THE STATISTICS OF ERYSIPELAS IN ENGLAND AND WALES.

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(With 2 Diagrams.)

There are some diseases amongst the tabulated causes of death which, although they contribute relatively little to the general mortality, yet, in view of their supposed etiological association with other morbid processes, are worthy of statistical investigation. Included in this category is erysipelas, the morbidity and mortality statistics of which form the basis of the present paper. The data relate mainly to England and Wales, but, in certain instances, the statistics for Glasgow have also been included.

The streptococcal character of the erysipelatous infection was demonstrated by Fekleisen as far back as 1883, but up to the present no one serological form of Streptococcus can be incriminated. In this respect it resembles scarlet and puerperal fevers, two diseases with which it is declared to possess a bacterial affinity.

History of notification.

Erysipelas first became a notifiable disease under the Public Health Act of 1875, but this Act was of limited application—the notification of infectious disease being restricted to outbreaks amongst paupers and those resident in workhouses. The radius of administrative action was extended by the Public Health Act of 1889, but, again, there was no finality as the Act was permissive or adoptive, notification being only compulsory in those districts which adopted the Act. These defects were remedied by the Act of 1899 which made certain infectious diseases compulsorily notifiable throughout the whole country. Erysipelas was included in this list.

Incidence.

Despite the existence of the machinery for the collection of the data on infectious disease, no serious attempt was made to publish the records in official reports. It was not until 1921 that, according to a new arrangement, information on the prevalence of several of the infectious diseases, both on a national and regional basis, was given in the annual reports of the Registrar-General. In that year the incidence of erysipelas, as well as of other infections, was

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stated for individual areas and counties, and was also reviewed for the whole country for a period of years. During 1930, the latest period of official information, 18,296 cases were notified. In Table I the recorded number of cases and the corresponding case rates expressed per 1,000,000 of the population are presented for each year, beginning with 1912. In that year the case rate was 630 per million and in 1914 it reached 728, a value never afterwards attained. The ensuing years were characterised by low prevalence; in 1918 the proportion had fallen to 366. Although the incidence was in excess of this figure during the next two years, it decreased considerably afterwards; in 1923 the case rate was the lowest on record, 321 per million. Since then the prevalence has increased and, at the close of the period under review, the proportion had risen to 460 per million of the population. Like that of most infectious diseases, its highest incidence occurs in the north of England where,

Table I. *Showing the annual case rates per million in England and Wales since* 1912.

Year	Erysipelas cases	Case rate per million
1912	22,886	630
1913	23,132	632
1914	26,908	728
1915	23,382	663
1916	18,510	534
1917	13,325	390
1918	12,463	366
1919	15,763	445
1920	16,051	431
1921	13,231	349
1922	13,171	345
1923	12,335	321
1924	12,879	332
1925	15,003	386
1926	14,597	374
1927	14,708	374
1928	16,359	414
1929	17,707	447
1930	18,307	460

during the period 1921–30, the case rate was 480 per million, or 65 per cent. in excess of that for the whole country. There was little difference between the ratios in the south and midland, which were 350 and 340 respectively, but in Wales the incidence, 250 per million, was lower than that recorded elsewhere.

Case fatality.

The number of deaths ascribed to erysipelas in 1930 was 1034. If we assume that the deaths in any one year occur amongst the cases in the same year, and, further, that the recorded cases represent the complete incidence, then the case fatality in 1930 was 5·7 per cent. Extending the period to 1921–30 so as to avoid any chance fluctuation in the annual records, the total number of cases was 148,177, the registered deaths 8169, corresponding to a case fatality of 5·5 per cent. This value is much less than that found by Boston and Blackburn in their analysis of 564 cases in Philadelphia Hospital during

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the five years 1903–7. The recorded fatality rate amongst their patients was 12·7 per cent. Although the rates are not actually comparable in point of time, nevertheless it is probable that the difference between them is largely due to the fact that the hospital patients were a select population, *i.e.* they were severe cases.

Mortality.

Although our knowledge of the morbidity on a national basis is restricted to more recent times, we are in the position of being able to discuss the crude mortality, deaths in terms of population, over an extended period. For this purpose the salient characteristics are assembled in Table II, which contains

Table II. *Showing the mortality from erysipelas per* 1,000,000 *persons and its variability in decennial periods in England and Wales.*

Decennium	Mean death-rate per 1,000,000 persons	Coefficient of variation
1871–80	95	23·0
1881–90	69	23·6
1891–1900	42	22·9
1901–10	32	16·2
1911–20	23	20·6
1921–30	21	15·8

(1) a series of decennial death-rates beginning with 1871–80, and (2) the relative variability of the annual rates within each decennium. During 1871–80 the death-rate was 95 per million and it declined by fairly even stages until 1911–20, when it was 23 per million, *i.e.* 76 per cent. less than that forty years previously. At the present time the mortality from erysipelas, like its fatality, is practically identical with that from scarlet fever. In contrast with this rapid decline stands the relative uniformity in the variability of the annual death-rates around their mean in each decennial period. The dispersion as represented by the coefficient of variation, although fairly high, only fluctuated slightly, from 22·9 to 23·6 in the first three decennia. During the last decennium the variability was less than in the previous periods, as the value of the coefficient was 15·8.

Age incidence.

The age incidence of the mortality from erysipelas follows much the same course as does the death-rate from all causes, but, with one exception, the mortality is lowest in the age group 5–10, whereas the general death-rate has its minimum value at 10–15. This fact is apparent in Table III which contains the average death-rates at ages amongst males and females from (1) all causes, and (2) erysipelas in England and Wales during the quinquennium 1919–23. Amongst male children aged 0–5 the mortality from erysipelas was 34 per million; it declined to 2 per million in the next age group, then steadily increased, attaining a value of 153 per million amongst adults aged 75 years and upwards. Up to and including the age group 25–35, the female rates are of similar dimensions to those for males but, afterwards, are in defect; the aggregated effects of this differentiation between the sexes being reflected in a standardised death-rate for females of 16 per million as compared with 19 for males.

Table III. *Average death-rates per* 1,000,000 *in age groups for males and females from* (1) *all causes and* (2) *from erysipelas in England and Wales during the quinquennium* 1919–23.

	Males		Females	
Age group	(1)	(2)	(1)	(2)
0 –	31,202	34	25,122	34
5 –	2,906	2	2,816	2
10 –	1,856	3	1,929	4
15 –	2,955	4	2,777	4
20 –	3,994	7	3,387	6
25 –	4,799	7	4,114	7
35 –	6,951	14	5,377	12
45 –	11,872	28	9,108	22
55 –	25,317	51	18,999	29
65 –	58,188	84	45,446	61
75 +	146,640	153	127,594	134

Table IV. *Showing the standardised death-rates per* 1,000,000 *from erysipelas during the quinquennium* 1919–23 *according to degree of urbanisation.*

	Male	Female
London	25	21
County Boroughs	23	18
Urban Districts	16	14
Rural Districts	12	12

Table V. *Showing some of the complications associated with deaths from erysipelas in the year* 1911, *and their percentage of total number of associated cases.*

Total deaths	979
Unassociated cases	549
Associated cases	430

Complications	No. of cases	Percentage of total associated cases
Septicaemia	32	7·4
Toxaemia	23	5·3
Meningitis	37	8·6
Total nervous diseases	73	17·0
Heart disease	23	5·3
Respiratory disease	124	28·8
Nephritis	29	6·7

Mortality according to urbanisation.

As will be seen from Table IV the mortality is highly correlated with urbanisation. It is highest in London—males 25 per million, females 21, and lowest in the rural districts where the values for the two sexes are identical—12 per million. The death-rate in the urban areas is intermediate between those for London and the rural districts.

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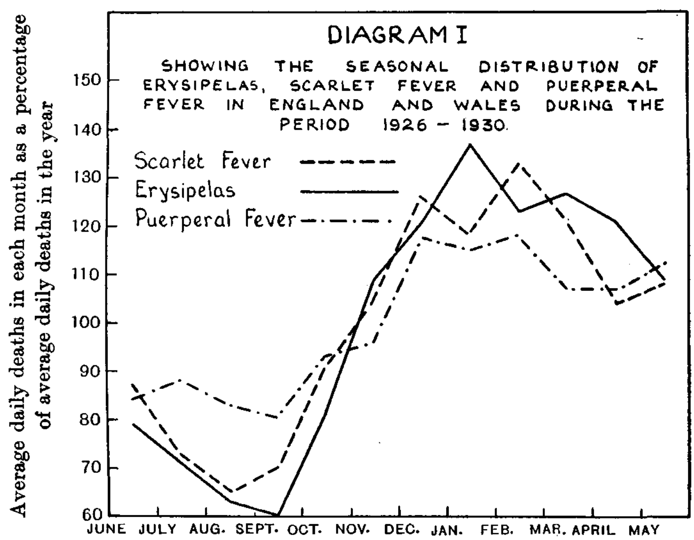
Seasonal incidence.

The curve of the seasonal incidence of erysipelas is well defined as will be observed from Diagram I which shows in England and Wales for the years 1925–29 the average deaths per day in each month expressed as percentages of the average daily deaths throughout the year. So as to illustrate clearly the difference between the summer and winter prevalence and also to show the autumn and winter incidence in an unbroken series the diagram has been drawn with June as the initial month. In other words, the year has been represented as extending from June to June. From early summer until October the mortality is in defect of the standard, the minimum appearing in September. In November the daily deaths exceed the average, and during winter and spring the daily excess amounts to approximately 25 per cent. Generally



speaking the curve has much the same trend as that for the allied diseases, scarlet and puerperal fever, which have been included in the diagram for comparative purposes. It must not be overlooked, however, that there are other diseases not of streptococcal origin such as diphtheria, the seasonal distribution of which conforms very closely to this curve, with a spring and winter excess and a summer defect.

Change in seasonal incidence.

The seasonal incidence of erysipelas, like that of scarlet fever, has not always been identical with its present distribution. It has changed in the course of time more markedly for scarlet fever than for either erysipelas or puerperal fever. This will be best illustrated by using the statistics of these diseases in London as the records are available over an extended period. Grouping the weekly data so as to yield information for lunar months and then expressing

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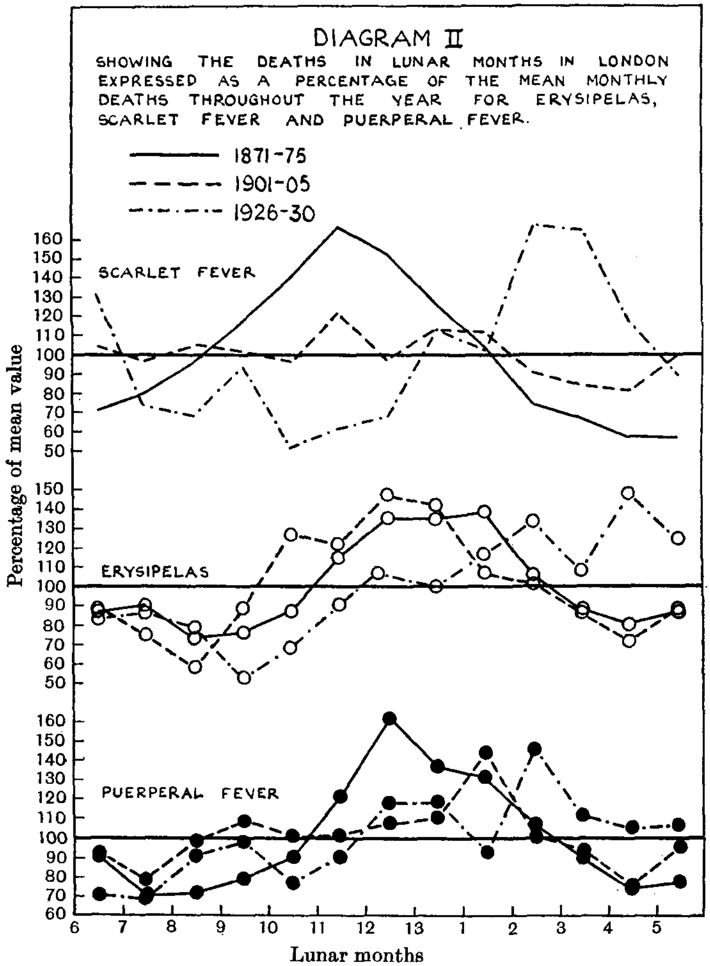
the individual monthly values as percentages of the average monthly mortality through the year, we find that, from 1841 to 1891, the deaths from scarlet fever were below the average during the first nine months, January to September, and in excess for the remainder. During the period 1891–1915 the trend underwent a change which afterwards became so intensified that it produced a complete alteration in the seasonal prevalence of the disease. The stages in this transition will be seen in Diagram II which shows the seasonal



incidence of the three infections for the quinquennial periods 1871–5, 1901–5 and 1926–30. (There was no set purpose in selecting these three particular periods. The results for any of the other quinquennia would have exhibited the change equally as well.) In the diagram the values have been so arranged as to represent the year from June to June. It will be observed that the maximum incidence of scarlet fever which previously had appeared in the winter has now shifted to the spring.

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As regards the seasonal curve of erysipelas the alteration has been less drastic than in the case of scarlet fever. If we survey the history from 1871 we find that, in the first quinquennium, the deaths in the period June to October were roughly 20 per cent. below the average: from approximately November to January they exceeded the monthly standard by 30 per cent. and afterwards fell below the normal. Thirty years later, 1901–5, the seasonal curve deviated only slightly from its predecessor. In the final period, the alteration which was first perceptible in 1916–20 became well defined, with the result that, at present, the trend closely approximates to that of scarlet fever.

As regards puerperal fever there has also been a shifting of the seasonal incidence, but the swing has been of less extent than that for either of the other two diseases.

RELATION TO ENVIRONMENT.

We have seen that the environmental conditions of city life are associated with the mortality from erysipelas—the death rate increasing with increased urbanisation. But to what extent do these adverse conditions affect the prevalence of the disease? It would seem reasonable to suppose that their influence would be more apparent in determining the morbidity rather than the mortality. The worse the conditions the greater would be the opportunity of contracting the infection, whereas the probability that death will ensue is very small—the case fatality at all ages as measured by the records of England and Wales being less than 6 per cent. If we regard density of population or overcrowding as representing an unhealthy environment, then for changes in the degree of overcrowding we should expect to find some variability in the size of the corresponding case rate from the disease. Nowhere can this association between morbidity and unhealthy environmental conditions be better examined than in the boroughs or sanitary divisions of a large city, because these areas possess a homogeneity which is not so apparent in the different sections of the whole country. Accordingly to measure the relationships between the two variables, the correlation coefficients were calculated between the case rate from erysipelas and the degree of overcrowding in each of the boroughs of London and in the sanitary districts of Glasgow. The results for certain periods were as follows:

Erysipelas and overcrowding.

Period	London	Period	Glasgow
1901–10	$r=0{\cdot}834 \pm 0{\cdot}058$	1899–1902	$r=0{\cdot}515 \pm 0{\cdot}128$
1911–14	$r=0{\cdot}641 \pm 0{\cdot}111$	1903–08	$r=0{\cdot}698 \pm 0{\cdot}105$
1919–23	$r=0{\cdot}745 \pm 0{\cdot}084$	1909–13	$r=0{\cdot}713 \pm 0{\cdot}103$

It is thus apparent that overcrowding and all that it connotes is closely correlated with the amount of erysipelas present in the two cities. The explanation probably lies in the fact that in congested areas there is greater likelihood of abrasions with a supervening infection by the erysipelatous Streptococcus. The results are, however, important in another direction be-

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cause they exhibit a more definite relationship than that which exists between the incidence of the allied infections—scarlet and puerperal fever—and overcrowding, as will be observed in the following sections:

Scarlet fever and overcrowding.

Period	London	Period	Glasgow
1901–10	$r = +0{\cdot}135 \pm 0{\cdot}186$	1899–1902	$r = -0{\cdot}860 \pm 0{\cdot}045$
1911–14	$r = -0{\cdot}353 \pm 0{\cdot}165$	1903–08	$r = -0{\cdot}861 \pm 0{\cdot}054$
1919–23	$r = -0{\cdot}064 \pm 0{\cdot}188$	1909–13	$r = -0{\cdot}663 \pm 0{\cdot}120$

In London the prevalence of scarlet fever is little influenced by social conditions as the coefficients are very small. If there be a relationship it is of a slightly inverse character, as in two out of three instances the coefficients are negative. On the other hand, in Glasgow there is a well-marked tendency for residential districts to have relatively more scarlet fever than the poorer areas. A plausible explanation of this phenomenon in Glasgow may be the greater immunisation by minimum dosage in the slums than in the better class districts. But why the differentiation between the two cities? Possibly the type of housing in Glasgow is the responsible factor. There is a great difference between the housing systems in the two cities, as is apparent from the following facts obtained at the 1921 Census.

	Percentage of population				Rooms per person	
No. of rooms (a)	London (b)		Glasgow (c)		London (d)	Glasgow (e)
1	6·2	80·2	13·2	94·8	0·55	0·31
2	17·5		51·5		0·64	0·42
3	23·8		20·8		0·78	0·63
4	21·2		6·3		0·90	0·85
5	11·5		3·0		1·04	1·15

The distribution of the population in London according to the number of rooms occupied is fairly symmetrical, whereas in Glasgow the curve of incidence is rather skew. We find that 80·2 per cent. of the total population of London and 94·8 per cent. of that of Glasgow lived in homes containing one to five rooms. The disproportion was more strongly marked at the bottom end of the scale. In London, 6·2 per cent. and 17·5 per cent. of the population lived in homes of one and two rooms: the corresponding proportions in Glasgow were 13·2 per cent. and 51·5 per cent.

These figures are, in themselves, not necessarily indicative of overcrowding because the smaller proportions of the population in London—6 and 17·5 per cent.—could be composed of families containing one or more members, whereas the constitution in Glasgow could be that of individual members. (According to Census regulations, a lodger occupying part of a house or flat is treated as a separate family.) But when the data in cols. (*b*) and (*c*) are supplemented by those in cols. (*d*) and (*e*) they demonstrate clearly the unsatisfactory position of Glasgow with London. The range between bad and good conditions is more accentuated in the former than in the latter; the room space per person extends from 0·31 in the one-room house to 1·15 in the five-room house in Glasgow, the comparable values in London being 0·56 and 1·04. Amongst the sections of the total population living in one and two rooms in Glasgow the room space per person was 44 and 35 per cent. respectively less than in London. Arising out of this greater concentration or massing of the population in tenement dwellings with deficient room space per person there will inevitably be greater opportunity in Glasgow than in London of acquiring immunity to the disease.

PUERPERAL FEVER AND OVERCROWDING.

To measure the relationship between unsatisfactory social conditions and the prevalence of puerperal fever, we must rely mainly on the data for the sanitary divisions of Glasgow, as the records of the incidence of the disease in the individual boroughs of London were not published before 1911. The only available information previous to that year was that which related to the County of London *in toto*. The case rates in the two cities during certain periods were:

Case rate from puerperal fever per 1000 *births.*

Year	London	Glasgow
1901	1·9	2·9
1902	2·4	3·6
1903	1·8	4·3
1904	2·1	3·6
1905	2·3	4·5
1906	2·4	4·8
1907	2·1	5·1
1908	1·9	5·0
1909	2·5	4·7
1910	2·5	5·1
1921	3·5	10·8
1922	3·3	10·4
1923	3·9	10·4
1924	3·5	9·5
1925	3·9	11·8
1926	4·3	12·6
1927	3·6	11·7
1928	4·1	17·5
1929	4·5	22·6
1930	4·3	25·6

Much of the difference between the case rates for the two cities is due to the fact that the term puerperal fever is more expansive in Glasgow than in London. In the former—in recent years at least—it includes all cases of pyrexia, whereas, in London, these are tabulated separately. But the difference between the size of the case rates in the two cities is not a matter of any great importance because the purpose in view is an examination of the incidence within the divisions of each city in relation to environmental conditions. Presumably the policy or practice in classifying maternal morbidity for a city as a whole applied equally to its subdivisions.

Accepting the data as being the best available we find that the correlation between the degree of overcrowding and the incidence of puerperal fever was fairly high in Glasgow and very small in London. The coefficients were:

London		Glasgow	
1911–1914	$r = +0{\cdot}083 \pm 0{\cdot}187$	1903–1908	$r = +0{\cdot}554 \pm 0{\cdot}141$
		1909–1913	$r = +0{\cdot}480 \pm 0{\cdot}134$

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This difference of degree of response by the three diseases to the influence of environment raises the question as to how far their causation is related. From the statistical standpoint this can be discussed under three main headings—correlation in time, place and season. According to modern bacteriological teaching scarlet fever and erysipelas are always, and puerperal fever very frequently, due to infection with haemolytic streptococci. There is thus an *a priori* probability that the incidence of the three infections will be correlated in the directions suggested. The correlation might well, however, be masked by the different immunological behaviour of the three diseases. One attack of scarlet fever usually confers a degree of immunity that affords protection against subsequent attack of that particular disease. Moreover, it has been clearly established that an immunity is frequently established as the result of latent infection. There is no evidence that a similar immunity develops to such streptococcal infections as puerperal fever or erysipelas at least as clinical entities. This difference in behaviour will probably not very greatly affect the correlation in time—as an increased frequency of haemolytic streptococci will increase the risk of contracting each of the three infections. It will, however, affect the correlation in space. The population of a crowded district subjected to frequent attacks with haemolytic streptococci will develop a high degree of antitoxic immunity. When exposed to a significantly increased risk of infection, it will therefore show a greater upward deviation from the expected erysipelas or puerperal morbidity than from the scarlatinal morbidity. On the other hand a less crowded district with a significantly lower rate of anti-scarlatinal immunity might, when exposed to similar risk, show a greater upward deviation in scarlatinal than in puerperal or erysipelas morbidity, since the former is the more contagious disease.

This thesis is fully confirmed by the results found in Glasgow, where the demarcation between a good and bad environment is clearly defined. It will be remembered that the room space per person in one-roomed houses was as low as 0·31 per person and it increased to 1·15 per person in the case of five-roomed houses. When the percentage of the population living more than two persons per room in each ward was correlated with the incidence of each of the three infections, it was found that the results were positive and statistically significant for both erysipelas and puerperal fever and highly negative for scarlet fever.

Time correlation.

To evaluate the possible relationship satisfactorily, trend lines were first fitted to the data—the annual case rate for each disease—scarlet fever, erysipelas and puerperal fever in England and Wales during the period 1912–30. The curve which described the distribution or trend of both erysipelas and scarlet fever was roughly of an exponential character. This type of curve when applied to diseases like those in question has certain limitations. It cannot make the necessary allowance for any possible periodic or cyclic nature of the two diseases. For all practical purposes the trend of puerperal fever could be fairly well represented by the equation to a straight line. The deviations from the trend lines, that is the differences between actual and theoretical case rates for the three diseases, were correlated with each other and the results were:

Erysipelas (1), scarlet fever (2), puerperal fever (3).

	Zero order
Erysipelas and scarlet fever	$r_{12}=0{\cdot}621\pm0{\cdot}145$
Erysipelas and puerperal fever	$r_{13}=0{\cdot}486\pm0{\cdot}180$
Scarlet and puerperal fevers	$r_{23}=0{\cdot}463\pm0{\cdot}185$

As will be observed the diseases are positively and significantly correlated, erysipelas and scarlet fever exhibiting the closest relationship, $r=0{\cdot}621$; puerperal fever is associated with the other infections to an almost equal degree, the values of r being $+0{\cdot}486$ and $+0{\cdot}463$ respectively. The fact that the correlation between puerperal fever and each of the other two infections is smaller than that between scarlet fever and erysipelas is, in this instance, not necessarily indicative of a lesser relationship. The reason is possibly that within the past four years the term puerperal fever has been made more inclusive. Hence with this ostensibly increased incidence there will be no compensatory increase in the scarlet fever and erysipelas morbidity. Accordingly the correlation will be reduced. The revised classification has, however, not been in practice sufficiently long to affect the results in any appreciable degree because the correlation coefficients obtained by utilising case rates agree very closely with those published by McKinlay (1928) in his very careful study "The relation between puerperal septicaemia and certain infectious diseases" (*J. Hygiene*, **27**, 186–95). In studying the secular trend of the diseases he utilised fluctuations or deviations between annual and predicted *death-rates* and obtained the following correlation coefficients:

$$r_{12}=0{\cdot}652\pm0{\cdot}078,$$
$$r_{13}=0{\cdot}448\pm0{\cdot}108,$$
$$r_{23}=0{\cdot}633\pm0{\cdot}081.$$

CORRELATION IN SPACE.

Although we have shown that the correlation between the prevalence of the three diseases is statistically significant, we cannot necessarily deduce a causal relationship, because it is possible for variables to be highly correlated in point of time and yet be absolutely unrelated both in place and season. For instance, two diseases may be very prevalent in a particular year but not co-existent in the same town or district. If, however, there is a correlated series of events such as prevalence both in place, time and season, then we can offer fairly satisfactory evidence of something more than a mere fortuitous connection between the occurrence of the diseases. Having seen that they are correlated to an appreciable degree in point of time and also have a similar seasonal distribution, we will now examine the extent of their spacial association. For this purpose the case rates of erysipelas were correlated with the corresponding values of scarlet and puerperal fevers in the sanitary divisions of Glasgow and the boroughs of London. The coefficients of correlation were as follows:

Erysipelas (1), scarlet fever (2), puerperal fever (3).

Period		Zero order	1st order
1901–1910	London	$r_{12} = +0{\cdot}333 \pm 0{\cdot}168$	
1903–1908	Glasgow	$r_{12} = -0{\cdot}718 \pm 0{\cdot}109$	$r_{12\cdot3} = -0{\cdot}463$
		$r_{13} = +0{\cdot}689 \pm 0{\cdot}109$	$r_{13\cdot2} = +0{\cdot}385$
		$r_{23} = -0{\cdot}689 \pm 0{\cdot}109$	
1911–1914	London	$r_{12} = -0{\cdot}389 \pm 0{\cdot}160$	$r_{12\cdot3} = -0{\cdot}412$
		$r_{13} = -0{\cdot}143 \pm 0{\cdot}186$	$r_{13\cdot2} = -0{\cdot}205$
		$r_{23} = -0{\cdot}114 \pm 0{\cdot}186$	
1909–1913	Glasgow	$r_{12} = -0{\cdot}758 \pm 0{\cdot}087$	$r_{12\cdot3} = -0{\cdot}691$
		$r_{13} = +0{\cdot}447 \pm 0{\cdot}170$	$r_{13\cdot2} = +0{\cdot}134$
		$r_{23} = -0{\cdot}489 \pm 0{\cdot}155$	

The results obtained in the two cities are widely different. In London there is no obvious correlation between the three diseases. During the period 1911–14 the correlation between the prevalence of erysipelas and that of puerperal fever was $-0{\cdot}143 \pm 0{\cdot}186$; between erysipelas and scarlet fever the values were larger, $r = +0{\cdot}333 \pm 0{\cdot}168$ during the period 1901–10 and $r = -0{\cdot}389 \pm 0{\cdot}160$ in the later period. The fluctuation in the sign of the coefficient suggests, however, that there is no definite relationship. In Glasgow, the association between the two diseases is of an inverse character:

$$r = -0{\cdot}718 \pm 0{\cdot}109 \text{ during 1903–8,}$$
$$r = -0{\cdot}758 \pm 0{\cdot}087 \text{ during 1909–13.}$$

These values indicate that where erysipelas is prevalent the scarlatinal morbidity is rather low. On the other hand, the only positive correlation in Glasgow is that between erysipelas and puerperal fever, the coefficient in 1903–8 being $r = +0{\cdot}689 \pm 0{\cdot}109$ and $r = +0{\cdot}447 \pm 0{\cdot}170$ in the later period. The causes possibly conducive to these fairly high negative and positive correlations in Glasgow have already been referred to when discussing the relationship between overcrowding and the incidence of each of the infections. But before we can draw any definite inference from the results for any two of the diseases we must take into account the possible influence of the third infection, be it scarlet fever, erysipelas or puerperal fever in any particular instance. Suppose that the real correlation, depending on a multiplicity of secondary factors other than the presence of haemolytic streptococci, between erysipelas and scarlet fever were low but that the correlation between each disease and puerperal fever were high, then, solely from this latter cause, there would be a correlation in any area between the incidence of erysipelas and that of scarlet fever. When the necessary allowance was made as in the first order coefficients, we find that the correlation between erysipelas and scarlet fever in Glasgow remains negative, whilst that between erysipelas and puerperal fever is still positive although reduced in size. The relationship between the two last-mentioned diseases is not quite as defined as has been alleged by

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some observers. It has been and still is generally accepted that the incidence of erysipelas is highly correlated with that of puerperal fever. Longstaffe in his *Studies on Statistics* adduces evidence of this relationship. He also cites the opinion of Dr T. C. Minor of Cincinnati who, in reference to the deaths in the United States in 1870, wrote as follows:

"1. Erysipelas and childbed fever seemed to prevail together throughout all the States. 2. Any marked increase, in any one locality, of one disease, was apparently accompanied by a corresponding increase of the other. 3. Where histories of past epidemics, of either disease, were obtainable from any of the States, the apparent connection of the two diseases was noticed by physicians at the time of such epidemics, and remarked on. 4. This relationship indicates that there is an intimate connection existing between childbed fever and erysipelas, and justifies the inference, that in any place where erysipelas is found, there will be found childbed fever."

To test further the relationship between the two diseases the data over more extended areas were analysed. The annual incidence of erysipelas, scarlet and puerperal fevers in England and Wales since 1919 was as follows:

Number of cases.

Year	Erysipelas	Scarlet fever	Puerperal fever
1919	15,752	82,358	2016
1920	16,029	119,445	2898
1921	13,220	137,012	2211
1922	13,157	108,199	2134
1923	12,321	85,582	2190
1924	12,868	84,621	2183
1925	14,989	91,311	2396
1926	14,581	81,641	2611
1927	14,695	84,406	1989
1928	16,349	102,572	2380
1929	17,701	120,193	2359

From these figures it will be seen that the incidence was low in 1923 and 1924 and high in 1928 and 1929. As the assignment of puerperal morbidity has become somewhat enlarged in recent years, it was at first thought that the increased number of cases in 1928 and 1929 might be attributable to a change in classification. But, since the prevalence of both erysipelas and scarlet fever also increased, it seems legitimate to assume that there was an actual increment of puerperal morbidity. The case rates of erysipelas and puerperal fever in the country boroughs, urban and rural districts of England and Wales were then correlated for the periods of low and high incidence respectively, and the results were:

	1923–24	1928–29
County Boroughs	$r = +0{\cdot}310 \pm 0{\cdot}070$	$r = +0{\cdot}049 \pm 0{\cdot}078$
Urban Districts	$r = +0{\cdot}184 \pm 0{\cdot}087$	$r = -0{\cdot}008 \pm 0{\cdot}090$
Rural Districts	$r = +0{\cdot}207 \pm 0{\cdot}086$	$r = +0{\cdot}014 \pm 0{\cdot}090$

They show that the correlation between the two diseases was not very close. The relationship was more distinct during years of low rather than of high prevalence. In 1923–24 the coefficients, although small, were statistically

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significant, whereas in the later period they were decidedly unimportant. Possibly the connection between the two diseases has been slightly minimised owing to the standard by which the puerperal case rate was expressed. In the present instance the case rate used for this disease in any district was that stated in the Registrar-General's annual report, *i.e.* $\frac{\text{cases}}{\text{total population}} \times 1000$. This index is, of course, not a perfect measurement, as puerperal fever incidence should really be related to the number of children born. But, even if the more correct method of expression had been adopted, it is extremely doubtful if any substantial degree of correlation would have resulted.

Summary and conclusions.

1. The annual number of notified cases of erysipelas is approximately 17,000, and assuming complete notification of the disease the general case fatality is approximately 6 per cent.

2. The death-rate, deaths in terms of the population, varies according to age, being highest at the beginning and end of life and at a minimum between the age of 5 and 10 years. The mortality of males is identical with that of females up to age 25, but is afterwards in excess.

3. The disease has in recent years a well-marked seasonal incidence—a winter and spring excess with a summer defect. In this respect it resembles scarlet and puerperal fevers and, although its seasonal incidence has changed in the course of time, the alteration has not been nearly so pronounced as that for scarlet fever.

4. The incidence is highly correlated with overcrowded conditions, the correlation coefficient being in some periods as high as $+0{\cdot}83$ in the divisions of London and $+0{\cdot}70$ in the sanitary districts of Glasgow.

5. The morbidity from erysipelas is fairly well correlated in time with that from scarlet fever and erysipelas, but in London, in the urban and in the rural districts of England and Wales, the spacial correlation is very small. On the other hand, in Glasgow the spacial correlation between the incidence of erysipelas and that of scarlet fever is highly negative, $-0{\cdot}718 \pm 0{\cdot}109$, whereas between erysipelas and puerperal fever the association is positive, $+0{\cdot}689 \pm 0{\cdot}109$ during the period 1903–8, but these values were much reduced when the partial coefficients were calculated.

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