S C A R L E T F E V E R.

A resumé of the behaviour of the Disease in Glasgow, during the twelve years, 1893-1904 with special reference to Climatic Conditions.

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by

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S C A R L E T F E V E R.

A resumé of the behaviour of the Disease in Glasgow, during the twelve years, 1893-1904 with special reference to Climatic Conditions.

Scarlet Fever, as is well known, is characterised by a period of greatest prevalence in the last quarter of the year, by an incidence rate highest between the ages of two and five years, and is essentially a disease of temperate climates, being almost unknown on the equator, and very rare in the polar regions.(1) From these two extremes it shades off gradually, until we find it most prevalent about midway between these points.

The object of this enquiry is threefold, viz.,-

(1) to ascertain, if possible, whether temperature or rainfall have any bearing on the increased prevalence of the disease during the autumn months, or whether climatic conditions have any definite relation to the frequency of epidemics -

(2) to inquire into the factors at work in spreading the disease, and -

(3) to ascertain the influence sanitation has had on these factors.

It/

It must be emphasised at the outset, that the influence of climate can only, with difficulty, be separated from that of other conditions of environment, and to obtain trustworthy and accurate statistics under this head, it would be necessary to eliminate the effect of variation in age-distribution of the population, density per inhabited room, differences in food, and other particulars.

It is generally admitted that the persistency of type displayed by measles and smallpox, is quite remarkable, but this fact has never been clearly demonstrated regarding Scarlet Fever. Records which tally closely with our modern descriptions of Scarlatina, do not date far back. Neither Sydenham[2] nor Sibbald[3] make any mention of sore throat in their descriptions of this disease. It was described by Morton[4] as con-fluent measles. Other observers[5] almost certainly include cases which now would be labelled Diphtheria. All through the eighteenth century this confusion continues, making it almost impossible to obtain any evidence of persistency of type from the records.

The mortality from Scarlet Fever has shown very/

very wide fluctuations from time to time. In the Registrar General's[6] first decennial summary, 1851-60, the deaths amounted to 88 per 100,000 for all ages; from 1861-70, the figure had risen to 97; but in the period 1871-80, the rate of mortality fell to 72. From 75 per 100,000 in 1878, the rate has fallen gradually but steadily until the present time when it stands at 33.
Not only do different outbreaks differ greatly in respect of mortality, but the epidemics have a tendency to occur in cycles; and an absence of the disease for a few years, has been repeatedly followed by a great increase in infectivity and mortality. It may be that part of the reduction in the mortality may be due to better diagnosis, cases, for instance, which formerly were called Scarlet being now registered as due to Diphtheria, but nevertheless, after making ample allowance for this fact, it is undoubted--ly the case that Scarlet is becoming less fatal.

The autumnal prevalence of Scarlet Fever has been observed by almost every writer on the subject. Hirsch[7] mentions that out of 435 epidemics in various parts of the world, 22 per cent occurred in Spring, 24 per cent in Summer, 29 per cent in Autumn, and 25 per cent in Winter./

Winter. Longstaff[8] in 1880, constructed a diagram which showed that the mortality from Scarlet Fever, increased throughout the summer, reaching its maximum at the end of October, falling thereafter to a minimum in April. The Registrar General gives a diagram in his Annual Summary for 1880, constructed from the death returns for forty years, which shows a similar seasonal distribu-tion. Matthews Duncan[9] traced the weekly curve of deaths from Scarlet Fever in London for twenty-eight years (1848-1875) and the autumnal rise was a marked feature of every year without exception. Dr. Whitelegge[10] Medical Officer of Health of Nottingham constructed a similar diagram, based not on the death returns, but on the actual cases, and has published the following table of the incidence of 13,000 cases occurring in Aberdeen, Edinburgh and Dundee, during the years 1885-6-7, the monthly totals being stated as a percentage of the monthly average.

Seasonal Curve of Cases, stated as Percentage of Monthly Average.
(Aberdeen, Edinburgh, & Dundee, 1885-6-7)

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
Cases.	70	89	80	45	50	60	82	118	162	185	155	101

It has been frequently pointed out that the mortality rises and falls proportionately less than the cases do, and this would seem to suggest that the autumnal prevalence of Scarlet Fever is attended by a low case mortality, a feature which is sometimes observed.

There seems to be some influence, varying in degree, at work, apart from personal infection which, of itself, tends to increase the number of cases during Autumn. Hirsch, referring to this influence, states that it is not "any particular kind of weather". Enteric Fever, which, in its incidence, has many points of resemblance to Scarlet Fever, reaches its seasonal maximum at the same time (end of October), and its minimum occurs at midsummer, while the minimum of Scarlet Fever is in July . In contrast to the close similarity of these latter two diseases, Smallpox and Whooping Cough have curves exactly the reverse, the maximum being in Spring and the minimum in Autumn, while Measles has a peculiar curve of its own.

In large cities Scarlet Fever is omni-present, and at various periods throughout the year groups of cases are constantly occurring almost like small epidemics. An explanation of these limited outbreaks has been sought for/

for in vain in the usual channels of infection - milk, infection caught at school, or even in the grouping of the cases in one locality. It therefore seems obvious that some meteorological conditions arise from time to time to favour the spread of the virus.

The data employed in enquiry,-

In order to avoid any error which might accrue from "paucity of data", a period of twelve years, viz.,- from 1893 to 1904 has been selected for the purposes of this enquiry. Although the "Infectious Disease Notifi--cation Act" was in operation in 1889, it was deemed advisable to commence with the year 1893 lest before that date the returns should be incomplete. From the weekly returns issued by the County Medical Officer of Health for Renfrewshire, the number of cases of Scarlet Fever notified each week in Glasgow, was extracted for the twelve years above mentioned, and these numbers were tabulated as follows:-

First Quarter's Cases.

eek.	1893.	94.	95.	96.	97.	98.	99.	1900.	'01.	'02.	'03.	'04.	Total.	Av. p. wk.
st.	98	94	76	53	35	37	72	71	54	38	31	38	697	58
nd.	116	78	73	57	48	81	83	93	59	55	42	20	805	67
rd.	121	126	76	61	55	75	147	71	68	58	40	35	953	79
th.	89	96	74	45	59	76	91	72	68	52	44	33	799	67
th.	117	87	69	38	51	76	91	83	55	54	38	36	795	66
th.	110	66	78	44	63	62	73	79	61	47	39	31	753	63
th.	72	59	55	49	66	78	114	93	69	47	44	32	778	65
th.	73	59	70	35	60	58	97	78	66	59	43	28	726	60
th.	64	84	47	47	62	77	84	87	89	50	34	22	747	62
th.	76	65	50	54	41	45	73	80	74	58	37	28	681	57
th.	44	65	56	54	47	73	56	60	55	60	29	33	642	53
th.	84	44	54	43	58	55	78	74	75	39	25	42	671	56
th.	52	49	65	50	71	63	70	52	49	49	24	37	631	53
Qr.	1116	972	843	630	716	856	1129	993	842	666	480	415	-	-

Second Quarter's Cases.

k.	1893	94.	95.	96.	97.	98.	99.	1900.	'01.	'02.	'03.	'04.	Total.	Av. p. wk.
h	84	42	62	45	52	66	74	73	67	59	31	27	682	57
h	59	50	49	65	37	47	66	77	74	50	19	66	669	56
h	71	41	51	45	31	52	91	83	61	40	50	76	662	55
h	55	45	61	63	35	44	77	81	46	40	41	61	649	54
h	51	55	49	36	39	33	78	58	59	53	36	38	585	49
h	80	49	59	48	41	44	56	85	75	40	27	25	624	52
h	81	37	46	42	42	42	79	74	57	50	30	26	604	50
st	67	54	59	49	41	57	70	56	47	61	46	17	624	52
nd	89	39	40	39	36	52	77	68	54	33	44	22	593	49
rd	75	54	62	37	40	55	84	86	47	39	32	28	639	53
th	69	65	57	29	50	56	81	47	46	44	43	17	604	50
th	41	51	47	30	36	59	77	59	63	43	38	26	570	48
th	59	42	50	37	28	73	77	65	62	46	59	21	619	52
	881	624	692	559	518	678	987	882	758	598	496	450		

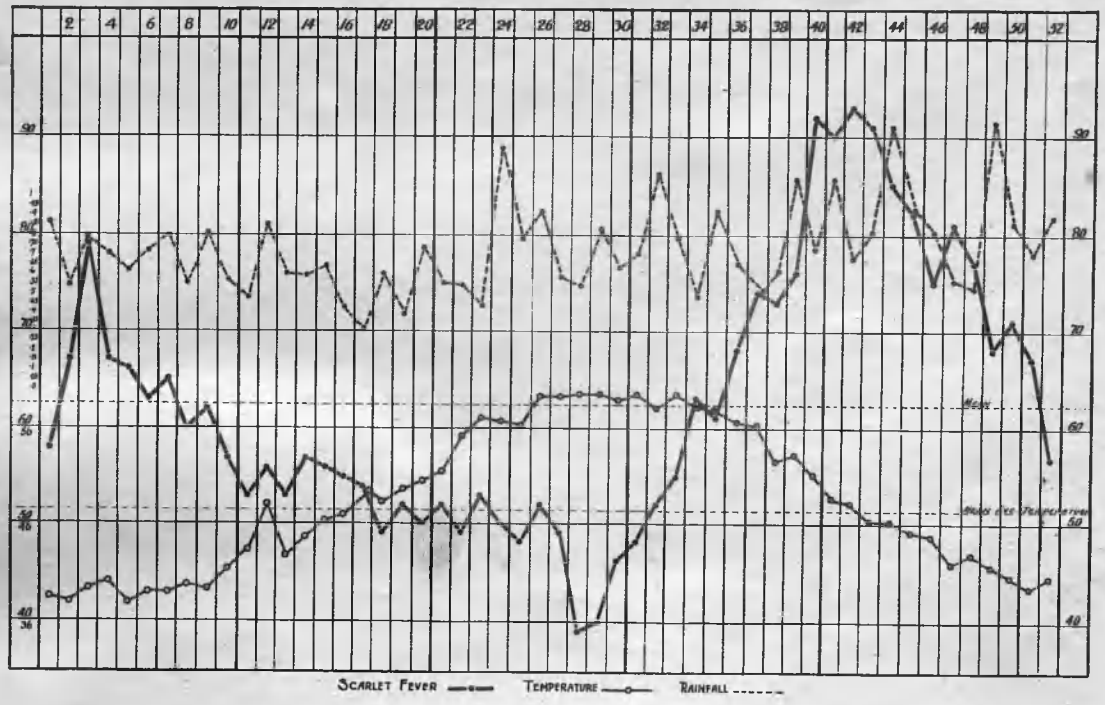
Third Quarter's Cases.

k.	1893.	94.	95.	96.	97.	98.	99.	1900.	'01.	'02.	'03.	'04.	Total.	Av. p wk.
h	83	39	52	32	38	57	63	62	69	33	46	14	588	49
h	39	13	35	28	25	52	91	34	66	27	38	17	465	39
h	56	55	49	19	22	36	45	91	46	27	19	9	474	40
h	74	45	53	38	35	49	67	41	34	57	40	15	548	46
t	77	46	59	43	45	51	62	71	44	30	28	15	571	48
d	86	37	66	55	40	48	65	80	52	41	34	24	628	52
d	82	36	75	41	34	60	89	86	50	42	35	28	658	55
h	68	78	95	60	48	59	119	75	63	43	45	32	785	65
h	59	90	80	53	35	80	98	96	40	29	49	27	736	61
h	71	97	87	62	45	80	89	93	60	60	43	33	820	68
h	79	131	80	62	74	71	109	92	62	46	55	29	890	74
h	87	98	96	58	71	54	137	73	72	51	49	34	880	73
h	81	110	94	61	78	68	116	92	124	40	33	27	916	76
	942	875	921	612	590	757	1150	986	782	526	514	304		

Fourth Quarter's Cases.

eek.	1893.	94.	95.	96.	97.	98.	99.	1900.	'01.	'02.	'03.	'04.	Total.	Av. D. W.
0th	97	122	90	76	80	142	151	97	77	66	63	45	1106	92
1st	130	134	78	75	79	103	132	146	72	54	38	38	1079	90
2nd	105	133	91	68	105	111	163	125	89	53	41	27	1111	93
3rd	69	134	112	54	124	86	149	123	108	55	40	39	1093	91
4th	76	156	97	62	102	85	132	107	79	61	37	31	1025	85
5th	79	117	98	70	86	104	135	71	89	64	39	34	986	82
6th	83	117	75	66	95	77	117	97	68	51	20	21	887	74
7th	84	91	71	73	85	107	116	98	147	48	24	24	968	81
8th	91	102	88	84	67	90	130	89	52	52	40	34	919	77
9th	49	104	75	85	61	79	93	81	62	60	38	27	814	68
0th	105	105	60	57	64	100	121	89	46	47	39	24	857	71
1st	93	83	64	72	82	94	98	69	44	44	27	29	799	67
2nd	58	72	55	62	56	98	83	69	39	40	28	20	680	57
	1119	1470	1054	904	1086	1276	1620	1261	972	695	474	394		

CHART I.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SCARLET FEVER
TEMPERATURE
RAINFALL

and touches its minimum in the twenty-eighth week (thirty--five cases). This latter figure is perhaps lower than it should be, owing to July being the holiday time in Glasgow. Especially in the last fortnight of the month there is a large exodus of people to coast towns, but it is to be noted that the returns for these coast towns do not show any increase in cases of infectious disease during this period, and it must therefore be taken that the twenty-eighth week is really the minimum. From these extremes the curve is an even one, except for a peculiar "kick" in the third week of the year, at which time, the curve, which has been falling steadily from the maximum, ascends from fifty-eight cases in the first week, to seventy-nine in the third. Thereafter the fall is gradual and sustained until the minimum is reached. This small wave, which is quite evanescent, is very peculiar, and its explanation is extremely difficult. The first solution which strikes one is that here we have school influence coming into play, i.e. the increase follows about one week after the schools reopen from the Christmas holidays. Were this the real solution, however, the increase would be sustained, but this is not so. It may be that the curve of Scarlet, like that of Measles/

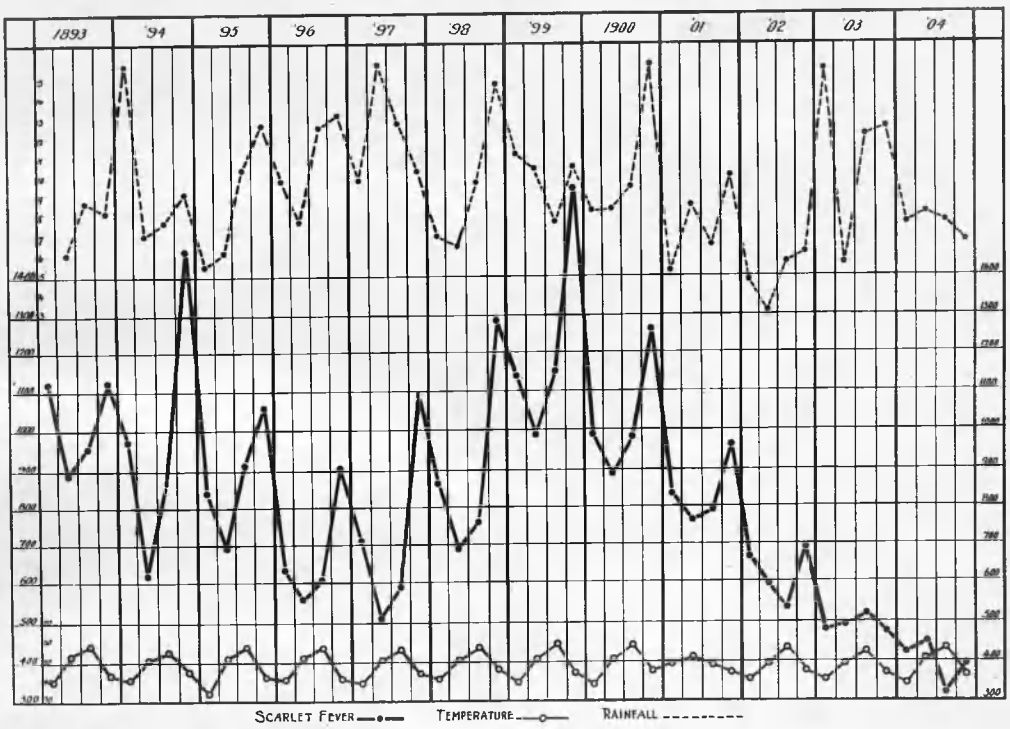
Measles and Smallpox, has two maxima, the secondary peak in Scarlet being less pronounced, and following sooner after the true maximum than in the two former diseases.

There appear to be two factors, at least, at work in determining the epidemic prevalence of Scarlet Fever.

(1) The influence of an accumulation of susceptible persons in the interval between two epidemics of the disease, and -

(2) Certain conditions, cyclical or otherwise, which appear to be operative in determining the periodicity of the epidemic. This latter is exemplified in Chart II in which the actual number of cases occurring in each quarter of the twelve years under review, is shown. On examining this chart, it is apparent that over and above the annual autumnal rise, there is a larger wave, extending over a period of about six years, having its peaks in 1893, and 1899, and its hollows in 1896, and 1904. This figure presents the features so graphically described by Dr. Ransome[11] as being "like a vast wave of disease, upon which the lesser epidemics show like ripples upon the sur--face of an ocean swell." Dr. Ransome's investigations were extended by Dr. Whitelegge,[12] and the latter has concluded/

CHART II.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SCARLET FEVER
TEMPERATURE
RAINFALL

concluded that in the shorter waves there is no increase in virulence - the disease simply assumes epidemic pre--valence,-and that in the longer or fundamental waves, the evidence of increased severity is obtained from -

(a) The increased death-rate, and -

(b) Persons at exceptional ages being attacked.

The following is a summary of the cases recorded each quarter (see Table A.) from 1893 to 1904 inclusive.

TABLE B.

Y e a r.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.
1893.	1,116	881	942	1,119
1894.	972	624	875	1,470
1895.	843	692	921	1,054
1896.	630	559	612	904
1897.	716	518	590	1,086
1898.	856	678	757	1,276
1899.	1,129	987	1,150	1,620
1900.	993	882	986	1,261
1901.	842	758	782	972
1902.	666	598	526	695
1903.	480	496	514	474
1904.	415	450	304	394
Totals.	9,658	8,123	8,959	12,325

Grand Total - 39,065 cases.

It will be apparent, from the above (Table B.) that, with the exception of the years 1903, and 1904, the number of cases recorded was highest in the last quarter, and lowest in the second or third quarters. This is also true for the average of the twelve years. In 1903, the third quarter was highest, while in 1904 the second quarter had the largest number of recorded cases. The disease has therefore in 1903 and 1904 departed from its original autumnal prevalence, and has become more evenly distributed throughout the year. This change is due to the absence of Epidemics. Whatever may be the main reason why the annual autumnal increase did not appear, it is certain that improved methods of disinfection, isolation, and a more rigorous use of the Clauses of the Public Health Act, 1897, relating to Infectious Disease, have contributed to this result. The fact must not be lost sight of, that, in Scarlet Fever, we have a disease which is divisible into two separate portions.

(a) The endemic amount of the disease, which is in Britain, almost certainly a constant feature, and -

(b) The epidemics, which appear from time to time and are superimposed above the endemic amount.

To/

To come to an accurate conclusion regarding epidemic prevalence, it would be necessary to know what is to be taken as the number of cases which should be reckoned as representing the endemic amount of the disease. The plan adopted to obtain this factor will be described later.

From Table B. it will be seen that, in all 39,065 cases of Scarlet Fever were notified as having occurred in Glasgow during the twelve years 1893 to 1904. 9,658 cases (25%) occurred in the first quarter, 8,123 cases (20%) in the second quarter, 8,959 cases (23%) in the third, and 12,325 (32%) in the last quarter. The total number of cases recorded annually, fell from 4,058 in 1893, to 2,705 in 1896, the figures reading as follows:-

Year.	Number of Cases.
1893.	4,058
1894.	3,941
1895.	3,510
1896.	2,705.

From 1896 to 1899, there was a decided increase/

increase, the numbers being as follows:-

Y e a r.	Number of Cases.
1896.	2,705
1897.	2,910
1898.	3,567
1899.	4,886

In 1899, the highest point during the twelve years was reached, and since that date, there has again been a gradual diminution in the annual number of cases, until in 1904, only 1,563 cases were recorded, i.e. not so many as were recorded in one quarter (last) of 1899 (1,620 cases).

These variations are graphically shown on Chart II. The most striking feature of this chart, is the great falling off in the number of cases recorded in the closing years of the period, The peculiarity of the years 1903, and 1904, also invites comment. In 1903, as already stated, the third quarter has the highest number of cases, but this number is actually lower than that recorded in any quarter of the previous ten years.

Again/

Again in 1904 the second quarter had the highest number of cases, but this number was smaller than that for any quarter in 1903.

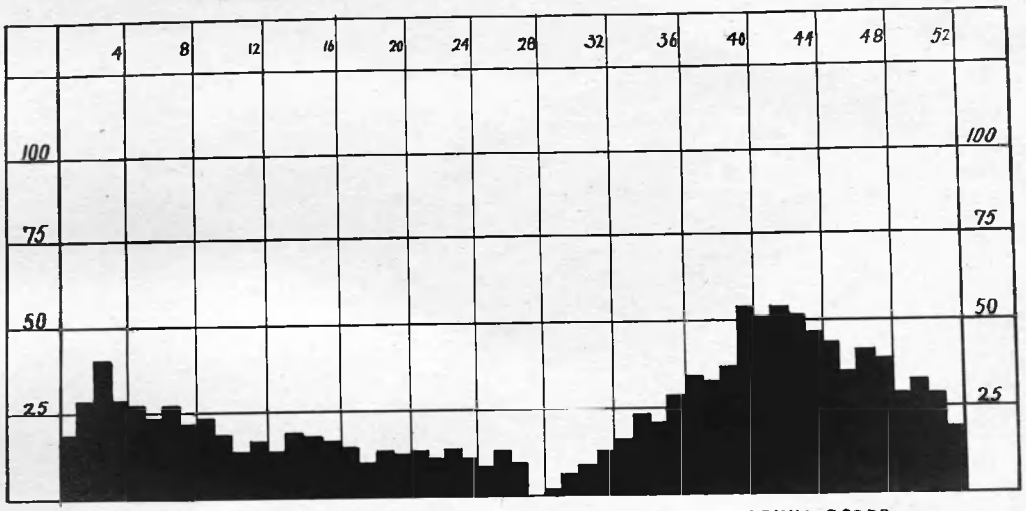
The explanation of this great decrease is not so simple as one would at first expect, but probably improved sanitation is one of the main causative factors of this improvement, although the way in which sanitation acts cannot be definitely stated. It may, however, be confidently stated that improved conditions of milk supply, more prompt removal of cases to hospital, and more thorough supervision of contacts have each played a not unimportant part in preventing the spread.

Much of the decrease in the yearly number of cases during the latter part of the period under review, has undoubtedly been due to the absence of epidemics, as on referring to Chart II the autumnal rise is absent in 1903 and 1904. In this chart the highest points touched by the curve are in 1894 and 1899, and if this interval of six years be taken as representing the "ocean swell" referred to by Dr. Ransome, it should be expected that the cases in 1903 or 1904 should show a tendency to increase the numbers. This, however, has not occurred, though the figures for 1905 show a decided increase over those of the/

the two preceding years, and may be the commencement of another large wave. The effect of "sanitation" on tubercular disease has been to change the period of greatest incidence from the age group 20.25, to the group 25 to 35 years, and this delay in the appearance of the large wave, may also be the effect of improved sanitation.

At this point, the difficulty already referred to of estimating the endemic prevalence of the disease, again presents itself, and the following procedure has been adopted in the hope that some light might be thrown on this point. The total number of cases in each of the fifty-two weeks of the twelve years under review were summed up, and on dividing by twelve, the average number of cases for each week was obtained. When these results were tabulated, it was found that the twenty-eighth week had the lowest number of cases. This number (thirty-nine) was taken as representing the low-water mark of the disease, i.e. the endemic amount, and Chart III has been constructed to show the excess of each week's cases over the twenty-eighth week The resulting diagram should, therefore, show the epidemic prevalence of Scarlet Fever. The figure is a fairly even curve, rising from the base line (twenty-eighth week) to its peak (forty-second week), and/

CHART III.



SCARLET FEVER, 12 YRS. 1893–1904. AVG WEEKLY CASES.
MIN. 39. 28TH WEEK

and then falling more gradually till it again reaches the minimum. There is a suggestion of a small secondary wave in the second and third weeks of the year.

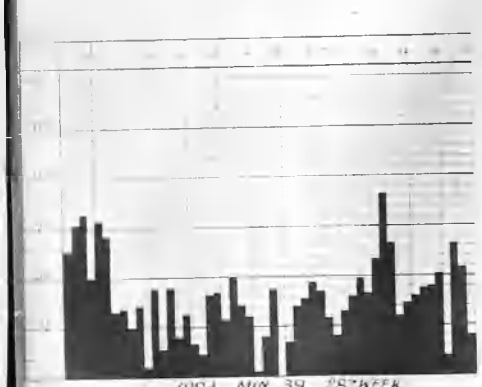
The duration of an epidemic depends upon two main factors. -

(1) The amount of susceptible material, and -

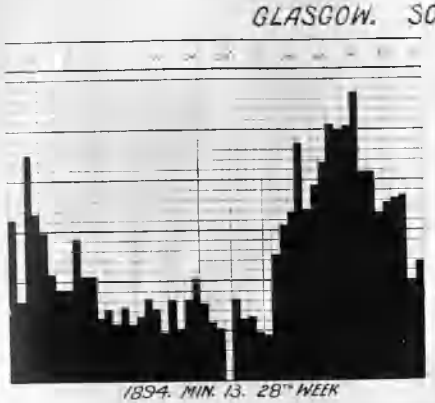
(2) The continued prevalence of virulent infectious material.

The supply of susceptible material may be said to be unlimited, as fresh batches of children are always attaining the age of greatest incidence (2-5 years). The continu--ance of an epidemic would, therefore, seem to depend on a sustained virulence in the organism. For the whole period of the enquiry, the lowest number of cases recorded in any single week of each year has been taken as repre--senting the endemic amount, and with this as a base line Chart IV. has been prepared to show the course of the disease during the twelve years. As already mentioned, the twenty-eighth week's cases may be artificially lowered in Glasgow (Fair Holidays), but this would not disturb the result to any extent.

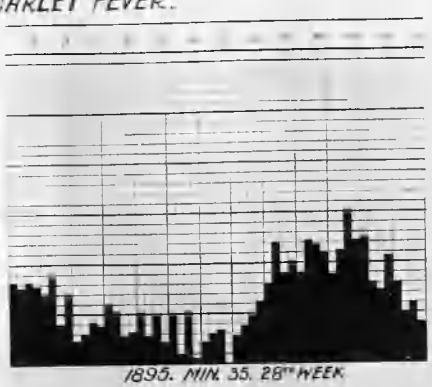
GLASGOW. SCARLET FEVER.



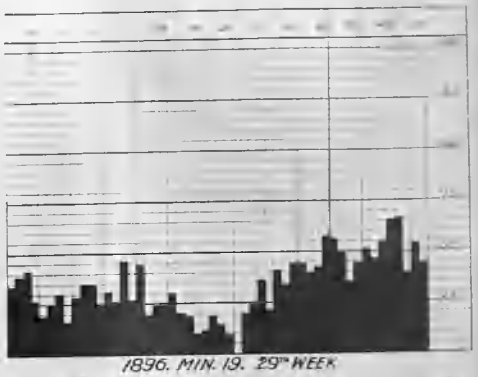
1893. MIN. 39. 28TH WEEK



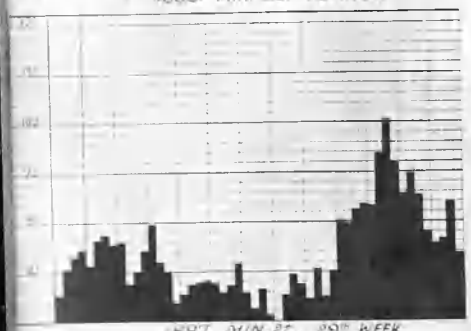
1894. MIN. 13. 28TH WEEK



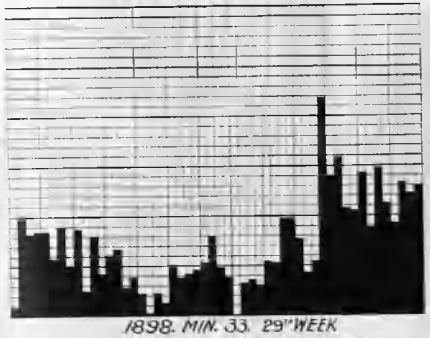
1895. MIN. 35. 28TH WEEK



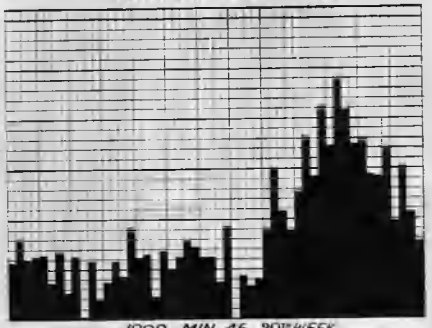
1896. MIN. 19. 29TH WEEK



1897. MIN. 22. 29TH WEEK

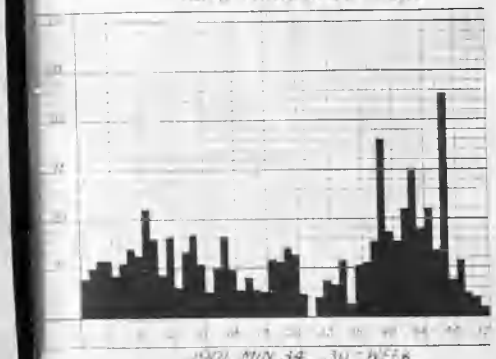


1898. MIN. 33. 29TH WEEK

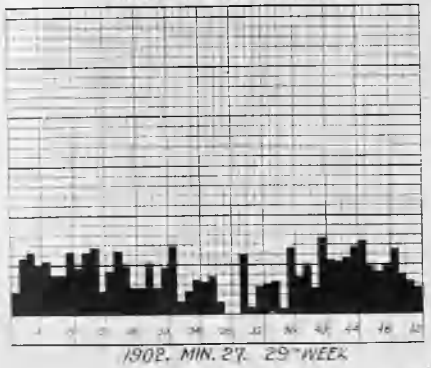


1899. MIN. 45. 29TH WEEK

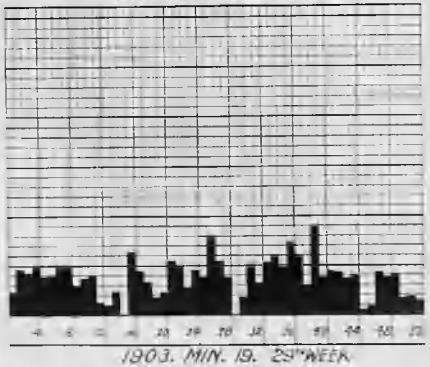
1900. MIN. 34. 28TH WEEK



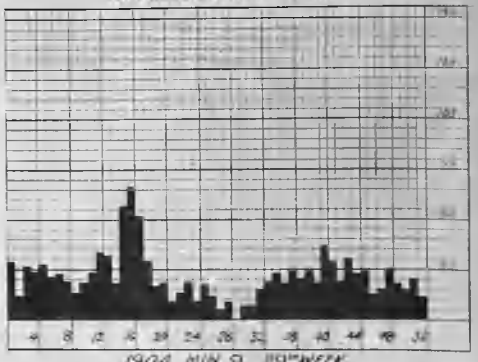
1901. MIN. 34. 30TH WEEK



1902. MIN. 27. 29TH WEEK



1903. MIN. 19. 29TH WEEK



1904. MIN. 9. 29TH WEEK

CHART IV.

Description of Chart IV. -

Chart III shows the average amount of each week's cases over the minimum for the whole period of twelve years, but, on the assumption that the lowest week of each year probably approached as near to the endemic amount as possible, Chart IV was constructed to show the epidemic or superimposed amount of Scarlet Fever. For instance, in 1893, the minimum occurred in the 28th (39 cases), and this was taken as a base line for the year. Again, in 1894, the minimum was 13 in the 28th week, and this formed the base line for 1894. And so on for each year. The result is a picture of the "epidemic amount of Scarlet Fever." The most noteworthy point about this figure is the great difference presented in the year 1903 and 1904 from the preceding years. The probable explanation of this has already been discussed.

It was formerly the prevailing belief that deficiency of rain in some way favoured the origin of epidemics, and it has been independently shown by Drs. Gresswell and Longstaff that the yearly mortality from Scarlet Fever is in inverse ratio to the amount of Rainfall. Dr. Gresswell (13) has also put forward the suggestion that "not only the rainfall of the year, but also that of prior years has influence on Scarlatina." It was remarked by Dr. Longstaff (14) that the chief increases in death-rates from Scarlet Fever, Erysipelas, Puerperal Fever and Rheumatism in England and Wales, occurred in years of deficient rainfall. Dr. Newsholme (15) remarks regarding Rheumatic Fever - "The effect of deficient rainfall is not produced immediately. It takes time to develop, and it is warrantable to assume that the influence of deficient rainfall is exerted as the result of its effect on the subsoil, this effect usually showing itself by a marked lowering of the ground water." This effect appears to be explicable in the following manner :-

It is assumed that a portion of the life history of the Specific Organism of these diseases is spent in the soil (Saprophytic Stage). This being so, increased warmth, and the absence of moisture, would lead to an increased multiplication/

multiplication of the organisms. The next stage in their history is that they are displaced from the soil by rainfall. This may seem strange, and no doubt many of the organisms are washed deeper into the soil, but there are many parts to which rain does not gain access, (particularly the ground below dwelling houses unprotected by cement or concrete founds), and from these parts, the air laden with organisms is pressed out of the ground, its place being taken by the rain water. Again, inside houses the temperature is usually higher, and the escape of contaminated air is aided by aspiration. Differences in barometric pressure at different points also help the exchange.

Mr. M. A. Adams, (16) Medical Officer of Health for Maidstone, remarks regarding Diphtheria in that town, - "As long as the soil is well washed by the winter's high tide, and afterwards dried and aerated during the summer's low tide, all goes well, diphtheria is kept in abeyance; but so soon as these salutory movements are arrested, or their order disturbed, diphtheria gains the mastery, reaching its acme of violence when stagnation is most complete x x x and the virulence of the disorder increases with the stagnation of the soil air.

Rainfall,-

It will now be possible to compare the rainfall which occurred during the period under review with the preceding cases, and in the following table the amount of rain falling in each quarter of the twelve years is given in inches (Registrar General's Weekly Returns - Scotland).

uarter.	1893.	'94.	'95.	'96.	'97.	'98.	'99.	1900.	'01.	'02.	'03.	'04.	Totals.
1st.	5.47	17.01	3.48	9.35	9.69	7.07	11.24	8.34	5.35	4.93	16.42	7.83	106.18
2nd.	6.12	7.19	4.25	7.64	17.08	6.54	10.48	8.36	8.79	3.02	6.31	8.19	93.97
3rd.	8.93	7.85	10.56	12.82	12.93	9.87	7.90	9.63	6.64	5.86	12.41	7.91	113.31
4th.	8.39	9.33	12.98	13.20	10.30	14.84	10.66	17.28	10.26	6.35	12.57	6.92	133.08
	28.91	41.38	31.27	43.01	50.0	38.32	40.28	43.61	31.04	20.16	47.71	30.85	446.54

From this table it will be seen that 106.18 inches of rain or 24 per cent. of the total rainfall fell in the first quarter, 93.97 inches or 20 per cent. in the second quarter, 113.31 inches or 25 per cent. in the third quarter, and 133.08 inches or 31 per cent. in the last quarter. The last quarter had therefore the greatest rainfall, and the second quarter the least. Of the cases/

cases for the corresponding periods, 9,658 or 25 per cent occurred in the first quarter, 8,123 or 20 per cent in the second, 8,959 or 23 per cent in the third, and 12,325 or 32 per cent in the last quarter. How closely the percentage of rainfall and cases for each quarter tally is shown in the following table of the results specified above.

	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.
Percentage of Rainfall, ...	24	21	25	31
Percentage of Cases, ...	25	20	23	32

It seems, therefore, that the number of cases occurring quarterly have a definite relation to the amount of rainfall, but the above table doesnot indicate any relationship between rainfall and epidemic prevalence, except to show that the wettest season of the year is the time at which Scarlet Fever is most rife. Assuming that rainfall acts by immediately displacing the ground air, then/

then this fact is in accordance with the view put forward by Gresswell, Adams and others (vide ante)

It will be necessary, however, to examine each year in more detail. In 1893, 11.59 inches of rain fell in the first six months, and 16.32 inches in the latter half. The mean weekly number of cases for the year was 78. The following table gives similar data for each of the twelve years:-

Year.	1st Six Mths.	2nd Six Mths.	Mean number of Weekly Cases.
1893.	11.59	16.32	78
1894.	24.20	17.18	76
1895.	7.73	23.54	67
1896.	16.99	26.02	52
1897.	26.77	23.23	56
1898.	13.61	24.71	68
1899.	21.72	18.56	94
1900.	16.70	26.91	79
1901.	14.14	18.90	64
1902.	7.95	12.21	48
1903.	22.73	24.98	38
1904.	16.02	24.83	30
Average,	16.68	21.45	62

This table seems to suggest that a diminished rainfall in the first six months of the year is followed by an excess of Scarlet Fever in the Autumn, although the year with the highest number of cases in autumn (1899) is directly antagonistic to this view. Another point to be noted in this table is that, though the rainfall has remained at about the same proportion in each half of the year during the period, the number of weekly cases fell from 94 in 1899, to 30 in 1904. This great decrease is almost certainly due to the absence of epidemics.

Assuming that the spread of Scarlet Fever is almost entirely due to personal contact, the disease is more likely to be prevalent in densely aggregated localities, and is kept active by new and susceptible material being added rapidly.

Much has been done during the last four years, and more is still being done in Glasgow by the Local Authority, to better the sanitary conditions of the slums. At present a vigorous crusade is being carried on against congested areas and uninhabitable houses. Several instances have occurred within the last two years, where mothers purposely exposed their children to "mild cases" of infectious disease, believing that they thereby produce a similar attack in

their/

their children. Many ignorant mothers of this class, take it as a foregone conclusion that their children must take every infectious disease, and consequently make no effort to protect their children from infection. Indeed, it is no uncommon thing to hear one of this class remark regarding a child "He's got to take the Scarlet, and the sooner the better." This attitude does a great deal of harm in more ways than one, because with reasonable care many children might be kept from infection until the age of greatest mortality is past. Moreover, the longer the delay, the greater appears to be the chances of immunity, and many children when they reach about ten to fourteen years without having had Scarlet Fever, escape it altogether. The "class" above referred to is about the lowest in the social scale, and one meets with this type commonly in the backlands of the older parts of the town. Many of these tenements are merely cave-dwellings, being cut off by surrounding buildings from fresh air and sunlight, and being unprotected from the damp arising from the ground or passing through the roof. As an example of the congestion, and concomitant evils existing in some quarters of the city, the following table of facts relat-

-ing/

to several tenements, was prepared by the writer for the Annual Report of the Medical Officer of Health for the City, and is deemed worthy of being added here:-

DEATH-RATES per 1,000 in Several Selected Tenements Represented during 1904. - (Average of the Four Years, 1899-1904).

Address.	General Death-rates.		Phthisis & Respiratory Diseases.		Persons per Acre. *	
	Area represented.	Old Sanitary District.	Area represented.	Old Sanitary Dist.	Area represented.	Old Sanitary Dist.
1-17 Perth St., And.	49.0	24.8	15.4	7.77	1,007	224
2 So. Stirling St., & Buchanan Court,	46.8	19.10	19.3	5.8	1,070	104
118 George Street,	41.5	15.3	15.6	4.06	560	106
CITY, ...	20.69		6.37		61	

*The density here is calculated on the whole area of site - built and unbuilt - and on half the width of the adjoining streets.

Clemow (17) in his article on "Scarlet Fever" in "The Geography of Disease" states - "Too little is as yet known with certainty as to the seasonal and meteorological relations/

relations of the disease, to state that these conditions are of any importance, or if so, of how much importance. The seasonal variations of Scarlet Fever vary widely in different parts of the world. In such places as New York, Michigan State, and England, in which the seasons of the year do not differ much, the period of maximum prevalence falls on a totally different month in each, being in April in the first, January in the second, and October in the third x x x x x x Extreme cold is almost as inimical as extreme heat.

The points of resemblance between Scarlatina and Enteric Fever have already been alluded to, and Dr. Niven in his Annual Report for Manchester (1901)[18] remarks regarding the latter disease "Enteric Fever increases after (1) A heavy rainfall - called the critical rainfall-occurring three to five weeks before the increase (a) preceded and followed by a period of comparatively dry weather, and (b) always accompanied by an ascending (ground) temperature." This being so, one would expect a similar state of affairs to exist regarding Scarlet Fever, but the figures for Glasgow afford no indication whatever of this point.

It would seem from observation that the micro-organism of Enteric Fever can multiply in the soil under favourable conditions, and Scarlet Fever has this in common with Enteric, that the infection apparently multiplies in milk. It is very unlikely that, while the bacillus of Enteric Fever can grow freely on potatoes, in broth, in milk, and in organic liquids generally, the external life of the Scarlatina infection is confined to milk. Perhaps, a clue to the great reduction in the fatality of Scarlet Fever is to be found in the enormous improvements which have taken place in the disposal of excreta, and in the attention/

attention which is now being paid to the regulation of milk supplies. Dr. Longstaff in his "Studies in Statistics," showed for the period 1865 to 1880 in England and Wales that there was a well maintained correspondence between diminished rainfall and excess of Scarlatinal Mortality. This, however, is not borne out by the curves for the succeeding ten years.(19) If a high rainfall depresses Scarlatinal Mortality, one would expect that this effect would be specially well marked in the third quarters of the respective years, since it is in that quarter that signs are exhibited most plainly of the effect of extraneous influences on the annual wave. The following table has been constructed to show the relationship between the rainfall of the third quarter and the Scarlatinal deaths in the third and fourth quarters of the years under review, if any such relationship exists.

	1893.	94.	95.	96.	97.	98.	99.	1900.	'01.	'02.	'03.	'04.
Rainfall 3rd. Qr.	8.93	7.85	10.56	12.83	11.9	9.8	7.9	9.63	6.64	5.46	12.41	7.91
Deaths Scarlet 3rd. Qr.	57	38	39	37	26	38	53	44	31	25	20	19
Deaths 4th Qr.	80	67	63	39	60	63	51	53	40	28	21	10

These figures show that whether the influence of rainfall in the third quarter is direct or indirect, and whether we should expect it to be manifest in the third or fourth quarters of the year, there is evidently no correspondence between high rainfall and low death-rate, but rather the contrary. In the same way, if the rainfall year by year be compared with Scarlatinal death-rates and incidence rates, we find that there is no correspondence manifest between total rainfall and either increase or decrease of Scarlet Fever incidence or mortality.

Rainfall, however, is by no means the sole influence at work, and the effects of temperature may now be considered in detail. As regards Scarlatina, tempera--ture seems to play a more important part than rainfall, and with these two influences constantly at work, it is extremely difficult to arrive at any definite conclusion regarding either.

In Chart I. is shown the average weekly tempera--ture for the twelve years, and when this is compared with the curve of the cases, the temperature curve is found to run in direct opposition to the number of cases, e.g., in cold weather the cases are more numerous than when the temperature is high. The number of cases begins to diminish as soon as the temperature begins to rise (fourth week), and the cases begin to increase on the first indication of a falling temperature (twenty-ninth week). The fall in temperature is very gradual, but the cases mount up suddenly, and in nine to eleven weeks reach their highest point (fortieth and forty-second weeks). The slight fall in the temperature seems to be sufficient to allow of an epidemic starting, and after it has gained a hold it follows the law of epidemics, and during the epidemic period temperature has very slight if any influence./

influence.

A theory has lately been put forward that "an epidemic of disease is the period of convalescence of the virus after it has lost its virulence, and that the interepidemic period is that in which the organism is able to carry on its saprophytic growth."(20)

Temperature may also act indirectly as a cause of increase in Scarlet Fever. In cold weather people stay more indoors, keep the windows closed, and have much more personal contact with each other. Now, personal contact may be said to have been proved to be the main channel of spread in Scarlet, and it is reasonable to expect that under these circumstances an increase of the disease should be looked for.

If we regard climate as being mainly determined by temperature and moisture, including the rainfall, the year may be divided into six periods, each having a climate peculiar to itself, though shading one into the other on each side by nice gradations. These six periods with their broad characteristics are as follows:-

Period.	Extending from	Climate Characteristics.
First.	4th wk. of October to 3rd wk. of December	Damp with Cold,
Second.	4th wk. of December to 3rd wk. of February	Cold.
Third.	4th wk. of February to 2nd wk. of April	Dry and Cold.
Fourth.	3rd wk. of April to 4th wk. of June	Dry and Warm.
Fifth.	5th wk. of June to 4th wk. of August	Heat.
Sixth.	1st wk. of September to 3rd wk. of October	Damp and Warm.

There are six phases of the curves, showing the annual number of cases through the weeks of the year, which call for special consideration.

(1) The date when the numbers begin to indicate an increase from the annual minimum point to which they fall.

(2) The period at which they show a rapid increase.

(3) The period at which they reach the annual maximum.

(4)/

(4) The period when they begin to record a decrease from the maximum.

(5) The period at which they show a rapid decrease, and

(6) The period when they reach the annual minimum.

(It is to be noted that nearly all the diseases which show a relative low attack rate at Season I. are bowel complaints, and in this respect Scarlet is allied to Enteric and Diarrhoea). In September no disease but Scarlet shows a rapidly increasing death-rate.

Applying the above periods to the average number of cases for the twelve years, we find the following:-

(1) The increase begins to appear in the twenty-ninth week, i.e., about the middle of period V. which is characterised by heat.

(2) The rapid increase begins about the thirty-fourth week, i.e., at the commencement of period VI. Damp and Warm.

(3) The annual maximum is reached in the forty-second week, i.e., at the end of the sixth period and the beginning of the first. Here dampness is a common feature, and is accompanied by a falling temperature.

(4) The decrease commences in the forty-third week, and all through period I. follows the temperature curve very closely, i.e., the cases become less numerous as the cold increases.

(5) The rapid decrease occurs in the last few weeks of the year. (first and second periods) where Cold is the common feature, and the rainfall is becoming less.

(6)/

(6) The annual minimum is reached in the twenty-eighth week, i.e., in period V. Heat.

Chart A. is prepared to show these facts, but it will be noted that the rainfall varies very greatly, and does not tally at all closely with the curve shown by taking a longer period of years say thirty or fifty. The diagram, however, in the main agrees with that prepared by Buchanan & Mitchell for London.(21)

"So far as Climate is concerned, no single meteorological influence appears to equal the effect of temperature on health. Thus a climate benefiting Pulmonary disease may promote hepatic disease, or whilst warding off rheumatism may communicate malaria or yellow fever." (Clemow)

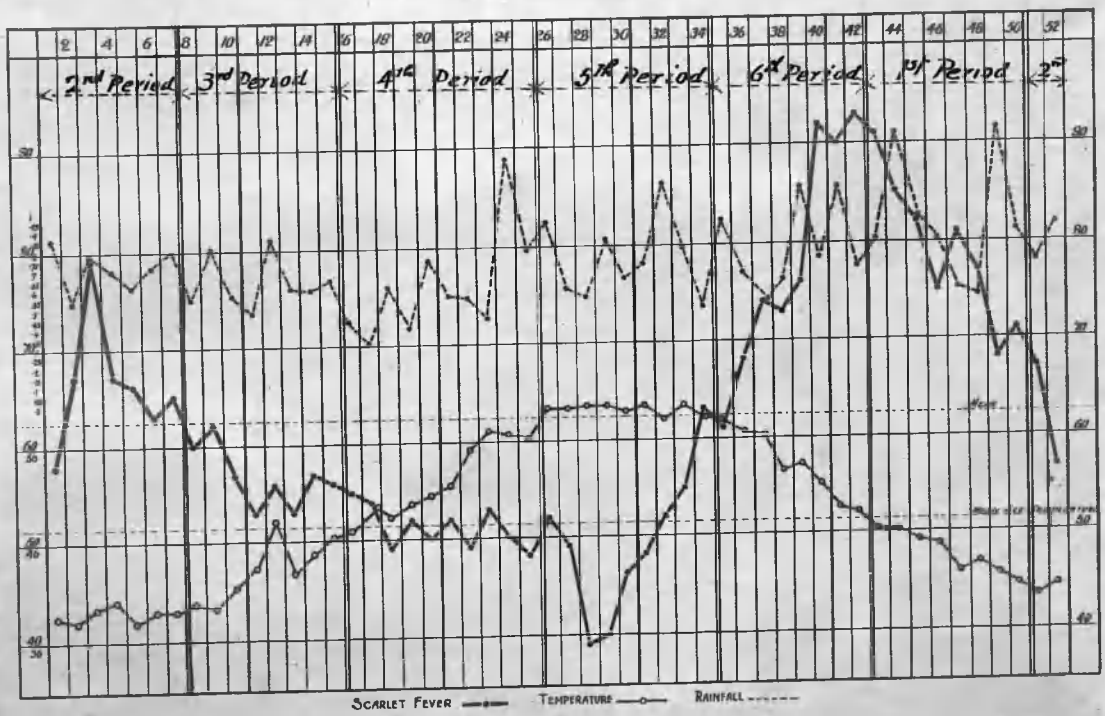
Diseases dependent on climate are of two kinds.(22)

(1) Those caused by telluric emanations, e.g., malaria,&c.

(2) Those caused by atmospheric vicissitudes.

The former diminish from the equator to the pole, the latter increase. Scarlet Fever is one of the latter.

CHART A


2nd Period
3rd Period
4th Period
5th Period
6th Period
1st Period
2nd
Scarlet Fever
Temperature
Rainfall

There are one or two other possible factors in the spread of Scarlet Fever which are worthy of note in relation to the seasonal variations in its prevalence.

I. Aerial Convection.-

The possibility of this mode of spread offers a wide field for speculation. Infective material is undoubtedly given off by every patient suffering from this disease, by the breath, skin and the discharges. That this material is capable of retaining its virulence for long periods is now an accepted fact, and in the same manner as the Smallpox virus is carried by winds, or the "bacterium lactis" gains access to milk, it seems reasonable to argue that the "contagium virum" of Scarlatina is likewise portable.

There is no evidence on record of the prevalence of Scarlet Fever around infectious disease hospitals, analogous to the experience with regard to Smallpox. Besides, the theory that aerial infection is the only means of spread explains too much, unless modifying influences are admitted. Why is it, if the contagion of Scarlet Fever can remain virulent and suspended in the air/

air for long periods that persons escape for years and thereafter prove their susceptibility by contracting the disease? Dr. Ransome draws a simile between this phenomenon and a battle. In the battle many bullets are fired off, but only a few take effect. It may be, that to produce an attack of the disease, a certain minimum charge of poison is necessary, and that dilution beyond a certain limit renders the virus harmless. Thomas makes the following statement regarding this point.(23)
"It is an undoubted fact that a dilution of the contagious principle, by attentive ventilation of the sick-room, very much diminishes, or entirely removes, the opportunities for infection.

II. Drainage Defects;- are held by several authorities including Drs. Squire and Carpenter, to play an important part in the spread of Scarlet Fever. This view, however, is not generally accepted, although, here again the analogy between Scarlet and Enteric Fevers, becomes evident, and Dr. Whitelegge(24) of Nottingham states that after careful investigation he has found little confirmatory evidence of such a theory.

III. Milk Supplies,-

It has long been recognised that milk is

pre-eminently/

pre-eminently a channel by which the infection of Scarlet Fever is spread, and an account of several "milk epidemics" investigated by the writer are here inserted to illustrate this fact.

Epidemic I.- On August 5th, 1905, a case of Scarlet Fever was notified in connection with the milk supply of a dairy in the Southern District of the City. On 15th August three other cases were notified and by the middle of September nineteen cases had occurred.

Dairy A.

On 31st August, two cases of Scarlet, were notified as obtaining their milk from a dairy in the Northern part of the City, and these were followed by five cases during the next fortnight.

Dairy B.

On 25th August, two cases were notified in connection with another South Side dairy, and these cases were followed by three others, all in separate families.

Dairy C.

Each dairy was visited, and careful investigation made for evidence of any illness; all the milk carriers were examined, but no suspicious circumstance was discovered. The milk supply was then enquired into, and here several interesting facts were brought to light.

Dairy/

Dairy A. derived its milk from three farms in the Mearns district. One of these farmers (a) after leaving milk at A. took the remainder of his milk each morning to Dairy C.

Dairy B. was supplied from a farm adjacent to that supplying A. and C., and tenanted by a son of the owner of the latter farm (b).

The keeper of Dairy B. stated that his supply was augmented about August 23rd with part of the milk which formerly went to Dairy A. i.e., he obtained some of farmer (a's) milk through (b). It will be noted that the cases in connection with Dairy B. occurred on August 31st i.e., one week after the milk was said to have been diverted. This story was denied by the farmer, although dairyman B's daily returns showed an increase in the number of gallons of milk about that date. These facts pointed strongly to farm (a) as the source of infection. Another farmer (c) supplied milk to Dairy A. each morning, and left the remainder at Dairy C. The only connection this milk could have with the other supply from farm (a) was that the farmers were on very intimate terms, and indeed, on visiting the farm (a) on 5th September farmer (c) with his wife and child were visitors at tea. No evidence of illness was discovered at any of the farms, and all the cows were in good condition.

All/

All the dairymen were advised to sterilize the milk before selling, and this resulted in stopping the Epidemic.

It seemed as if no explanation would be found to account for the epidemic, but on 25th September a case of Scarlet was notified in the Southern District as having sickened on 28th July and being now "desquamating," the diagnosis only having been ascertained on the appearance of peeling. Investigation revealed the fact that during all the time this child was ill, the household was supplied with milk from Dairy A. The cans were left at the door each morning taken inside, and returned the following morning. In disinfecting the cans the handles were never treated, and it may be through these cans that the butts became infected, and that the infection spread in this way from the house to the dairy, from the dairy to farm (a) from farm (a) to Dairy B. and farm (c), and from farm (c) to Dairy C. No further cases occurred after this child was removed to hospital, although sterilization of the milk was stopped on recommendation.

Epidemic II.- About the beginning of April, 1904, it became evident that Scarlet Fever cases were occurring in connection with the milk supply of dairy in the Western District of the City. The first case was reported on 5th April/

April as having sickened on 1st April, and from the former date to the 22nd April, sixty-six cases were notified. Immediately upon the discovery of Scarlet Fever associated with this dairy, enquiries were instituted. The dairy staff was medically examined as were also the members of the dairyman's household. Information was sent to the Medical Officer of Health for Lanarkshire asking for immediate examination of the farm supplying the milk. The carriers of the milk were visited, and they, with the other members of the family were examined. The milk supply was cut off, until a report came from the County Medical Officer of Health. Disinfection of the whole dairy premises was carried out, and instructions were given that no milk vessels should be allowed to enter infected households.

The farm having been declared free, and the dairy disinfected, the milk supply was resumed. A few days elapsed, during which cases that had been previously infected, developed, but when new ones appeared the farm supply was again stopped, and the farm inspected by the Glasgow Authorities, with negative result.

On 8th April, another dairy in the Central District of the City deriving milk from the same farm, began/

began to have Scarlet Fever cases among its customers, and from 8th to 25th sixteen cases occurred. All the carriers were paraded, and seven who showed abnormal condition of the throat were detained from further work. The dairyman's son, whose throat was in a similar state (but who had been in hospital with Scarlet Fever a year before) was sent off on holiday, and the premises disinfected. After 25th April, the cases were almost entirely secondary ones occurring in the households already affected. Several of the others were doubtful cases which had sickened early, but were being kept under observation until peeling of the skin occurred. In many cases the symptoms were slight, and by no means conclusive of Scarlet Fever. In many instances there was little or no rash, and the throat symptoms were very mild. No cases were reported after 2nd May, and although every conceivable point was investi-gated, no source of infection was ever traced. There had been no teat eruption, or any other sickness among the cattle at the farm.

Epidemic III.- On 19th February, 1903, information was received from the Inspector of the South Suburban District that several notifications of Scarlet Fever had been received, and that the milk supply in each case was derived/

derived from one or other branch of a certain dairy. On going over the cases the following was found to be the state of affairs. Out of a total of seven cases, three were connected with the Langside Road branch (A), two with Prince Edward Street branch (B), one with the Sinclair Drive branch (C), and one with the Cart from the main depot. One case sickened on 14th February, five on 16th, and one on 17th. All the cases, with one exception, were adults, and this of itself excluded school infection.

On visiting each branch the following particulars of milk supply were obtained:-

A. (2 cases) Morning Milk from Farm (a) Busby,
Midday from Wholesale Depot. Total 25 pints.

B. (3 cases) Morning Milk from Farm (a) Busby,
Midday from Depot. Total 33 pints.

C. (1 case) Morning milk from Farm (a) Busby, and
Farm (b) Eaglesham.
Total supply 91 pints, supplemented by about
15 pints from Depot.

One case occurred where the milk was derived directly from the wholesale depot.

Farm (a) supplied all the affected branches, and also the depot. The fact that one case occurred in connection with the cart coming directly from the depot would seem to throw suspicion on the wholesale depot. The manager stated that it was practically impossible to ascertain the source

of/

of the milk carried by this particular cart, but he supplied a list of all his supplies. A list of the names and addresses of the carriers was also obtained, although the evidence was entirely against the presumption that these were the source of infection. No illness had occurred in connection with the dairies themselves.

Information was sent to the County Medical Officer of Health, Lanarkshire, and a request made that the farm staff and cattle be examined. He replied on 21st February as follows:-

"I have to inform you that a case of Scarlet Fever, sister-in-law of farmer, not a dairy-worker, was notified at this farm on 12th February, and was removed to hospital on the same day. I visited the farm yesterday and learned from the Medical Attendant that he had two of the inmates under observation for Scarlet Fever. The first of these was a dairy-worker (M.S.) who has had a sore throat, sickness and vomiting, but no rash. The illness in this case dates from 5th February. The other is the case of a milker, who has a sore throat, followed by rheumatic pains in wrists and ankles, but without a rash being noticed. His illness dates from 13th February.

Both cases have been removed to hospital for

observation/

observation, and the premises have been disinfected."

(Signed) Medical Officer of Health.

No other cases occurred thereafter, and in this case the evidence of infection spreading from the farm through the milk supply is undoubted.

IV. School Infection.-

In a disease such as Scarlet Fever, where personal infection plays so important a part in the dissemination, the school-room should be expected to be a common source of spread, but this is not the experience in Glasgow. From time to time, however, limited groups of cases can be traced to class infection, as the following examples will illustrate.

(1) From 21st April to 8th May, 1903, nine cases occurred in one classroom of a school in the Southern District. On enquiry it was found that a girl who sickened on 18th April, had attended school during the acute stage of her illness, and was only known to have Scarlet Fever on the appearance of desquamation.

(2) In January, 1904, five cases occurred in another school, the first case sickening on 10th January, followed by others on the 11th, 16th, 21st, and 28th January.

No/.

No missed case was discovered here.

(3) On 24th October, 1904, a case of Scarlet Fever sickened in Boys' Ward, No. 3. of an Institution in the City, and was removed to hospital on the 26th. From this latter date until the 28th November there was no illness to suggest Scarlet. On this latter date, however, a case sickened in Girls' Ward, No. 3 of the same Institution, and was kept under observation until the 7th December, when she was recognised to be definitely desquamating and sent to hospital. Desquamation apparently was noticed for four days before removal. Following this, four cases have sickened,- the first in Boys' Ward, No. 2. on the 6th December, the Assistant Matron on the 8th, a case in Girls' Ward, No. 1 on the 9th, and a case in Girls' Ward No. 2 on the 11th. This erratic distribution of the disease suggested that the infection was conveyed by some agent who had access to the various parts of the Home, and the explanation is apparently the following:-

When the first suspicious case sickened, owing to the lack of nurses, the Assistant Matron was told off to include the patient among her other work. She continued at this work until the 7th December, when the patient was removed to hospital. Unfortunately, she resumed her ordinary/

ordinary duties without any precautions having been taken to disinfect her clothing or room. She herself sickened of the disease on the 8th inst. and up to the 15th three other cases, sickening on 6th, 9th, and 11th, occurred.

The above examples are sufficient to show that School Attendance plays a part in the spread of Scarlet Fever.

SUMMARY & CONCLUSIONS.

The generally accepted view at present is that Scarlet Fever is spread mainly by personal contact, and that the infection is direct. Now, in order to keep a disease present in a community such as Glasgow, it would appear necessary that about ten per cent. of the population should always be capable of infecting susceptible persons. That personal infection plays a very important part in the spread of the disease is not denied, but recent work on the subject tends to point to "milk" as being the chief channel of infection in Scarlet. The investigations of Klein in the historic "Hendon" outbreak, when published, were received with grave doubts in certain quarters, but, nevertheless, Klein may be held to have proved conclusively that Scarlet Fever in the human may be spread by means of a disease affecting bovines. The examples detailed on previous pages, although none of them tally with the Hendon cases, serve to demonstrate the dangers of a milk supply which has become contaminated with the Scarlet Fever virus.

One is forced therefore to come to the following conclusions regarding the spread of Scarlet Fever -

1. There can be little doubt that direct transmission of/

of the disease from person to person is a large factor in the spread of Scarlet Fever, and it may likewise be stated that the infection is direct.

2. There can be no doubt that milk is also an important channel of infection, probably even more important than personal infection.

3. The falling off in the number of cases notified during the last five years of the enquiry, is entirely due to the absence of epidemics. This fact is graphical--ly shown in Chart II where the absence of the autumnal rise is to be noticed.

During the latter half of the period, no departure of any moment took place from the average rainfall or temperature obtaining in the first six years. Climate must, therefore, have no great bearing on the diminished number of cases notified. The probable explanation is that here we have appearing the results of improved sanitation. The result of the application of Sanitary principles to Phthisis Pulmonalis has been, as is well known, to delay the period of greatest death-rate from the age period 15-25, to the age period 25-35, i.e., the deaths though not prevented altogether are delayed for ten years. The various factors which have brought about this change may/

may be stated to include -

(a) Improved methods of removal of house refuse etc., and more thorough treatment of sewage.

(b) Better water supplies and drainage.

(c) Better housing - more cubic space per head, and better supervision against overcrowding.

(d) Improved supervision of Milk Supplies, and -

(e) Prompt isolation of infected cases, and efficient supervision of contacts.

(d) must be ranked as the most important of all. Cows are well known to be liable to Tubercular disease, and tubercle bacilli have often been found in milk from such animals. Now, according to Klein bovines are subject to a disease which in the human subject is known as Scarlet Fever, and he has proved that the infection spreads in the milk. Hence the great importance of securing a milk supply which is above suspicion.

It will be noted from Chart II that the large "wave" of disease which was due to have appeared in 1904 (five yearly) had not set in, but the figures for 1906 show an increasing number of cases, and it may be argued that sanitation has caused the delay in the appearance of this wave, in the same manner as it delayed the highest death period from Phthisis. In other words, the large epidemics/

epidemics are becoming less and less numerous, under the influences of the forces now at work combating the disease.

4. It would appear that Scarlet Fever is closely allied to Enteric, that it is essentially a soil disease, and that the infection is capable of being spread through the medium of the urine of persons suffering from the disease. This is borne out by the frequency of nephritis as a complication of Scarlet Fever. Again, the curves of these two diseases have their maxima and minima at the same seasons.

5. As regards climate it may be stated that for the twelve years under review the following facts obtain:-

(a) The number of cases vary directly with the rainfall

(b) The number of cases vary indirectly with the temperature, -

and that period six (vide ante) characterised by INCREASING cold and damp, is the season where the cases are most numerous.

In conclusion, it may be remarked that infection from a previous case may be the explanation of all, as it is the undoubted cause of many cases, although its associations in regard to age, sex, and season are rather with diseases in/

in which infection from person to person is believed to play a minor part. "It is possible that a complete explanation may ultimately be found in varying degrees of physiological susceptibility on the one hand, and in varying facilities for access of the virus in the other, without invoking the aid of any other agencies than those with which we are familiar; but it is also possible that in time to come modes of infection will be brought to light which are now as little suspected as bovine scarlet-fever was three years ago."(25)

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