they were left at home.

The average size of house from which cases were removed was 3.15 rooms, whilst in the home-isolating houses it was 4.46 rooms. The average number in the family in the first class was 3.4, and in the second 2. In houses of over four rooms, where the case was removed to hospital, only 3.1% of the susceptibles were attacked, but when the case was kept at home 6.2% were attacked. In houses of four rooms or less the percentages attacked were 9.8 and 20 respectively. As the secondary cases notified simultaneously with the primaries, are excluded from these figures, it might be objected that in the houses availing themselves of hospital isolation there may be a larger proportion of such secondaries, and that this accounts for the smaller proportion of secondaries after notification. A priori, it would seem probable that in these small crowded houses the damage would largely be done before the notification of the primary case. But, as a matter of fact, the very reverse is true. The proportion of secondaries notifed simultaneously with the primary is greater in the

larger better-class houses relatively to the number of susceptibles present when the primary case developed. In the year 1903 29 secondaries were notified along with the 194 primaries removed to hospital; whilst 9 secondaries were notified along with the 85 primaries which stayed at home. Thus where in the hospital protected families 29 of 468 susceptibles had already developed the disease when the first case was notified, being 6%, actually 9 out of 86 susceptibles, 10%, had already developed in those instances where the cases were kept at home.

If we contrast the total susceptibles attacked in families where hospital isolation is made use of and in those where it is not, we find that in the first class 15.6% of susceptibles are attacked, and in the second class 22% are attacked.

The number of the secondaries occurring after notification in houses from which the primary was removed would have been still less, had it not been that in 3 instances the actual primary case was overlookdd to begin with, and was the last of those affected to be removed to hospital. These overlooked cases gave rise to 13 of the 38 secondaries, or about a third of the total. Such occurrences should be avoided by a systematic examination of all members of the family at the time of the removal of the first notified case.

Return Cases: Before leaving the subject of the spread of the disease in individual houses, it is requisite to deal more particularly with that class of secondaries which are termed return cases. Definition: By "return" case one really means a case that has been infected by a convalescent discharged from hospital. It is, however, frequently a very difficult matter indeed to be absolutely sure that the discharged convalescent is the actual source of infection. Fresh cases may crop up in a house from other causes. One occasionally gets proof of this in the notification of a second case in a house a day or two before the discharge of the primary case. Even where the second case occurs within a short period of the discharge from hospital of the first, the source of the infection may be other than the convalescent. It may be that some articles, toys, clothing, or what not, have been held back from disinfection, or the germs of the disease may have clung to some part of the house. This latter possibility is, I consider, deserving of more consideration than appears usually to be given to it, and I shall deal with it further under the subject of recrudescence of the disease. After the discharge of the convalescent from hospital, a fresh case may be notified within a week, a month, three or four months, a year, or later. The convalescent can only reasonably be blamed for what occurs within a comparatively short period. His infectivity, if present at all, will as a rule be greatest at the time of his discharge, and will thereafter diminish, although sometimes the occurrence of certain complications after he reaches home, such as rhinorrhoea, or otorrhea, may explain a deferred infectivity. The maximum interval between the discharge of a convalescent and the onset of illness in another member of the household, which can come under the definition of a return case has been somewhat arbitrarily fixed at one month (vide Dr Simpson report for Metropolitan Asylums' Board.) I take this as the standard, although personally I think it is unduly long and that fourteen days would be more correct. Home return cases. Return cases have been spoken of as only occurring after hospital isolation, but I have had ample evidence that this is a mistake. In a number of instances I

have observed that after the release from home quarantine of a scarlet fever case other members of the family developed the disease within the prescribed period. During the year 1903 there were 3 such cases, compared with 17 hospital return cases. The percentage of susceptibles, who became return cases was 4 in the houses practising home isolation, and 3.8 in those utilising hospital isolation. In the year 1902 there were 8 home-return cases, and 33 hospital return cases. As I have not figures showing the numbers of susceptibles for that year I cannot compare the attack-rates in the two groups, but the figures show that home return cases are by no means uncommon. This is what I think one might expect when the condition of isolation in the two classes are looked into. A hospital treated case is provided, in a well managed hospital with 2,000 cubic feet of air-space. The ward in which he is treated is well ventilated, and free access of sunlight is permitted. After the first three weeks or so of his illness he is allowed outside into the fresh air, and has opportunities of taking proper exercise, his diet is carefully attended to and is ample and suitable. His period of isolation is determined by a medical superintendent who is not subject to the pressure so frequently brought to bear by parents or friends upon the private medical attendant, and there is not therefore so great a risk of it being unduly abbreviated. A home treated case on the other hand is, with the rarest exceptions, confined to one room during the whole period of quarantine, and very often the cubic capacity of such room is under 2,000 cubic feet. He has no opportunity of taking exercise in the open air; ventilation of the sick-room and the admission of sunlight are probably less carefully attended to than in a hospital, and the feeding of the patient is probably less judicious, and amongst the poor even insufficient. As noted above there is apt to be a premature release from quarantine. The only disadvantage from which the hospital treated case suffers is that it is associated with other patients or convalescents, and unquestionably that is to some extent a drawback, which may however be lessened or perhaps entirely removed by the grouping

of cases of different types and stages and their separation from others. The following table shows the intervals which elapsed between the occurrence of home return cases and the release of the corresponding primaries, in the years 1901-1903:-

Date of Notification of Primary	Date of Release of primary	Date of Notification of Return	Interval in days
1901			
May 31st	July 12	August 10th	29
July 27th	August 29th	Sept 25th	27
July 24th	Sept 27th	Oct. 10th	13
Aug. 30th	Oct. 14th	Oct. 24th	10
Sept. 2nd	Oct. 11th	Nov. 2nd	22
Sept 14th	Nov. 6th	Nov. 21st	15
Nov. 16th	Dec. 16th	Dec. 31st	15
Oct. 27th	Dec. 7th	Jan. 2nd	26
Dec. 27th	Jan 21st	Jan 23rd	2
1902			
Jan 1st	Feb 3rd	5th Feb	2
Jan 11th	Feb 17th	Feb 25th	8
Jan 24th	Mch. 25th	Apl. 13th	19
Apl 30th	June 4th	June 22nd	18
Oct. 21st	Nov. 27th	Dec. 1st	4
1903			
Feb 28th	Apl 6th	Apl 15th	9
Feb 25th	Mch. 30th	Apl 18th	19
Apl 15th	May 16th	June 9th	24

Causes of Return Cases: What are the causes which lead to return cases? Professor Simpson in his enquiry for the Metropolitan Asylums'Board deals with 90 scarlet fever convalescents discharged from hospital and giving rise to return cases by personal infection. 54 of these were suffering from discharges from the nose or sore nose, 3 were desquamating, 7 were suffering from throat symptoms and enlarged glands, 20 from colds, and only 3 appeared healthy at the time of examination. There is every probability that the last 3 had suffered from similar affections to those seen in the remainder, which had passed off previous to examination. My own observations of the condition of convalescents giving rise to return cases largely revealed similar symptoms to those mentioned. The following facts were noted regarding convalescents suspected of giving rise to return cases in 1903:-

TABLE E.

Case	PRIMARY CASE				Days between arrival home of Primary and onset of illness of Return	RETURN CASE		Remarks.
	Days in Hosp	Features of Illness	Condition on leaving Hospital	Condition when Return Notified.		Features of Illness	Days in Hosp	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	49	Case of Average sev-erity, complicated by rhinorrhoea, which ceased some days be-fore she left hosp.	Appeared perfectly well	Slight rhinorrhoea	5	Severe attack with abscess of cervical glands	56	
2	70	Average severity	Slight sore nostril	Sores at nostril	12	Average severity	Home 60 treat-ed	2nd case was away from home when 1st re-turned & only home 4 days when attacked
3	73	Severe case, marked throat symptoms	Appeared perfectly well	Throat much congest-ed, streptococci present	3	Severe attack marked throat symptoms	55	
4	35	Average severity complicated with otorrhoea and en-larged cervical glands	Appeared perfectly well	Well	9	Very severe, throat symptoms marked: otorrhoea, erysipelas bronchial symptoms	54	mother stated that after 1st case came home he had sore throat & en-larged glands
5	25	Ill 3 weeks before admission. Had neph-ritis when admitted No desquamn. or other symptoms during stay in hospital	Appeared perfectly well	Slight congestion of Pharynx	9	Very mild	Home treated 38 days isolated	Mother stated that primary had sores on face after she came home
6	56	Severe attack throat symptoms marked	Throat slightly con-gested	Apparently quite normal	10	Average severity with enlargement of cervical glands	52	Mother stated that 1st case had nasal dis-charge after return home
7	45	Average severity complicated with rhinorrhoea	Appeared perfectly well	Perfectly well	4	Average severity, no complications	46	Mother stated that 1st case was 'feverish' & had rash 2days after return home
8	56	Very severe attack glandular abscess	Appeared well except for boil	Old boil on leg, otherwise normal	3	Mild attack	50	
9	38	Mild case	Slight glandular en-largement & post-nasal discharge	Slight rhinorrhoea	3	Average severity, no complications	55	Post nasal dis-charge became pre-nasal after Primary return-ed home
10	36	Average severity	Throat slightly congested	Slight congestion of pharynx	9	Died. Angina maligna, rhinorrhoea, haemorr-hage	..	
11	48	Average severity with slight otorr'a	Quite well	Well	4	Average severity	57	Case of 'diph-theria' notified at this house a few months before.
12	56	Mild attack, complic-ated with otorrh'a	Well. Otorrhoea absent for 12 days	Otorrhoea	16	Mild attack, slight sores at nostril	39	Otorrhoea started again 2 days after 1st case got home
13	60	Severe attack, gland-ular abscess, sug-gestive of tubercul-ar mischief	Small sinus in neck still open	Sinus closed. Well	6	2 cases, 1 with ne-phritis severe, 1 out again over	one 49, other 92	
14	56	Average severity, uncomplicated.	Quite well	Well	27	Mild; complicated with eczema	54	Primary case was 5 days ill before removed
15	42	Average severity, uncomplicated.	Well	Well	24	Average severity, uncomplicated.	45	Primary case was 7 days ill before removed.
16	44	Average severity, uncomplicated.	Well	Abscess in arm dis-charging	27	Average severity, sores about nose only complication.	45	The abscesss developed a fortnight after Primary got home
17	40	Severe attack, throat symptoms marked, glandular swelling, & slight post-nasal discharge.	Slight post-nasal discharge	Quite well.	28	Average severity, slight nasal dis-charge, & slight sores on face.	42	Mother said Primary case had been per-fectly well since came home.
18	56	2 cases. Average severity. One had slight sores at nostrils, and epist-axia.	Quite well.	Quite well.	22	Died 4 days after admission. Angina maligna.	..	Previous re-currence of the disease in this house. Vide below.
19	76	2 cases. Desquamat-ing on admission. One had a relapse, average severity uncomplicated.	Well	Well	25	Average severity, with nephritis.	50	Possibly house infection pro-duced before re-moval of Primaries.
20	42	Average severity, complicated with old-standing chronic inflammation of lachrymal duct. Ab-scess on cheek from this source opened during stay in hosp.	Dishcarging sinus on cheek.	Well	35	Mild attack.	56	This is the same house & family as case 18.
21	46	Average severity, complicated abscess on shoulder due to accident before admission.	Perfectly well, abscess healed.	Well.	35	Mild attack.	38	The first case removed was secondary to a doubtful case kept at home. No dis-infection of rooms had been carried out owing to ex-pected confine-ment of mother.

The 21 instances comprised in the foregoing table include 6 arising after the discharge of patients admitted in 1902. The remainder were associated with the discharge of patients admitted during 1903. I have arranged them in three groups according to the length of the interval which separated the discharge of the primary case and the onset of illness of the return cases. If we accept the definition of return case given above, as one in which the onset of illness occurs within one month of discharge of the primary, the last two cases in the table do not come under the classification. It will, however, be seen from the table that the line which separates them from the second group is a purely arbitrary one. On the other hand, I contend that there is a well-marked distinction between the cases arranged in the first group and those in the second. In the first group, comprising 13 cases, the interval referred to varies from 3 to 16 days, and the average is 7.1 days. In the second group the interval varies from 22 to 28 days, and the average is 25.5 days. As regards the condition of the primary case, in the first group 6 out of 13, being nearly 50%, showed some slight abnormality at the time they were discharged from hospital, and 10 out of 13 showed some abnormality, either at time of discharge or at time of notification of return case, whilst in 2 of the remaining 3, the parents reported intervening illness: in the second group only 1 out of 6 showed any abnormality on leaving the hospital, namely a slight post-nasal discharge, 1 other had an abscess in the arm after she returned home, and with this exception all the primary cases appeared perfectly normal at the time of the notification of the return, and the parents reported them as having been perfectly well since they had returned home. In my opinion the first group only should be classed as return cases in the sense that the infection is conveyed directly from the convalescent to the other members of the family. In the second group I consider that although no positive evidence was forthcoming the facts point fairly conclusively to the recrudescence of infection from articles in the house or the house itself. Instances 20 and 21 are still more

conclusively of this nature. These last two groups should, then, in my opinion, be classed together with the recrudescences of the disease which occur at still longer intervals, of six months, a year or more, with which I shall presently deal.

Taking the first 13 instances as examples of true 'return' cases, one may note that in the majority some abnormal condition of the throat or nose appeared to be the source of the mischief. In one instance a relapse appeared to have taken place: in no instance was desquamation present. A point of some importance is the large proportion-5 out of 21-of severe attacks among the primary cases. Their average stay in hospital was 49 days. It has been remarked that return cases most frequently follow primaries which have spent an exceptionally long time in the hospital, but I do not think it has been sufficiently emphasised that this lengthy stay has been in consequence of the severe nature of the illness, a severity in the great majority well marked at the time of their admission. As regards the nature of the attack in the return case, if we take the whole 21 instances which comprise 23 persons, we find that there were two deaths, and that including these there were 6 of exceptional severity. The proportion of severe attacks in the primary cases, which were supposed to have produced return cases, and in the return cases themselves, is very nearly the same, viz., 23.8% in the first and 26% in the second. The case-mortality of return cases was equal to 8.7%, whilst the case-mortality of all cases notified during 1903, was 3.2%. If, however, only the group which I have regarded as true return cases be taken we get a case-mortality of 7.1% for the return cases. Taking for the purposes of this comparison the three years 1901-1903 and contrasting the return cases (as defined under 1 month) with the total cases notified, we find that out of 81 return cases 4 died giving a case-mortality of 4.9%, whilst the general case-mortality was 4.4%.

I consider the figures and facts which I have cited go some way to disprove two statements, which are frequently made by the

opponents of hospital isolation, namely, (1) that return cases are of an exceptionally severe type, (2) that such severity of type is due to the effect of incarceration in a hospital causing a mild and benignant primary case to assume a severe type, and making it capable of, and even apt to pass on the disease with an exalted virulence to another member of the family. These figures show the case-mortality of return cases during the three years 1901-1903 to be little above that of the total cases for the same years. They also show that the primary cases which produced them were themselves of a severe type. I consider that the risk and likelihood of a convalescent giving rise to a return case is much more a matter of personal idiosyncrasy and of the nature of the attack from which he has suffered than it is of the form of quarantine to which he has been subjected. This statement is borne out by the facts cited above that the proportion of return cases is almost identical whether the primary be treated at home or in hospital. With regard to idiosyncrasy it is interesting to note that return cases are peculiarly apt to occur in certain families. In one family, the discharge of three different members was in each case followed by a return. ~~belonged to a family.~~

The facts detailed in Table $\mathcal{E}$, point to the presence of some abnormal condition in the convalescent as necessary to his power of producing fresh cases. The possibility of a perfectly healthy convalescent, who has been living with others, suffering from various sequelae of the disease, being able to act simply as a carrier of the disease is asserted by some writers. My own observations do not support this view, and I believe that some abnormal condition is always present in a convalescent who gives rise to a return case.

Summing up the evidence regarding the spread of the disease in invaded houses, I find that (1) the disease appears to be highly infectious in its earliest stages, as evidenced by the large proportion of secondaries notified simultaneously with the primary cases, or within seven days of the notification of the latter. (2) That the case remains infectious throughout the

illness, as shown by the late occurring secondaries, where the primary case is kept at home. (3) that it is difficult to exactly affirm the non-infectiousness of any individual convalescent, and that the infection appears to linger in the nasal-pharyngeal mucous membrane, particularly where the case has been a severe one, this tendency being particularly marked in special families. (4) that hospital isolation of cases occurring in houses of 4 rooms or less, limits the spread of the disease in the house, the number of susceptibles attacked being reduced; (5) that return cases due to infectivity of discharged convalescents occur after both home and hospital isolation.

Whilst considering that infection in this disease is chiefly conveyed from the nasal-pharyngeal tract, I am of opinion that the desquamating particles of the cuticle also act as carriers of the infection. I have frequently observed in the case of mild overlooked attacks recognised later on by the occurrence of secondary cases that no abnormal condition of the naso-pharynx was apparent whilst desquamation was well marked. On the other hand, it does appear that desquamation continuing or appearing a month or more from the commencement of the illness has little, if any infectivity.

Recrudescence of the Disease in Individual Houses.

From the consideration of return cases one naturally passes to the question of recrudescence of the disease in the same house after longer intervals of time. The term return case has been limited to those cases occurring within a month after the release of the primary from quarantine-whether such quarantine be at home or in hospital. The term recrudescence I would apply to the reappearance of the disease in a house after longer intervals of time. I have on a number of occasions noticed such fresh outbreaks of the disease in individual houses after periods varying from 2 or 3 months to a couple of years, sometimes in the same family and sometimes in the family of a new tenant recently come into the house. With the view of obtaining data regarding the question of the importance of this factor in producing the endemicity of the disease in this Borough, the notifications of all cases of scarlet fever made since the adoption of the Notific- Act in 1892 have been tabulated, leaving out of account such cases as fall under the heads of secondary or return. I have for the purposes of this investigation excluded cases occurring in the small area which was annexed to the Borough at the end of the year 1901, as I have no information regarding the occurrence of cases in the houses therein during the greater portion of the period considered. During the 12 years 1892-1903 the total number of dwellings in the Borough has increased from 17,100 to 22,474, giving an average of 19,787. During the same period 4,376 of these dwellings were invaded by scarlet fever, being 22 % of the average, 712 were invaded twice or oftener, being 3.6 % of the average, and 16.2% of the total invaded, and 93 were invaded oftener than twice, being .47 % of the average and 2.1% of the total invaded. The total number of recrudescences which took place was 803, constituting 15.5% of the total primary cases, and they occurred after the following intervals of time:-

From 3 to 6 months	75
" 6 months to 1 year	93
" 1 year to 2 years	166
" 2 years to 3	109
" 3 " " 4	78
" 4 " " 5	98
" 5 " " 6	74
" 6 " " 12	111

It is naturally a difficult matter to decide to what extent recrudescence of the disease in a particular house is due to the stirring up of infectious material therein, and how many instances of recrudescence are due to a chance re-introduction of the disease from without by personal infection; but I think that these figures show a number of recrudescences considerably greater than would arise simply from the action of chance, especially those occurring within the shorter period. Where infection clings to a house one would expect that it would show itself within a comparatively short period, say within two years. Recrudescence occurring after a long interval would appear more probably due to a chance re-invasion. This is of course not an invariable rule, as the infecting material might lie dormant for a long period owing to the absence of susceptible subjects. It is interesting to note in this connection how frequently one finds in sporadic cases of scarlet fever that the patient's family have only shortly entered into the tenancy of the house. In the family of the preceding tenant all those susceptible to the disease may have suffered some considerable time before and there may latterly have been no cases in the family. Again one would expect that in the case of an infected house, not one but many recrudescences would be the rule. Of the 712 houses in which recrudescence took place during the period under review, there are however only 83 in which it occurred twice, and 10 in which it occurred oftener. There is therefore no evidence of the existence of houses so saturated with the infection that it is not comparatively easily got rid of by ordinary process of disinfection. In order to determine exactly the relative frequency of early and late recrudescence it is necessary to ignore those occurring after a period of 6 years, or more, inasmuch as such can only be noted for the last 5 years of the 12 under consideration; it is also necessary to limit the comparison to the recrudescences taking place in the 6 years 1898-1903, as it is only for these years that the data to hand are complete. In the earlier years, 1892-1897, cases notifed in

certain houses may really be recrudescences within less than six years, the preceding cases having occurred prior to the adoption of notification. During these six years I find that 494 recrudescences occurred at the following intervals:-

Between 3 & 6 months after previous case	43
" 6 months and 1 year	53
" 1 year & 2 years	103
" 2 years " 3 "	73
" 3 " " 4 "	65
" 4 " " 5 "	87
" 5 " " 6 "	70

These figures show a distinct though not a great fall in the frequency of recrudescence after increased intervals of time. If such recrudescence were mainly due to chance re-introduction of infection from without, I think it will be conceded that such re-introduction would become more probable as the interval of time was increased. I think, therefore, that the figures point to the fact that recrudescences are only in small part due to chance fresh invasions, and that the infection of scarlet fever is apt to linger in a house which has once been infected. It must be borne in mind that I have excluded from consideration, so far, all secondary and return cases, but as already pointed out, return cases occurring several weeks after the discharge from hospital or release from home isolation of a primary case may be attributed more reasonably to house infection than to personal infection; and again secondary cases which occur more than seven days after removal to hospital of a primary are very probably accounted for in the same way. If these cases be added to those classed above, as recrudescences occurring between 3 and 6 months, the number of the latter will be materially increased, and the higher proportion of recrudescences occurring after a short interval will become even more marked. As regards the precise source of infection in houses, in which recrudescence takes place, it is impossible to dogmatise. No microbe has so far been satisfactorily demonstrated to be the cause of the disease. We may lay the blame on infected clothing or bedding, on infected toys or books, and undoubtedly all these are capable of harbouring the infection, and every sanitary official is aware how apt the householder is to hold back

some article which may have been exposed to infection. In most cases, however, it is impossible in enquiring into the origin of cases, secondary, return or recrudescent, to obtain an admission of the fact that such articles have been withheld or to fix the article which can be blamed. In addition to the retention of infection by moveable articles, however, I believe that the infection is apt to cling, perhaps even more frequently, to the actual structure of a house, in various nooks and crannies, to the old paper on the walls, between the boards of the floor, etc. The importance of this seat of infection is shown by the somewhat frequent recrudescences of scarlet fever in a house when a new tenant moves in, or within a month or two of this entry. Here everything soft and moveable has been removed, so there is no question of infection from that source. On the other hand, very probably with the carrying out of cleansing operations old dust and dirt is disturbed, and the dormant germs of scarlet fever may be awakened to life.

During the year 1903 out of 43 recrudescences, 26 were in the families of the same tenant, and 17 were in the families of new tenants.

But apart from instances where the notification book shows the previous existence of the disease in an invaded house, one cannot help being struck with the number of instances in which sporadic cases occur in families shortly after their entry into a house. Knowing how mild scarlet fever is apt to be and how frequently it may be overlooked I am inclined to attribute these cases to the infection left by a previous tenant, in whose family a mild overlooked case had occurred.

During the last five months it has been noted for each case of scarlet fever how long the family have occupied their present house, and up to the end of May, 1904, out of 82 primary cases notified, the families affected had resided in their present houses for the following periods:-

Less than 6 months	11
6 months to 2 years	21
over 2 years	50

With regard to the effect of hospital isolation in preventing recrudescence of the disease, I may give the following figures. There were 515 recrudescences after previous home-treated cases, and 289 recrudescences after hospital treated cases. Of the houses invaded during the 12 years, in 2676 the primary case was kept at home, and in 1688 it was sent to hospital.

The recrudescences therefore form 19.2% where the previous case was not removed, and 17.1% where it was removed.

Removal to hospital of a primary case does therefore appear to lessen the chance of recrudescence, although not to a very great extent. It may however be remarked that the propprtion of recrudescences occurring within six months, that is those which probably include fewest chance re-invasions, is decidedly smaller where the primary case has been sent to hospital than where it has been kept at home.

During the years 1892-1903, recrudescence took place within six months in 1.4% of the houses where hospital isolation had been utilised, and in 1.8% where home isolation had been carried out. In the last six years the difference is even more striking, the figures being 2.3% and 1.1% respectively.

Summing up the facts which I have given above regarding the reappearance of this disease in individual houses at varying intervals of time, I would say that such reappearances are largely due to the stirring up of dormant infectious material, the presence of which is attributable to imperfect methods of disinfection.

The actual number of cases which come under the head of 'recrudescent' is no measure, it seems to me, of the importance of such infected houses as factors in maintaining the continued presence of the disease in a town, and causing it to be endemic. From cases arising from house infection the disease may rapidly spread by the commoner channels of personal infection to susceptible persons in neighbouring houses and in school. Owing to the high degree of infectivity of scarlet fever in its earliest stages, one case is very apt to have given rise to many of its kind before measures of isolation of however satisfactory a nature are brought into play.

Spread of the disease in Districts and Generally through the town.

As regards the manner in which scarlet fever spreads in any house which has been invaded, one is in a position to speak with considerable certainty; the infecting source is known, and the circumstances which favour or retard the passage of the infection to other members of the household can be accurately studied.

In the case of the spread of the disease from one house to another, and throughout a district, it is quite otherwise. In by far the majority of primary cases it is impossible to prove any contact with a preceding case; the affected persons are too young to supply the requisite information as to their move-ments or their associates; many possible sources of infection are open and it is difficult to single out the correct one.

It is however clear that the disease can only be properly dealt with when the conditions which affect its spread, and the channels by which such spread takes place, are properly appreciated. The problem is somewhat complex, and various factors must be considered as playing a part: the season of the year and meteorological conditions generally have a well marked influence in promoting or retarding the spread; the presence in the town generally or in special districts of excessive numbers of persons susceptible to the disease will naturally favour the spread, and the reverse conditions retard it; those factors which are responsible for the endemicity of the disease whether they be physical, as natural situation, or nature of subsoil,etc.,or climatic, or social and industrial, as crowding of the population in rooms and in areas,etc., will also exercise an influence in producing epidemic waves and the wide diffusion of the disease. As regards the actual channels of infection.-During the epidemic here in the years 1901-1902 the disease, starting from two small areas, gradually spread over the whole town, one ward after another becoming particularly affected. When special streets or small areas were watched by means of spot maps, one could observe how the invasion of one house in a hitherto unaffected area was soon followed by a series of others in the immediate vicinity. I was strongly impressed with the importance of this house-to-

house infection. On the other hand the schools which form the other point of contact for the susceptible population, appeared to me to play quite a subordinate part in the spread of the disease. This was shown by the large proportion of primary cases which occurred in the persons of children not attending school, and by the absence of association in the same class of cases occurring about the same time.

The fact that a child suffering from scarlet fever is in most cases withdrawn from school at the very commencement of the illness, and that as soon as the case is notified, or possibly even earlier, the other children in the family are also kept away from school probably explains this comparatively small part which the schools play in the spread of this disease.

On the other hand, what happens in and near the home of the sick child? In many cases for a day or two after the onset of illness medical advice is not sought; neighbours and friends come into the house to give their advice regarding the nature of the illness, and very frequently they bring their own children with them. Even after medical advice has been sought, the case has been notified, and instructions regarding isolation have been issued, there are still, especially where the case is not removed to hospital, many circumstances which favour the spread of the disease to other houses in the neighbourhood: visits of neighbours are apt to continue; the children of the household who are still themselves apparently well are mixing freely with their playmates in the neighbourhood: it may be that these children are suffering from the disease in its initial stages, and shortly after develop well-marked attacks; or perhaps which is of greater importance in favouring the spread of the disease they may, protected by a previous attack or by natural insusceptibility, be yet capable of carrying the infection on their persons or clothing, or be suffering from slight sore throat of scarlatinal nature capable of infecting others with true scarlatina.

The map which accompanies this paper shows the town divided (a) into 10 wards, (b) into 80 enumeration districts.

A comparison of the prevalence of the disease during the

three years, 1901-1903, in the several wards and in the different enumeration districts, has been made, and is epitomised in the accompanying tables. At the time of the 1901 Census full details regarding the populations of the enumeration districts were obtained, and the increase of population for each district during the years 1902 and 1903 has been estimated by the number of new houses erected in each. It has not so far been found possible to estimate the populations for the years prior to 1901, and it has therefore been necessary to limit the comparison to the three years mentioned. This may however be regarded as a pretty fair test, as during that period there were altogether 2475 cases notified, and it includes the rise and fall of an epidemic and more than a twelvemonth following.

Table 7, in which the wards are compared as regards attack-rates and death-rates, and the extent to which hospital isolation was made use of, brings out the following facts:-

(1) that the three wards (Shields, St Hilda & Holborn) with the lowest average attack-rate for the whole period under consideration, were also the three in which the largest proportion of cases were sent to hospital;

(2) that of the next three best isolators (Laygate, Tyne Dock & Rekendyke) two come respectively 4th and 5th lowest as far as attack-rate is concerned, whilst the last group, isolating only 40 to 50% of cases, includes Westoe Ward with much the highest attack-rate and only one (Bents Ward) with an attack-rate of less than 8 per 1,000, which is the rate for the Borough as a whole.

(3) The fall in the attack-rate from 1901 to 1903 is relatively greatest in Laygate and Rekendyke Wards, where hospital isolation was most vigorously carried out during the latter part of the period. These two wards occupy the 7th and 9th positions in 1901, but in 1903 they occupy the 3rd and 4th, and their averages for the three years come 5th and 8th.

As the wards are not natural divisions and comprise districts varying greatly, both topographically and socially, the various factors which favour or retard the spread of scarlet fever cannot be indicated by the varying proportion of cases which occur in them. One factor besides the question of isolation can be accurately gauged for each ward and that is the proportion of children to the total population of the ward, as shown in Table 9.F In 1901 I found that over 92% of the cases occurred in children under 15. The comparatively low proportion of children in the Bents and Tyne Dock Wards no doubt partly accounts for their favourable position;

the exceptional position of the Bents Ward as having a comparatively low attack-rate (6th lowest) with only a small proportion of cases sent to hospital is partly explained by this circumstance.

So far as it goes then, the comparison of the wards indicates that the isolation in hospital of a high percentage of cases assists in limiting the spread of the disease. It must, however, be admitted that, the comparison being made between areas differing in so many other circumstances besides that of hospital isolation, the figures do not form in themselves a proof of the value of such isolation. On the other hand, I consider that they do largely disprove the statements, cited at the beginning of this thesis, that hospital isolation favours the spread of the disease in the localities to which it is applied. If discharged hospital convalescents were such potent agents in spreading infection as has been maintained it would be in the neighbourhood of their own homes that most damage would be apparent. The figures in Table G conclusively prove that 70 to 80% of cases in a district can be removed to hospital during a considerable period, and such district remain in a highly favourable position as regards attack-rate and death-rate from this disease. The figures regarding Laygate and Rekendyke Wards in the various years form a more positive proof of the value of hospital isolation. It is shown in the table that the death-rates in most part correspond with the attack-rates. In the case, however, of the Beacon Ward the death-rate is disproportionately large, whilst in Laygate it is the reverse. As regards the last mentioned, it is of interest to note that the case-mortality in 1901 was 8%; in 1902 it was 13.3%, and in 1903 it was nil. The general death-rates in the wards for 1902-1903 are also given in the table, and it will be noted that they place the wards in a very different order from that which they hold in virtue of their scarlet fever rates.

Table 7, showing Incidence of Scarlet Fever on different Wards of South Shields, during the years 1901 to 1903.

Wards	Shields	St. Hilda	Holborn	Beacon	Bents	Westoe	Laygate	Rekendyke	Deans	Tyne Dock	Whole Borough
Attackrate, 1901	9.3	8.9	8.4	15.3	9.3	19.0	13.8	16.9	13.1	9.0	12.5
" 1902	4.2	4.8	4.8	6.8	10.6	10.8	6.8	9.0	11.5	6.3	8.0
" 1903	2.2	3.5	2.5	4.8	3.6	5.5	2.6	2.8	3.4	3.4	3.6
Av'ge " 1901-03	5.3	5.8	5.2	9.0	7.9	11.8	7.7	9.0	9.3	6.1	8.0
% of cases to Hosp 1901	50	42	56	41	34	30	34	35	37	35	39
" " " " "1902	72	92	66	42	44	44	58	43	41	53	48.9
" " " " "1903	90	95	95	47	53	60	88	93	63	89	71
Avge. do. 1901-03	70	76	72	43	43	44	60	57	47	59	52.9
% Popn. under 15	37	36	36	35	32	37	40	38	39	33	34
Av. Sc.Fever death-rate 1901-3	,29	.126	.146	.16	.33	.736	.67	.373	.366	.193	.36
Av.General Death-rate 1902-3	22.2	23.7	24.1	15.4	15.5	14.4	22.7	17.0	16.3	17.6	18.2

Table G.

Attack-rates from Scarlet Fever in the Enumeration Districts of South Shields during the three years, 1901 to 1903.

District	Average Houses	Average Population	% childn. under 15	Corrected Attack-rate % houses	Crude attack-rate	Proportion of tenements of less than 5 rooms	Persons per room	% to Hosp.
						per cent		
1 Holborn 54	243	1176	31	0	0	86	2.22	
2 Shields 20 &24	129	540	30	1.8	1,5	83	1.70	80
3 Tynedock 74	301	1277	39	2.4	2.6	90	1.86	62
4 Shields 15	289	1223	40	2.5	2.7	98	2.15	65
5 Holborn 56-57	319	1391	37	3.1	3.1	96	2.06	50
6 Hilda 24	251	1002	31	3.2	2.7	86	1.95	71
7 Laygate 48	261	1164	39	3.2	3.4	93	1.87	66
8 Shields 17	241	832	32	3.3	2.9	92	2.08	57
9 Laygate 50	200	836	38	3.4	3.5	98	1.99	71
10 Laygate 52	239	1037	40	3.4	3.7	95	2.29	66
11 Shields 18	245	1119	26	3.7	2.8	89	2.05	71
12 Shields 19	257	1010	37	3,7	3.7	99	2.4	77
13 Shields 16	289	1049	36	3.9	3.8	95	1.95	54
14 Hilda 20-21	304	1308	36	4.0	3.9	90	1.81	83
15 Holborn 53	272	1217	37	4.0	4.0	93	2.43	90
16 Beacon 8	157	727	37	4.4	4.4	91	.59	71
17 Deans 35	198	922	43	4.7	5.5	89	1.73	54
18 Rekendyke 63	278	1268	38	4.8	5.0	93	1.83	64
19 Tynedock 75	294	1285	35	4.9	4.7	80	1.52	50
20 Bents 4,5,22	407	1684	33	4.9	4.4	85	1.69	68
21 Holborn 55	266	1145	34	4.9	4.5	90	2.14	100
22 Rekendyke 61	291	1306	37	5.1	5.1	90	1.71	66
23 Deans 76	118	535	35	5.2	5.0	38	.97	33
24 Tynedock 80	199	941	39	5.2	5.5	88	1.85	81
25 Rekendyke 64	221	1154	42	5.5	6.3	96	1.81	35
26 Hilda 25	307	1371	31	5.7	4.8	61	1.68	66
27 Deans 68	217	1027	44	5.8	6.9	83	1.83	53
28 Deans 69	210	1082	38	5.9	6.1	84	2,13	76
29 Rekendyke 62	292	1371	39	6.1	6.5	92	1.82	57
30 Bents 27	239	972	32	6.2	5.4	66	1.06	38
31 Hilda 44	255	1087	42	6.3	7.2	96	2.18	70
32 Deans 70	299	1328	38	6.4	6.6	96	1.46	25
33 Laygate 51	188	913	44	6.6	7.9	100	2.44	73
34 Deans 67	429	1828	40	6.6	7.2	90	1.58	32
35 Tynedock 79	220	1019	36	6.9	6.8	74	1.4	46
36 Hilda 45	111	518	43	6.9	8.1	98	2.19	55
37 Beacon 7	198	883	40	6.9	7.5	89	1.55	46
38 Bents 3	342	1531	32	7.0	6.1	66	1.42	38
39 Laygate 49	286	1277	37	7.3	7.3	86	1.78	66
40 Shields 14	290	1457	42	7.5	8.6	95	1.72	56
41 Bents 23	275	1216	34	7.5	6.9	80	1.47	68
42 Westoe 30	255	1133	34	7.6	7.0	60	1.25	16
43 Laygate 47	248	1040	37	7.6	7.6	95	1.83	73
44 Shields, 7,8,9	354	1761	36	7.8	9.8	93	1.88	37
45 Beacon 4	193	844	30	7.9	6.2	56	1.1	33
46 Rekendyke 58	138	597	39	8.1	8.6	94	1.72	41
48 Beacon 12	295	1300	34	8.3	7.7	93	1.43	43
47 Tynedock 77	249	1112	38	8.1	8.4	91	1.33	52
49 Beacon 6	285	1361	31	8.3	7.0	23	1.19	20
50 Rekendyke 58	209	1008	31	8.4	7.1	61	1.59	40
51 Laygate 42	265	1228	44	8.4	10.1	98	2.04	33
52 Tynedock 78	323	1386	37	8.6	8.6	82	1.31	35
53 Beacon 10	214	1007	40	8.6	9.3	86	1.94	50
54 Rekendyke 60	321	1422	41	8,6	9.6	97	1.69	51
55 Beacon 9	155	678	46	8.6	13.5	99	1.86	47
56 Tynedock 76	221	936	40	8.7	9.5	81	1.24	33
57 Rekendyke 65	207	1007	42	8.9	10.1	97	2.02	66
58 Beacon 5	234	997	29	9.1	7.2	54	1.15	17
59 Bents 2	272	1218	31	9.1	7.7	76	1.39	62
60 Westoe 32	294	1487	37	9.1	9.1	67	1.31	18
61 Deans 71	368	1593	40	9.2	10.0	93	1.5	37
62 Bents 26	224	1053	23	9.5	6.2	25	1.36	7
63 Holborn 46	295	1318	38	9.5	9.8	91	2.05	27
64 Rekendyke 72-73	206	929	39	95	10.1	96	1.68	42
65 Laygate 45	141	742	42	9.9	11.3	99	2.03	56
66 Westoe 33	291	1277	38	10.0	10.3	59	1.08	37
67 Beacon 13	230	1068	31	10.2	8.6	63	1.47	45
68 Westoe 38	302	1381	39	10.3	10.9	94	1.61	45
69 Westoe 39	314	1458	41	10.9	121	96	1.89	63
70 Deans 73	192	884	42	11.0	12.5	89	1.91	25
71 Deans 34	255	1140	32	11.2	9.7	41	1.18	38
72 Bents 28-29	435	2079	37	11.2	11.2	83	1.34	20
73 Westoe 31	314	1378	29	11.3	8.9	58	.98	35
74 Beacon 11	239	1455	39	11.8	12.5	93	1.89	26
75 Westoe 36	107	535	32	11.9	10.3	57	1.32	54
76 Westoe 37	273	1331	36	12.0	11.7	73	1.56	34
77 Bents 1	291	1211	30	12.2	9.9	47	.98	17
78 Laygate 43-44	327	1584	37	12.2	12.2	92	1.57	40
79 Deans 72	260	1370	38	12.2	12.6	91	1.41	51
80 Rekendyke 59	232	1093	37	12.5	12.5	81	1.4	24
81 Westoe 41	252	1227	37	13.0	13.0	70	1.36	36
82 Deans 66	306	1564	41	13.5	15.0	80	1.69	41
83 Westoe 29	136	616	37	13.9	13.9	46	1.57	26
84 Westoe 40	249	1268	44	14.1	16.8	99	1.83	38
85 Rekendyke 36	110	516	31	151	12.7	55	1.19	50
86 Holborn 69	88	429	34	15.9	14.7	86	2.45	92

Passing now to a comparison of the Enumeration Districts: There are altogether 80 of these, and most of them are entirely contained in one or other of the wards. There are, however, certain exceptions where an enumeration district lies partly in one ward and partly in another. In these cases the portion of the district in one ward may be, and in fact usually is, of quite a different character from the portion in the other. I have therefore considered it best to adhere to the ward boundary rather than the district boundary in these cases for the purpose of this comparison. The population of each enumeration district varies from 800 to 1,500; but in the case of these divided districts the populations of the parts is sometimes much smaller, and in order to avoid the fallacy arising from this circumstance in considering the attack-rate for such a short period as three years, it has appeared best to consider them along with the adjoining enumeration district in the ward to which they belong if, as is usually the case, such adjoining district is of similar character. One is then comparing districts with populations ranging from about 1,000 to 1,500, sufficiently large to minimise effects which are simply due to chance. In the comparison of the wards the total cases occurring have been considered, but in this comparison of enumeration districts I shall take into account only the primary cases as defined in a previous part of this paper.

The primary cases may either be reckoned per 1,000 of the population, or they may be indicated as a percentage of houses invaded. I have chosen the latter method, and I give for each district the percentage of houses invaded by scarlet fever during the three years 1901-1903. I consider that comparison of small districts is most fairly made by considering only primary cases, because if secondaries be taken into consideration the element of chance in the presence in an invaded house of a large number of susceptibles becomes too prominent.

I find that the proportions borne by the percentages of houses invaded in different districts to the rates per 1,000 of population are in most cases almost identical in this town, the number of persons in each dwelling being nearly uniform.

In the 86 enumeration districts and portions of districts arranged as mentioned above, the proportion of houses invaded varies very considerably. In one only were there no houses invaded; in the others the rate varies from 1.5% to 16.8%. I have compared these districts in the following respects (a) as regards age constitution; (b) as regards proportion of houses of less than 5 rooms; (c) as regards the population per room; (d) as regards the proportion of the primary cases removed to hospital. In all these respects they exhibit considerable differences.

With respect to age constitution, I find that whilst in the Borough generally 37% of the inhabitants are under 15 years of age, the proportion varies in the districts from 23 to 46%. Inasmuch as 92% of the cases occur in persons under 15 years of age, it is evident that such great differences in the age constitution of these districts must have a large share in determining their relative attack-rates. To be perfectly accurate, these rates should be corrected by the same method as is employed by the Registrar-General in correcting the death-rates of the great towns, viz., by finding the attack-rate which would obtain in any district if the number attacked at each age were the same as in the town as a whole, and from this standard rate obtain a correcting factor by which the actual rate could be multiplied. Leaving aside, however, this exact but laborious process, I think that an approximately correct result may be obtained by multiplying the actual rate by the per cent of children in the Borough as a whole and dividing by the per cent of children in the district. This means that the cases occurring in persons over 15 years of age are ignored, which I think is justifiable as the attack-rate of such persons is only 1/20th, of that on those under 15 years. (In 1901 the attack-rates in South Shields were 32.4 per 1,000 on children under 15 and 1.6 per 1,000 on persons over 15 years.)

Table G gives the 86 divisions arranged in the order of their corrected attack-rates and shows also the crude attack-rates, the average population and the average number of houses for the period 1901-1903, and particulars regarding the size of houses and the population per

room in each district. The number of persons per room can only be calculated so far as the houses of less than 5 rooms are concerned, as the census information that I am provided with does not give the sizes of the houses having 5 rooms or more. The poverty of a district is perhaps best gauged by the figures showing the population per room, and the strength of the working class element in any district will be pretty accurately indicated by the proportion which the number of houses of 4 rooms or less bears to the total number of houses. In the Borough as a whole 83% of the houses have less than 5 rooms, and the average population per room in these houses is 1.6 persons. In the various districts the proportion of houses of less than 5 rooms varies from 23% to 100%, whilst the persons per room in these houses varies from .59 to 2.45. In order to ascertain the effect on the prevalence of the disease of these factors, viz., the proportion of small houses and the room-crowding, in any district, one must eliminate as far as possible the other variable factor, i.e., the proportion of cases sent to hospital. If we compare the 31 districts in which less than 40% of the cases were sent to hospital, with respect to attack-rate and housing circumstances, we find that there does not seem to be any proportion between the attack-rate and the number of small houses in the district affected. A low proportion of small houses coincides with a high attack-rate just as frequently as it does the reverse. 14 of the 31 districts have an attack-rate of less than 9%, and their average proportion of houses of less than 5 rooms is 73%, whilst 17 with an attack-rate varying from 9 to 14% contain an average proportion of houses of less than 5 rooms of 68%. Again comparing the same 31 districts, I find that the average number of persons per room is 1.43 in the 14 with attack-rates of less than 9%, and 1.42 in the 17 with attack-rates of more than 9%, so that neither does this factor exert any apparent influence on the prevalence of disease in a district. If we compare the 26 districts in which from 41 to 60% of the cases were sent to hospital we get similar results: 11 of these with attack-rates of less than 8% have an average

proportion of small houses equal to 89%, and an average room population therein of 1.8 persons, whilst 16 districts with an attack-rate of more than 8% have an average proportion of small houses equal to 86%, and an average room population equal to 1.61 persons. Lastly, comparing the 28 districts, in which over 60% of the cases were removed to hospital, I find that 15 of these with attack-rates of less than 5% have an average proportion of small houses equal to 92%, and an average room population of therein of 1.9 persons, whilst 13 districts with attack-rates of more than 5% have an average proportion of small houses equal to 88%, and an average room population of also 1.9 persons.

We may therefore conclude that the size of a house in any district and the crowding of the population therein do not influence the spread ofthe disease from one house to another, and the differences in these respects may be ignored when comparing different districts as regards attack-rates and hospital isolation. I would here emphasise what has been set forth in another part of this paper that the size of house and overcrowding therein undoubtedly favour in a high degree the occurrence of secondary cases in an invaded house. It will be noted that although there is practicaaly no difference in respect of size of house and room population between districts of low attack-rates and those of high attack-rates in which hospital isolation is practised to an equal extent, that there is a considerable difference in these respects between the three groups of districts arranged according to the degree in which hospital isolation was practised. In the group were less than 40% of the cases were isolated, the small houses constitute 68 and 73%; in the group isolating 41 to 60% of cases, the small houses constitute 86 and 89%, and in the group isolating over 60% of cases such houses constitute 88 and 92%. Again in the first group the room populations are 1.42 and 1.43 persons, in the second 1.8 and 1.61, and in the third 1.9. This is ofcourse simply stating that hospital isolation is particularly applied to the poorest and most crowded districts of the town.

Effect of Hospital Isolation.- In Table G I have marked off 5 groups of districts. The first group comprises 21 districts in which less than 5% of the houses were invaded. Putting aside No.1 in which there were no cases, it will be seen that in all these districts 50% or more of the cases were sent to hospital. The average percentage of cases isolated was 68.7. The second group comprises 17 districts in which between 5% and 7% of the houses were invaded; here the proportion of cases sent to hospital varies from 25 to 81%, the average percentage isolated being 52.3. The third group comprises 19 districts in which 7.1 to 9% of the houses were invaded, the proportion of cases sent to hospital varies from 16 to 73% the average percentage isolated being 45.2. The fourth group comprises 13 districts in which 9.1 to 11% of the houses were invaded, the proportion of cases sent to hospital varied from 7 to 63%, the average percentage isolated being 37. The last group comprises 16 districts, in which more than 11% of the houses were invaded. Here the proportion of cases isolated varied from 17 to 92%, the average percentage isolated being 40.

These figures show a steady rise in the attack-rate coinciding with the fall in the proportion of cases isolated when the averages of a number of districts are taken. The only group which is an exception to the above statement is the last one, and that is owing to the figure for the 86th district in the list. It may be remarked that this is a small district, one of the portions of an enumeration district referred to above as lying in two wards, and which it has not been possible to tack on to any other district; the houses invaded are 1-roomed situated at the head of one common stair, and hence this district cannot fairly be compared with other districts of the town. There are, however, a considerable number of districts in which a high proportion of cases isolated coincides with a high attack-rate and vice-versa. Apart from the element of chance which must enter in when a small district is considered for a comparatively short period, such a result may arise either from the want of efficient isolation or the

special efficiency of the isolation in an adjoining district, or again from causes other than personal infection which favour or otherwise the endemicity of the disease. I do not, therefore, think that these few exceptional districts lessen the force of the argument reached by comparison of groups, as given above.

We may now compare groups of districts arranged in degree to the proportion of hospital isolation. Taking for this purpose the same groups that were used when considering the influence of the size of house and room population upon attack-rates, we have group A of 31 districts, isolating not more than 40% of cases, with an average percentage of houses invaded equal to 9.4: group B of 26 districts isolationg between 41 and 60% of cases, with an average percentage of houses invaded equal to 8.2: and group C of 28 districts isolating 61 to 100% of cases, with an average percentage of houses invaded equal to 4.8. Again the figures bear strong testimony to the value of hospital isolation, particularly when vigorously carried out.

In order to still further verify these results, I have taken 6 groups of districts, having various percentages of their cases isolated in hospital, and totalled up for each group the houses, populations and cases, and from these figures I have estimated the percentage of houses invaded and the attack-rate per 1,000 of the population. The first group comprises 15 districts, in which over 70% of the cases were isolated in hospital: the total population is 15,523, and the total number of houses is 3283: the attack-rate was 10 per 1,000 of population, and 4.7% of houses were invaded. The second group comprises 13 districts, in which 61 to 70% of the cases were hospital isolated, the total population is 16,380 and the total number of houses is 3,683; the attack-rate here was 13.7 per 1,000 of population, and 6.1% of houses were invaded. The third group comprises 13 districts, in which 51 to 60% of the cases were isolated in hospital, the total population is 13,752, and the total number of houses 2,955; the attack-rate was 17.3 per 1,000 and 8% of houses were invaded. The fourth group comprises 13 districts, in which 41 to 50% of the cases were sent to hospital, the total population is 18,632, and the total

number of houses is 2,987; the attack-rate here was 19.3 per 1,000 of the population, and 8.8% of the houses were invaded. The fifth group comprising 19 districts, with a population of 23,881 and containing 5,243 houses, in which between 31 and 40% of the cases were hospital isolated, had an attack-rate of 20.5 per 1,000 of the population, and 9.4% of the houses were invaded. The sixth and last group comprises 12 districts, having a population of 14,496 and containing 3,162 houses, in which less than 30% of the cases were hospital isolated, had an attack rate of 20.3 per 1,000 of the population, and the percentage of houses invaded was 9.3, the figures being almost identical with those of the preceding group. These figures are even more striking testimony of the effect of hospital isolation in limiting the spread of the disease in a district, and again it is seen that good results are only obtained when a high percentage of cases, 70 or at least 60%, are isolated.

It may be objected that the districts to which hospital isolation has been most freely applied are naturally less subject to attack by scarlet fever, and that this explains the benefits apparently derived from such isolation. It is, therefore, desirable to enquire what other common characteristics, besides a high degree of hospital isolation, are possessed by the districts with low attack-rates, and to what extent these characteristics distinguish them from districts with high attack-rates. As regards the 21 districts with less than 5% of houses invaded; this group includes almost all the districts in the town to which the term 'slum' is applicable, with perhaps half-a-dozen districts to which the term would not be applied and which entirely consist of small working-men's dwellings; there is only one district in the group in which poverty and dirt are not strongly evident: further, these districts, with the one exception mentioned, are all old property. In other respects they differ widely; some stand on high ground, old ballast hills, and are freely exposed to the winds; whilst others are built hardly above sea-level on an old bed of the river, by the river bank or far from it in the heart of the town. In

some of the districts the houses are crowded on to the land, whilst in others considerable open spaces intervene. The only common conditions apart from hospital isolation are, then, the features of poverty: this is also the feature which distinguishes them from the other groups of districts. In the second group there is one slum district; the rest are respectable working-class districts, with perhaps two in which a better class of property is found: the same varying conditions of elevation and exposure as well as of subsoil are found in this group. The next two groups are again chiefly respectable working class with a certain proportion of middle class element. The last group, in which over 11% of houses were invaded includes one slum district (69 Holborn), to which reference has already been made and otherwise comprises superior working class dwellings and middle class.

I do not find, therefore, that any of the natural features of a district have a large share in producing the differences in attack-rate. That poverty and dirt prevent the spread of the disease, will hardly I think be argued. Other infectious diseases, such as measles and whooping-cough, where no hospital isolation is practised, are much more prevalent in these districts than in the better quarters of the town. I therefore consider that the value of hospital isolation in diminishing the incidence of scarlet fever on a district is demonstrated by the figures I have given above. Hospital isolation of only 30 to 40% of the cases is not of much avail, in a working-class town at least, and it is necessary to isolate 70% or more in order to obtain good results.

The extent of the difference between the attack-rates in districts isolating over 70% of their cases and in those isolating less than 40% although very considerable, the figures being 10 per 1,000 and 20.3 per 1,000, respectively, does not completely show the benefit to be derived by the application of such a policy of hospital isolation to the whole town. I have, in this paper, treated the enumeration districts as distinct entities, but it is very apparent that the degree of incidence of the disease on any district will, whatever methods of isolation be used, be largely

affected by the prevalence in adjoining districts, and this fact must be borne in mind when drawing conclusions from a comparison of district attack-rates.

Summary and Conclusion.

I have in this paper shown that the isolation of scarlet fever cases in hospital in South Shields has been attended by good results both in reducing the number of secondary cases in invaded houses and in limiting the spread of the disease in districts. Whilst being satisfied that considerable benefits are derived from hospital isolation of the great majority of cases in a town of this class, I believe that the system is capable of considerable improvement. I think that the facts recorded in this paper to a large extent refute the theories put forward by some opponents of hospital isolation. I find no evidence whatever that hospital convalescents are more than very occasionally infective and the source of return cases. In my experience it is rare for cases which are mild on admission to hospital to afterwards assume a severe type, and many of the severest cases which have come under my observation have been secondary to home-treated cases or mild unrecognised cases.

As regards improvements in the type of hospital for the treatment of this disease, I consider that wards of a much smaller size than those at present in vogue are required, in order that cases in the early stage may be separated from those in a later stage, whilst patients suffering from sundry complications may be separated from those suffering from uncomplicated attacks. With respect to the length of stay in hospital, I consider that this should be chiefly governed by the condition of the naso-pharyngeal mucous membrane, with a minimum period of one month. Apart from hospital isolation, I consider that there are various directions in which we can improve our present methods of prevention of the disease. Disinfection should be more thorough and more on the lines in of that adopted in cases of small-pox. In many cases this would mean spraying of rooms with disinfectant fluid in addition to fumigation and the removal of persons who had been in close contact with the patient to a disinfecting station. With a view to detecting mild cases

I consider that at the time of each notification, and perhaps once ot twice within the next ten days, all the members in a household in which the disease has appeared should be subjected to medical examination. A visit of inspection should also be made about a week after the discharge of a case from home or hospital quarantine for similar purpose, and lastly medical men should be encouraged to report to the Health Department all cases of illness in which the slightest suspicion of scarlet fever is raised, as is already done in this town. Cases reported in this last mannerare kept under observation by the Health Department and, if later a posibive diagnosis can be arrived at,communication is sent to the medical man reporting the case, who then fills up the statutory notification form. Cases which escape all these methods of detection must be very few,,and if the agency of the Education Authorities is made use of, by obtaining reports from their officers regarding all suspicous [redacted] symptoms in absentees, the net is made still finer.


MAP OF THE
COUNTY BOROUGH OF SOUTH SHIELDS.
1891
YARDS
Scale of one Quarter Mile
BOROUGH OF TYNEMOUTH
RIVER TYNE
THE NARROWS
HERD GROIN
LIGHTHOUSE
HERD SAND
SOUTH PIER
FERRY LANDING
NORTH SEA
NORTH MARINE PARK
SOUTH MARINE PARK
COAST GUARD STATION
THE BENTS
BENT HOUSE
CEMETERY
ALBERT EDWARD DOCK
LOCK
OPEN SPACE
WHITBURN RAILWAY
COTTAGE
WESTOE VILLAGE
WESTOE VILLA
CRICKET FIELD
CAULDWELL
JARROW SLAKE
ST. PAULS CHURCH
JARROW BRIDGE
RIVER DON
DON ALKALI WORKS
NORTH EASTERN RAILWAY
NORTH EASTERN RAILWAY COY'S WHARF
BASIN
DOCK OFFICE
JARROW CHEMICAL WORKS
TYNE DOCK
STAITHES
ST. MARYS CHURCH
SITE OF WEST END PARK
BRINKBURN
MOOR HOUSE
UNION WORKHOUSE
WEST LANE
PARLIAMENTARY BOUNDARY
MUNICIPAL BOUNDARY
ESPARTO GRASS WAREHOUSES
LEAM LANE
LOW SIMONSIDE
SIMONSIDE LODGE
SIMONSIDE COTTAGE
PASSENGER LINE FROM NEWCASTLE
Reference =
WARDS
1 Shields
2 St Hilda
3 Holborn
4 Beacon
5 Bents
6 Westoe
7 Laygate
8 Rekendyke
9 Deans
10 Tyne Dock
Enumeration Districts
boundaries marked