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OBSERVATIONS ON THE INCIDENCE OF SCARLET FEVER IN DIFFERENT DISTRICTS OF THE SAME TOWN.*

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HAVING been invited by the Secretary of the North of England Branch of this Society to read a paper on the occasion of the Annual Provincial Meeting this year, I have chosen the subject of Scarlet Fever for several reasons, viz.: (1) On account of the special interest in the subject evoked by recent papers and discussions dealing particularly with the effect of hospital isolation on the prevalence and spread of the disease; and (2) On account of the prominent position which this disease has occupied in South Shields from the earliest times of which we have record.

Out of a great many points of interest which one comes across in the study of this disease from a preventive medicine standpoint, I have selected one as the subject of my paper, viz., the differences which the various districts of one town exhibit in respect to the prevalence of the disease. The town on which my observations have been made is South Shields, but I think it is probable that similar differences are evident between the several districts of other towns, and hence I have preferred to use the term "the same town," and not "South Shields."

At the time of my appointment to South Shields, some three years ago, and for the next six months, scarlet fever was epidemic in the town, and it was in reporting on this epidemic at the end of the year

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1901, that I was first struck with the marked differences in the prevalence of the disease shown by the various districts of the town. I have since then had two further years' experience of the course of the disease, during which the epidemic wave has entirely subsided and been followed by a year in which the number of cases of scarlet fever reached an unprecedentedly low figure; and I have also made investigations into the distribution of the disease during the period 1892 to 1900, as well as during the years 1901 to 1903, the total period considered being one of twelve years.

At last census the town was divided into eighty enumeration districts, and I obtained for each of these full details of population, with the numbers living at different ages, and regarding the number and size of houses therein. From these figures the population for the preceding and following years has been calculated by means of the record of houses built in each district in each of the years in question, the number of new houses being multiplied by the average number of persons per house found to exist in the district at the census.

I would in the first place put before you the figures for the years 1901-1903, as these are evidently the most accurate, and as this is the period during which I have been personally in charge. I may point out that the distribution of the disease during this comparatively limited period gives fairly reliable data for instituting a comparison between different districts, for the following reasons: (1) The large number of cases occurring during the period, viz., 2,475; (2) The fact that, with one exception, every enumeration district in the town has been invaded; (3) The manner in which the epidemic wave swept through the town, passing from two small areas, first westward and southward to the borough boundary, and then north and east to the sea, thus passing over the whole borough. The town is divided into ten wards, and the following table shows the extent to which scarlet fever prevailed in each of these during 1901 to 1903 (Table I).

In this table the attack rates are given for each of the three years, as well as the average rates. The average rates are those to which the chief importance must be attached, and it is seen that they vary very considerably, viz., from 5·2 per 1,000 to 11·8, the one rate being more than double the other. Why should there be this great difference? It is somewhat difficult to answer this question. Each of these wards differs from the others in various respects, *e.g.*, age-constitution, social condition, physical features such as elevation, exposure, and subsoil. They also differ with respect to the proportion of cases which have been removed to hospital.

TABLE I.
INCIDENCE OF SCARLET FEVER ON DIFFERENT WARDS OF SOUTH
SHIELDS, 1901-1903.

Wards	Shields.	St. Hilda.	Holborn.	Beacon.	Pents.	Westoe.	Laygate.	Rekendyke.	Deans.	Tyne Dock.	Whole Borough.
Attack-rate, 1901	9.3	8.9	8.4	15.3	9.3	19.0	13.8	16.9	13.1	9.0	12.5
Ditto 1902	4.2	4.8	4.8	6.8	10.6	10.8	6.8	9.0	11.5	6.3	8.0
Ditto 1903	2.2	3.5	2.5	4.8	3.6	5.5	2.6	2.8	3.4	3.4	3.6
Average attack-rates, 1901-1903	5.3	5.8	5.2	9.0	7.9	11.8	7.7	9.0	9.3	6.1	8.0
Corrected average attack-rates ...	5.17	5.75	5.28	9.0	8.65	11.09	6.92	8.32	8.36	6.51	—
1901 % of cases removed to hospital ...	50	42	56	41	34	30	34	35	37	35	39
1902 ditto	72	92	66	42	44	44	58	43	41	53	48.9
1903 ditto	90	95	95	47	53	60	88	93	63	89	71
Average ditto	70	76	72	43	43	44	60	57	47	59	52.9
% of population under 15 ...	37	36	36	35	32	37	40	38	39	33	34
Average scarlet fever death rates, 1901-1903	.29	.126	.146	.16	.33	.736	.67	.373	.366	.193	.36
Average general death rates, 1902-1903 ...	22.2	23.7	24.1	15.4	15.5	14.4	22.7	17.0	16.3	17.6	18.2

In respect to one of the above-mentioned characteristics, viz., age-constitution, we have definite information to guide us as to the part such differences play in increasing or lowering the attack rate in any district. It is well known that it is in the early years of life that the great majority of attacks of scarlet fever occur, and that consequently a higher attack rate is to be expected in a district having a large proportion of children in its population, than in one where the proportion of children is low.

In the year 1901, during which 1,263 cases of scarlet fever were notified in South Shields, the attack rates on the numbers living at various ages were as follows:—

0—5,	33 per 1,000	} 38.7 per 1,000
5—10,	45 „ „	
10—15,	18 „ „	
15—20,	4.8 „ „	} 11.6 „ „
20—25,	1.2 „ „	
25—30,	1.6 „ „	} .9 „ „
30—35,	1.9 „ „	
Over 35,	0.26 „ „	

From these figures one can calculate for each ward or district a “standard” attack rate, by finding the number of cases which would

occur therein if the population living at each different age suffered in the same degree as in the town generally. If, then, the attack rate for the whole town be divided by the standard rate for any district, we obtain a factor by which, if the actual attack rate of any district be multiplied, we get the "corrected attack rate." I have carried out a process of this kind, dividing the population for the purpose into three age-periods—those under ten years, those between ten and twenty, and those over twenty years. To make a separate calculation for each quinquennial age-period was, I considered, unnecessary. These three periods appeared to me to be the best to select; the cases occurring in persons over twenty years of age are so rare that varying proportions in a district of persons between twenty and forty on the one hand, or over forty on the other, would not appreciably affect the attack rate; the attack rates for the first two quinquennia are not very dissimilar, and, moreover, the proportion between these two age groups remains very much the same in the various districts; the proportion between the numbers living in the 10-15 and 15-20 groups respectively, also remains much the same in the various districts.

After the attack rates for the wards have been corrected in this manner, we find that the rates vary just as much as before, viz., from 5.17 per 1,000 in Shields ward to 11.09 in Westoe ward. On the other hand, the arrangement of the wards in the order of their attack rates is considerably altered by the correction for age. The following facts are shown by the foregoing table, viz. :—

(1). That the three wards, Shields, St. Hilda, and Holborn, which have the lowest average attack rates, all between 5 and 6 per 1,000, are the wards from which the highest proportion of cases was removed to hospital. The annual average proportions of cases removed were 70, 76, and 72 per cent respectively.

(2). That the three wards, Tyne Dock, Laygate, and Rekendyke, having between 50 and 60 per cent of their cases isolated in hospital, occupy the next three most favourable positions as regards average attack rates.

(3). That the four wards having less than 50 per cent of their cases isolated, showed the highest corrected attack rates.

The table also shows that in each ward a larger proportion of cases was isolated in hospital in each succeeding year, and that in each ward, with one exception, the attack rate fell in each succeeding year.

Apart from age-constitution and the extent of hospital isolation, the wards differ, as I have stated above, in many respects, and in most of them one finds that different parts of the ward also vary widely from each other. There are certain other points, however, in which they may be more or less accurately compared.

COUNTY OF BOROUGH SOUTH SHIELDS

—SCARLET FEVER.— 1901 — 1903.

Sectioned according to Attack Rate.

●	OVER 25 PER THOUSAND.
●	21 TO 25 " "
●	18 " 21 " "
●	14 " 17.8 " "
●	10 " 14 " "
●	4 " 10 " "
<u>UNSECTIONED — NO CASES.</u>	

COUNTY BOROUGH OF SOUTH SHIELDS

— SCARLET FEVER. —

1901 — 1903

Sectioned to show Percentage of Cases sent to Hospital.

In the table is shown for each ward the general death-rate, the average for 1902-1903 being given, and a very striking fact is that the three wards with the lowest scarlet fever attack rates, have general death-rates very much in excess of six of the remaining seven. The other ward with a high general death-rate is Laygate, which occupies the fifth most favourable place as regards scarlet fever attack rate. The high general death-rates in these four wards, Shields, St. Hilda, Holborn, and Laygate, are, as may be guessed, an indication of the poverty of the inhabitants and the general insanitary conditions of existence which prevail in them. These wards, in fact, contain almost all the slums of the town, and are very largely composed of property of this nature. The only other line of interest in the table is that which gives the scarlet fever death-rates. When arranged in order of these rates, the wards occupy somewhat similar positions to those shown by the attack rates: St. Hilda and Holborn occupy the most favourable positions, and Westoe is still the worst. On the other hand, the Beacon ward occupies an exceptionally favourable position (third), and Laygate ward comes very low in the list, indicating a high case mortality in the latter. So far, then, as it is possible to compare areas differing from each other in so many respects as do these ten wards, I find that low attack rates coincide with a high degree of poverty and the removal of a large proportion of cases to hospital, and that high attack rates are found in the better-class wards (consisting chiefly, I may say, of respectable artisan population with a comparatively small admixture of middle-class population) and where the proportion of cases removed to hospital was smaller.

I pass now to a comparison of the enumeration districts as regards attack rate. There are altogether eighty of these, and most of them are entirely contained in one or other of the wards; there are, however, certain exceptions where an enumeration district lies partly in one ward and partly in another. In these cases the portion of the district in one ward may be, and often is, of quite a different character from the portion in the other. I have therefore considered it best to adhere to the ward boundary, rather than the district boundary in these cases, for the purpose of this comparison. The population of each enumeration district varies from 800 to 1,500, but in the case of these divided districts the population of the parts is sometimes much smaller, and in order to avoid the fallacy arising from this circumstance, in considering the attack rates for short periods it has appeared best to consider them along with the adjoining enumeration district in the ward to which they belong, if, as is usually the case, such adjoining districts is of similar character. The districts so arranged number altogether eighty-six.

ENUMERATION DISTRICTS IN ORDER OF CORRECTED ATTACK-RATE FOR TRIENNium, 1901-1903.

District.	Corrected Attack-rate, 1901-1903 per 1000.	Per cent Cases to Hospital.	Proportion of tenements of less than five rooms.	Persons per room in these.	Social Condition.	Physical Features	1892-1900. Average Triennial Attack-rate
1 Holborn 54	—	—	86	2.22	Poorest Class : sparsely popu- lated	Variable elevation : on clay and ash	5.8
2 Shields 20, 24	4.4	80	83	1.70	Poorest Class : densely popu- lated	Low-lying : on clay	8.8
3 " 15	5.9	75	98	2.15	Ditto	Stands high : on ballast	1.98
4 Tyne Dock 74	6.0	62	90	1.86	Ditto	Ditto : on clay	8.6
5 Holborn 56, 57	6.8	50	96	2.06	Ditto	Low-lying : clay	8.5
6 Laygate 48	7.0	66	93	1.87	Poor Class and Poorest : dense- ly populated	? Low-lying : clay	13.9
7 " 52	7.5	66	95	2.29	Poor Class : densely populated	Low-lying : clay	6.8
8 Hilda 24	7.7	71	86	1.95	Poorest Class : population crowded, but with open spaces	Low-lying : clay and gravel	11.7
9 Laygate 50	7.9	71	98	1.99	Poorest Class : densely popu- lated	Ditto	14.5
10 Shields 18	8.2	71	89	2.05	Poorest Class : sparsely popu- lated	Varying high : on ballast	8.2
11 Holborn 53	8.6	90	93	2.43	Ditto	Stands high : on ash hills	10.0
12 Shields 19	9.1	77	99	2.4	Poorest Class : population crowded, but with open spaces	Stands high : on ballast	5.7
13 Hilda 20, 21	9.2	83	90	1.81	Poor and Poorest Class : dense- ly populated	Low-lying : on clay	7.0
14 Shields 17	9.4	57	92	2.08	Poorest Class : sparsely popu- lated	Ditto	7.2
15 Beacon 8	9.8	71	91	0.99	Poor Class : sparsely populated	Stands high : on sand	8.2
16 Shields 16	9.9	54	95	1.95	Poorest Class : dense, with open spaces	High : sand and gravel	6.3
17 Deans 35	10.1	54	89	1.73	Respectable Artisan : densely populated	Stands high : on sand and sandstone	13.6
18 Rekendyke 63	10.6	64	93	1.83	General Labourer Class : dense- ly populated	Lies low : made	13.7

19	"	61	10.6	66	90	1.71	Mixed Working Class: densely populated	Lies low: made	10.7
20	"	64	10.6	35	96	1.81	Working Class: densely populated	Lies low: gravel	12.5
21	Tyne Dock	75	10.9	50	80	1.52	Ditto	Stands high: on clay	19.8
22	Holborn	55	11.2	100	90	2.14	Poorest Class: sparsely populated	Variable elevation: clay and ash	9.7
23	Tyne Dock	80	11.2	81	88	1.85	Semi-rural: widely separated from town, Poor Class chiefly	Lies Low	10.4
24	Deans	76	11.3	38	38	0.97	Middle Class: sparsely populated	Stands high: on sandstone	4.7
25	"	69	11.4	76	84	2.13	Very Poor and Ordinary Artisan: sparsely populated	Lies low: on clay	8.9
26	Bents 4, 5, 22	...	11.6	66	85	1.69	Working Class: densely populated	Low-lying: on clay	7.5
27	Hilda	25	12.4	66	61	1.68	Poor Class to very: dense, with spaces	Moderate elevation: sand, gravel, made	13.4
28	Deans	68	12.4	53	83	1.83	Poor Class: densely populated	Stands high: on sandstone	17.8
29	Rokendyke	62	12.6	57	92	1.82	Working Class: dense	Lies low: on gravel	13.8
30	Hilda	44	13.5	70	96	2.18	Poor Class: densely populated	Moderate elevation: made ground	9.8
31	Deans	70	13.9	25	96	1.46	Respectable Artisan	Moderate elevation: sandstone and clay	10.2
32	Laygate	51	13.9	73	100	2.44	Very Poor: densely populated	Low-lying: clay and made	12.6
33	Deans	67	14.5	32	96	1.58	Superior Artisan	Stands high: sandstone	12.5
34	Hilda	45	14.6	55	98	2.19	Poor Class: densely populated	Lies low: clay	4.3
35	Tyne Dock	79	14.8	46	74	1.4	Respectable Artisan: sparsely populated	Stands high: clay	18.4
36	Shields	14	14.9	56	95	1.72	Working Class: dense	Moderate elevation: on clay	10.7
37	Bents	3	15.0	38	66	1.42	Middle and Superior Working: dense	Stands high: on clay	11.4
38	"	27	15.5	38	66	1.06	Ditto	Moderate elevation: on clay	30.7
39	Laygate	49	15.5	66	86	1.78	Poor Class: densely populated	Ditto	16.0
40	Beacon	7	15.6	46	89	1.55	Working Class: sparsely populated	Stands high: on sand	12.6
41	Westoe	80	16.2	16	60	1.25	Middle and Superior Artisan: sparse	High: on clay	7.3
42	Bents	23	16.7	68	80	1.47	Poor Class: dense population	Lies low: on clay	14.4

ENUMERATION DISTRICTS IN ORDER OF CORRECTED ATTACK-RATE FOR TRIENNIUM, 1901-1903—Contd.

District.	Corrected Attack-rate, 1901-1903 per 1000.	Per cent Cases to Hospital.	Proportion of tenements of less than five rooms.	Persons per room in these.	Social Condition.	Physical Features.	1892-1900. Average Triennial Attack-rate
43 Beacon 6	16.7	20	28	1.19	Middle Class ...	Stands high : on sand	15.2
44 Shields 7, 8, 9	16.8	37	93	1.88	Working Class : sparse	Stands high : on sand	10.1
45 Rekendyke 58	16.9	40	61	1.59	Working Class : dense	Moderate elevation : clay	14.8
46 Beacon 4	17.2	33	56	1.1	Middle Class and Superior Artisan : dense	Ditto : sand and clay	13.4
47 Tyne Dock 77	17.6	52	91	1.33	Working Class : densely popu- lated	Stands high : clay	10.0
48 Laygate 47	17.8	73	95	1.83	Ditto ...	Low : clay	14.0
49 Rekenkyke 65	17.8	66	97	2.02	Ditto ...	Low : gravel	12.1
50 Beacon 10	18.0	50	86	1.94	Ditto ...	Moderate elevation : sand	13.1
51 Laygate 42	18.0	33	98	2.04	Ditto ...	Ditto : made	11.7
52 Westoe 32	18.0	18	67	1.31	Superior Artisan : dense, with open spaces	Ditto : limestone	12.2
53 Beacon 11	18.2	56	93	1.89	Working Class : densely popu- lated	Ditto : sand	12.6
54 " 12	18.5	43	93	1.43	Ditto ...	Ditto	14.8
55 Rekendyke 57	18.6	41	94	1.72	Ditto ...	Low-lying : clay	11.9
56 Bents 26	18.7	7	25	1.86	Middle Class : sparse	Moderate elevation : made and clay	18.4
57 Laygate 45	18.8	56	99	2.03	Poor Class : dense	Low : clay	12.0
58 Tyne Dock 78	18.9	35	82	1.31	Working Class : dense	High : clay	14.8
59 Rekendyke 60	19.0	51	97	1.69	Superior Artisan : dense new	High : sandstone	21.4
60 Bents 2 ...	20.0	62	76	1.39	Middle and Working Class : dense	High : clay	9.2
61 Deans 71	20.1	37	93	1.50	Superior Artisan : dense, new	High : sandstone	4.0
62 Beacon 5	20.2	17	54	1.15	Middle Class : dense	Moderate elevation : sand and clay	15.9
63 Holborn 46	20.3	27	91	2.05	Working Class : dense	Low : gravel	16.3
64 Beacon 13	20.5	45	63	1.47	Middle and Working Class : dense	Low : ash and made	10.9
65 Westoe 38	20.8	45	94	1.61	Working Class : dense	High : limestone	13.6

66	Lyne Dock 76	...	21-2	33	81	1-24	Superior Artisan: sparse	...	High: clay	...	14-9
67	Rekendyke 72, 73	...	21-9	42	96	1-68	Working Class: dense	...	Low: made	...	8-3
68	Westoe 39	...	22-4	63	96	1-89	Working Class: dense	...	High: limestone	...	14-7
69	" 33	...	22-5	37	59	1-08	Superior Artisan: dense	...	Ditto	...	37-3
70	" 36	...	23-3	54	57	1-32	Middle Class and Superior Working: dense population	...	Stands high: on sandstone	...	24-0
71	Deans 72	...	23-4	51	91	1-41	Working Class: sparse	...	Low: made	...	12-5
72	" 73	...	23-4	25	89	1-91	Ditto	...	Ditto	...	3-9
73	Westoe 37	...	23-6	34	73	1-56	Working Class: dense	...	High: sandstone	...	17-1
74	Laygate 43, 44	...	23-8	40	92	1-57	Ditto	...	Moderate: made	...	11-5
75	Beacon 9	...	23-8	47	99	1-86	Ditto	...	High: on sand	...	16-6
76	Deans 34	...	24-2	32	41	1-18	Superior Artisan and Middle Class: sparse	...	High: on limestone	...	34-0
77	Westoe 31	...	24-8	35	58	0-98	Middle Class and Superior Artisan: fairly dense	...	High: clay	...	10-4
78	Westoe 41	...	25-7	36	70	1-36	Superior Artisan: dense	...	High: limestone	...	10-2
79	Rekendyke 59	...	26-0	24	81	1-40	Ditto: new	...	High: sandstone	...	31-2
80	Deans 66	...	26-2	41	80	1-69	Working Class: dense	...	Moderate: sandstone	...	18-6
81	Westoe 40	...	27-1	38	99	1-83	Ditto	...	High: limestone	...	11-2
82	Bents 1	...	28-6	17	47	0-98	Middle Class: sparse	...	High: sand	...	21-4
83	" 28, 29	...	29-3	20	83	1-34	Respectable Artisan: dense	...	Ditto	...	11-0
84	Westoe 29	...	29-6	26	46	1-57	Middle and Working Class: sparse	...	Moderate: clay	...	12-8
85	Rekendyke 36	...	29-7	50	55	1-19	Superior Artisan: sparse	...	High: sandstone	...	9-8
86	Holborn 69	...	30-3	92	86	2-45	Very Poor: dense, with open space	...	Low: clay	...	4-7

In the comparison of wards the total cases notified have been considered, but in the comparison of enumeration districts I take into consideration only the primary cases, excluding secondary and return cases. In comparing districts of such small size with respect to the endemicity and spread of the disease, I think that it is better to exclude the secondary cases, as their occurrence is almost entirely governed by the number of susceptible persons in an invaded house, and is thus very largely a matter of chance. The figures compared are, then, the primary cases per 1,000 of the population during the triennium 1901-1903, and the table shows the eighty-six districts arranged in order of their corrected attack rates for this period. The districts so arranged fall into six groups: In the first the attack rates are less than 10 per 1,000; in the second, from 10 to 14 per 1,000; in the third, above 14 and under 18 per 1,000; in the fourth, from 18 to 21 per 1,000; in the fifth, from 21 to 25 per 1,000; and in the sixth, from 25 per 1,000 upwards, the highest rate being 30·3 per 1,000, and the lowest 4·4 per 1,000, putting aside the district in which no cases occurred. The sixteen districts with attack rates of less than 10 per 1,000 per triennium belong almost entirely to Shields, St. Hilda, Holborn, and Laygate wards, with only two districts from other wards. If the table be referred to, it will be noticed that all the districts in the first group have one common feature, the poverty of their inhabitants, with all that that implies in the way of bad sanitary conditions. The average proportion of houses of less than five rooms is 92·1 per cent, whilst the average number of occupants per room in these houses is 1·96. The property is old, much of it consisting of good-class houses converted into tenements. In respect of density of population, the districts vary, five of the sixteen being sparsely populated, and several having large open spaces in them, whilst the remainder are examples of the most crowded districts of the town. Nor as regards natural situation do they show any uniformity; seven stand high, and eight are low-lying, one being of medium elevation. The subsoils also vary, clay, ballast, ash, and sand being all represented.

With respect to the proportion of cases sent to hospital, in none was the percentage less than 50, whilst the average number removed was 69·6 per cent.

The sixteen districts with attack rates between 10 and 14 per triennium largely belong to Deans and Rekendyke wards. Socially the members of this group show great diversity, varying from purely middle-class districts to very poor districts resembling those of the first group. Averages are therefore not very illuminating; but it may be stated that the average proportion of houses of less than five rooms is 85 per cent, with an average room-population of 1·8

persons, indicating considerably less poverty than existed in the first group. As in the first group, the greatest diversity exists as regards elevation and subsoil. The average percentage of cases sent to hospital was 54·3.

The seventeen districts with attack rates above 14 and under 18 per 1,000 per triennium, contained on the average 78 per cent of houses of less than five rooms, these houses having an average room-population of 1·43 persons. The social class is distinctly better than that of the second group, and entirely other than that of the first group. The cases removed to hospital averaged 46 per cent.

In the fourth group, with rates ranging from 18 to 21 per 1,000, there are sixteen districts; the average proportion of small houses is 82 per cent, having a room-population of 1·61 persons; and the average proportion of cases removed to hospital is 39 per cent. This group is, on the whole, on a somewhat lower social level than the third, but with a lower average of cases removed to hospital it shows a higher average attack rate.

The fifth group comprises twelve districts, with rates varying between 21 and 25 per 1,000. The average proportion of small houses is 79 per cent, with an average room-population of 1·47 persons. Socially this group is composed almost purely of respectable working-class districts with one or two terraces of middle-class property. The average proportion of cases sent to hospital from this group was 41 per cent, being slightly greater than the average of the immediately preceding group.

The last group comprises nine districts, in which the attack rates were above 25 per 1,000 per triennium, the lowest rate in this group being more than two-and-a-half times as great as the highest rate in the first group. In this last group the average proportion of small houses is 72 per cent, with an average room-population therein of 1·64 persons. There is thus evidently an exceptionally large number of large houses in the districts of this group; six of the districts, in fact, are inhabited by shopkeepers and the best class of artisan, whilst only one, viz., the last in the list (Holborn, 69), is a slum district. The average proportion of cases sent to hospital from the districts of this group was 38 per cent, or just about half the average sent from the districts of the first group. If the natural features of the districts in the last group be considered, it is found that they all stand high, or moderately high, with the exception of the last on the list. Five of the nine have a subsoil of sandstone or limestone, and two others have sand subsoils, only two having clay. Comparing this group of districts with the first group in respect of natural features, it may be repeated that half of the first group stand high, so that elevation

is evidently not a determining factor. The differences of subsoil in the two groups can hardly be supposed to affect the prevalence of the disease. We are therefore left with the other two points of distinction, to wit, social condition and extent of hospital isolation. In the group with low attack rates we find poverty and a high degree of hospital isolation; and in the group with high attack rates the social conditions are comparatively good, the class being chiefly the best paid and most intelligent of the working-class of the town, together with a low degree of hospital isolation. The intermediate groups show generally the same coincident characteristics in a less marked degree, although there are many individual exceptions.

On the whole, therefore, the examination of the attack rates in the enumeration districts during the triennium 1901-1903 confirms the conclusions arrived at by consideration of the attack rates in the wards. The exceptional instances where poor social conditions and a high proportion of cases isolated, coincide with a high attack rate, do not, in my opinion, invalidate this conclusion.

We may consider now the incidence of the disease on the several districts during the period 1892-1900. During this period hospital isolation was carried out to a considerably smaller extent than during the triennium 1901-1903, and the area to which it was specially applied was somewhat different. It is therefore useful to keep the figures for the two periods separate. During the nine years 1892-1900 the population of the town increased by about 16,000, and in some of the districts the whole of the houses were built during this period. I have calculated for each district the average attack rate per triennium. The rates are given in the table of enumeration districts, and vary from 1.98 per 1,000 to 37.3 per 1,000.

To what extent do the variations in prevalence during this earlier and longer period support the conclusions arrived at from consideration of the figures for 1901-1903, and do they indicate any other social or physical features in a district as factors in producing the results? As regards natural features, as before, no relation whatever is traceable between subsoil and attack rate; in respect to elevation of site, the position is similar to that shown by the 1901-1903 figures, viz., that low attack rates are found both in low-lying and in elevated districts, and, contrary to what might be expected, it does not appear that elevation of site has any tendency to lessen the prevalence of this disease, as the twelve districts with the highest average triennial attack rates, varying from 17 to 30 per 1,000, all stand particularly high. As previously remarked, I do not consider that elevation of site actually favours the spread of the disease; but that these elevated sites are taken up chiefly by better-class property, occupied by a class

who are for other reasons specially exposed to the ravages of this disease. When localities of similar social status are compared, I do not find that the elevation of the site affects the prevalence. As regards the prevalence of the disease in districts of varying social status, the figures for 1892-1900 again show on the whole a marked coincidence between low attack rates, and poverty and insanitary conditions. Of the eighty-six districts in the town, fifteen are described as of the poorest class, and eleven of these have attack rates of less than 10 per 1,000 per triennium during this period, although the total number of districts with attack rates below this figure is only twenty-seven. At the other end of the scale we find that the four districts with attack rates of over 30 per 1,000 per triennium, are all of a superior class socially, one being occupied by middle-class and the others by superior artisan class. The intermediate groups show in a less degree the same thing, a tendency to high attack rates in superior working-class districts, and to lower rates where greater poverty prevails.

There appears, then, to be no doubt that scarlet fever in South Shields is much more prevalent in the better-class districts than in the poorer, and that this has been so for the last twelve years at least. Before 1892 I have no figures to show the distribution of the disease, as it was not till then that the Notification Act was adopted. We are now faced with the question to what extent the favourable position of the poor-class districts depends on the greater use of hospital isolation, and whether apart from such isolation they are less liable to the ravages of this disease. To answer this question, except in a very tentative fashion, is difficult. Ever since the introduction of hospital isolation, there has naturally been a tendency to apply it particularly to the poorest localities; there was found the greatest difficulty in securing any form of home isolation, and the greatest need for hospital treatment for the sake of the patient. It is not, therefore, easy to find very poor localities in which the proportion of cases sent to hospital has been low. If figures were available which showed the distribution of the disease in the borough before the adoption of hospital isolation, we would have the necessary data for answering the question, but in South Shields hospital isolation was carried out to a considerable extent for ten years before the adoption of notification. The information, however, that is available regarding the distribution of the disease in the seventies and eighties, points to a distribution of the disease almost the reverse of the present. Whenever, in the Annual Reports from 1875 to 1885, reference is made to the distribution of this disease, it is pointed out that it chiefly affects the poorest and most insanitary quarters, and those

with the largest general death-rates. In 1873 a Local Government Board Inspector attributed its prevalence to "the filthy condition of the back streets." Dr. Spear, in his report for 1875, says that "such conditions (viz., those cited by the Inspector) greatly favour the spread of the disease"; in 1877 the same authority remarks: "The disease is specially prevalent in insanitary areas, particularly new, jerry-built parts." The same remark is made in the 1878 report. In 1885 Dr. Campbell Munro remarks that "the disease was very prevalent and fatal in the most insanitary areas, and those having the highest general death-rates." The streets mentioned as having suffered severely are, in some of the localities, least subject to the disease during the past decade.

If such a marked alteration in the distribution of the disease has taken place, it appears to me that the specially vigorous application of hospital isolation to these poor-class localities is probably a factor in producing the result. With the purpose of showing to what extent, if any, social and sanitary conditions apart from hospital isolation influence the prevalence of the disease, we may compare the attack rates in districts isolating similar proportions of their cases in hospital. During the nine years 1892-1900 there were twenty-nine districts in which less than 30 per cent of the cases were sent to hospital. The average attack rate for these districts per triennium was 15·8 per 1,000; in nine of these districts, inhabited by the general labourer class, it was 13·1 per 1,000; in seven, inhabited by the superior artisan class, it was 24·3 per 1,000; and in nine middle-class districts it was 14·3 per 1,000. There were only three "poor" and one "very poor" district in which such a small proportion of cases were isolated, and their average rate was 8·4 per 1,000.

Again, there were forty-two districts in which from 31 to 49 per cent of the cases were sent to hospital during 1892-1900; the average attack rate for these districts was 12·15 per 1,000 per triennium; in thirteen of these districts, described as of the "poorest" or "poor" class, the rate was 11 per 1,000; in twenty-one districts inhabited by the general labourer class, it was 12·6 per 1,000; and in eight inhabited by the superior artisan class it was 12·75 per 1,000.

Again, there were ten districts in which 50 per cent to 59 per cent of the cases were isolated in hospital; the average attack rate for these districts was 10·3 per 1,000; in five of them belonging to the "very poor" class it was 7·8 per 1,000; and in the other five respectable working-class districts the average rate was 12·9 per 1,000.

In the remaining five districts, isolating over 60 per cent of their cases in hospital, the average attack rate was 6·47 per 1,000; they all belonged to the "very poor class." It will be noted that in the great

majority of the districts the proportion of cases sent to hospital was very low, only fifteen reaching 50 per cent. The figures clearly show that with practically similar degrees of hospital isolation, the "poor" and "very poor" districts suffered distinctly less than the more respectable neighbourhoods, and that the districts inhabited by the general labourer class suffered less than those occupied by the superior artisan and middle class.

As the figures cover a period of nine years, during which scarlet fever was always fairly prevalent in the town, and as hospital isolation was not carried out to such a degree as, in my opinion, to have much effect on the course of the disease, one seems compelled to admit that scarlet fever is naturally less prevalent in these insanitary districts at the present time, whatever it may have been in the past. I do not propose to take up time by discussing the reason of this circumstance, but I shall pass on to the consideration of the effect of hospital isolation in diminishing or otherwise the prevalence of the disease in districts of similar social features. The figures for 1892-1900 show only slight reduction of the average rate for any particular class with the increase in the amount of hospital isolation; but as only five districts isolated 60 per cent of their cases, the effect of hospital isolation cannot be elucidated from these figures.

I now return, therefore, to the figures for the triennium 1901-1903. During that period, I find that there were twelve districts in which less than 30 per cent of the cases were sent to hospital, and that these districts have an average attack rate of 21.7 per 1,000; in seventeen districts from 30 to 39 per cent were sent to hospital, and here the average attack rate was 19.2 per 1,000; in eleven districts from 40 to 49 per cent were sent to hospital, and here the average attack rate was 20.1 per 1,000; in seventeen from 50 to 60 per cent were sent to hospital, and here the average attack rate was 15.8 per 1,000; in twelve from 60 to 70 per cent went to hospital, and the average attack rate was 13.1; in sixteen over 70 per cent went to hospital, and the average attack rate was 11.2 per 1,000.

These figures show a progressive lowering of the attack rate with the increase in the proportion of cases sent to hospital, when this rate is 50 per cent or more. Of fourteen "very poor" districts, in eleven more than 60 per cent of the cases were isolated, and the average attack rate was 9.8 per 1,000; and in three between 50 and 60 per cent were isolated, and the average attack rate was 8.7 per 1,000. Of twelve "poor" districts, four isolating over 70 per cent had an average attack rate of 10.9 per 1,000; five isolating between 60 and 70 per cent had an average attack rate of 11.8 per 1,000; and three isolating between 50 and 60 per cent had an average attack rate of

15.2 per 1,000. Of thirty-three ordinary working-class districts, eight isolating over 60 per cent had an average attack rate of 15.2 per 1,000; eight isolating between 50 and 60 per cent had an average attack rate of 15.7 per 1,000; nine isolating between 40 and 50 per cent had an average attack rate of 20.6 per 1,000; and eight isolating less than 40 per cent had an average attack rate of 19.8 per 1,000. Out of sixteen superior artisan districts, five isolating from 40 to 54 per cent of cases had an average attack rate of 21.4 per 1,000; eight isolating from 30 to 39 per cent had an average attack rate of 19.8 per 1,000; and four isolating less than 30 per cent of their cases had an average attack rate of 21.8 per 1,000. Out of nine middle-class districts, three isolating from 30 to 39 per cent of their cases had an average attack rate of 17.7 per 1,000; and six isolating less than 30 per cent had an average attack rate of 21.6 per 1,000.

The comparison, then, of groups of districts belonging to a similar social class gives similar results. The "very poor" districts isolating less than 60 per cent do, indeed, show a slightly lower attack rate than those isolating more than 60 per cent, but in the two groups where there are the best data for the comparison, viz., "poor" districts and ordinary working-class districts, we see the fall in the attack rate coinciding with the rise in the proportion of cases sent to hospital, *when such proportion reaches 50 per cent*. No inference can be drawn from a comparison of the middle-class and superior artisan groups, as the proportion of cases sent to hospital is so small.

To still further verify these results I have taken six groups of districts having various percentages of their cases isolated in hospital, and totalled up for each group the populations, cases, and removals to hospital, and from these figures I have estimated the attack rate per 1,000 of the population and the percentage of cases removed. The twelve districts from which less than 30 per cent of the cases went to hospital have a total population of 14,496; 21 per cent of the cases went to hospital, and the attack rate was 20.7 per 1,000. The seventeen districts from which between 30 and 39 per cent of cases went to hospital have a total population of 21,389; 35 per cent of the cases went to hospital, and the attack rate was 19.4 per 1,000. The eleven districts from which 40 to 49 per cent of the cases went to hospital have a total population of 11,820; 42 per cent of the cases went to hospital, and the attack rate was 20.5 per 1,000. The seventeen districts from which 50 to 60 per cent of cases went to hospital have a total population of 17,703; 52 per cent of the cases went to hospital, and the attack rate was 15.4 per 1,000. The twelve districts from which 60 to 69 per cent of the cases went to hospital have a total population of 15,293; 65 per cent of the cases went to

hospital, and the attack rate was 13·2 per 1,000. The sixteen districts from which 70 per cent or more of the cases went to hospital have a total population of 15,610; 79 per cent of the cases went to hospital, and the attack rate was 10·6 per 1,000. These figures are nearly identical with those arrived at before, but rather stronger evidence of the favourable position occupied by districts isolating a large proportion of cases in hospital.

From the facts and figures which I have put before you I consider that certain general conclusions may be formed regarding some of the factors which favour the prevalence of scarlet fever in a district, and those which tend to limit and reduce its prevalence.

Comparison of districts of the same town is in some respects more reliable than comparison of different towns; in dealing with one town we have similar meteorological conditions, and an equal efficiency or inefficiency with respect to methods of disinfection and isolation, in all of which respects different towns may vary widely, causing their comparison in regard to one point, such as proportion of cases isolated in hospital, to be misleading. No doubt, on the other hand, the absence or the weakness of the barriers between one district and another of the same town considerably reduces the value of comparison of adjoining districts, particularly when of small size; a district is not only affected by the policy of hospital isolation, say, adopted in itself, but also by that adopted in its neighbours. In the epidemic diseases of children, however, I think it is very often seen that the disease is not generally diffused through the town at the same time, but that it may for a considerable period, weeks or months, be confined to a certain district, and my own observations incline me to believe that scarlet fever spreads very largely from one house to others in the near neighbourhood. By the agency of a school a fresh district is invaded, and the process is repeated there.

In the first place, I have shown that the physical features of a district do not apparently appreciably influence either the extent of the endemicity of the disease, or its spread in epidemic times. The fact that the districts most markedly affected all stand high, I have explained as due to the preference for such districts naturally exhibited by the superior artisan population, who are of all classes of the community most subject to the ravages of the disease.

In the second place, I have shown that, apart from the extent to which hospital isolation is adopted, very poor-class districts, including all to which the term "slum" is applicable, are apparently less subject to the disease than more respectable neighbourhoods. Whether this is due to a special insusceptibility to the germ of the disease shown by a population strengthened by the comparatively

free operation of the law of the survival of the fittest, or whether it is due to an antagonism between filth and the scarlet fever germ, I cannot say.

In the third place, I have attempted to estimate the results attained in different districts by varying degrees of hospital isolation, and, so far as they go, my figures tend to show that such isolation, if carried out to a high degree (the isolation of 50 per cent or more of the total cases), lessens the prevalence and spread of the disease. When social differences are ignored and the total districts are compared, I have shown that districts isolating the largest proportion of cases suffer far less than the others; and even when the comparison is limited to districts of the same social class, my figures show a well-marked advantage in districts where the proportion of cases isolated is high. Circumstances have so far prevented the adoption of a vigorous policy of hospital isolation in the superior artisan and middle-class districts.

In conclusion, I should like to call attention to the fact, as shown by the figures both for 1892-1900 and for 1901-1903, that it is most amply proved that, in South Shields at least, the isolation of cases of scarlet fever in hospital does not result in an increased prevalence of the disease and an intensifying of its virulence. If the discharged hospital convalescents were the main instruments in maintaining the presence of the disease in the town in a high degree, surely the districts to which most of these belong would not occupy such a favourable position.

DISCUSSION.

The PRESIDENT (Dr. Groves) in inviting discussion, said that the whole medical profession should be grateful for any facts which militate against or otherwise the question of isolating cases of infectious disease in hospital.

Dr. ARMSTRONG thought every word of the paper was weighty. He considered one last remark Dr. Boyd made summed up the whole position, with regard to faddists, and the difficulty of putting them down. There was one point to which he referred—a difficult point—and he was not going to say a word of opposition to anything Dr. Boyd had said, and that was the question of school attendance. He had always had the impression that schools had a very strong effect upon the spread of scarlet fever. He thought that was the worst element in towns such as his own. As most of the members of this Society were aware, he had always been an advocate in favour of the extension of the hospital system. He believed with Dr. Boyd, that the hospital system was calculated to lessen scarlet fever, and he was glad to say his Sanitary Authority were of the same opinion. They had been carefully considering the question for some time past, and his Council had within the last two or three weeks decided to spend £53,000 on increased hospital accommodation. Some of them were familiar with the hospital at Walker Gate, and they were going to extend this at the cost of the amount named.

That did not look as if the Sanitary Authority of Newcastle were doubtful as to hospital isolation. He wished to thank Dr. Boyd very heartily for his excellent paper. With regard to the closing of schools, they had been experimenting in Newcastle for two years with reference to measles and whooping cough. His Authority during that period had paid £2,000 in notification fees, and except in one little instance very little good was gained. In one school which they closed early, they did apparently put a stop to the disease. The difficulty with educational bodies would be to get the schools closed at an early stage. He indicated in the report he made upon the subject, that if they were inclined to take up notification of these two diseases again, he hoped it would be on the understanding that they began with the early closing of schools, and did not wait until 10 per cent of the children were attacked.

Dr. EUSTACE HILL thought the paper a valuable contribution to a much vexed subject. He said he had the good fortune to be Medical Officer of Health for South Shields for a short period, and he was bound to say as regards the incidence of disease in the poor part of the town, even in the short period he was there, he recognized that infectious diseases were least in places where you would expect them to be higher. It was impossible to say much with regard to scarlet fever there, but there was no doubt that certain mortalities were less in the low part of the town than in the better portion of the population. The question of the survival of the fittest, which Dr. Boyd mentioned, perhaps did deserve some slight consideration, because if they had a juvenile population liable to attack from scarlet fever, decimated from such diseases as infantile diarrhoea, or other diseases resulting from want of food, they got a lesser incidence among other diseases at a later period of life. Then, again, the schools, as Dr. Armstrong mentioned, had a great bearing upon the subject. It was rather difficult to come to a conclusion as to the reliability of figures as to cases of scarlet fever. His own experience in the County of Durham was that the more you isolate patients, the less the prevalence of the disease. He had had considerable opportunity of ascertaining whether this was the case or not, because he had fifty or sixty annual reports of Medical Officers passing through his hands, and it is almost universal, especially in places like Darlington and Chester-le-Street, for them to say year after year that isolation results in a diminished incidence. He thought they could not get over that fact. If he had referred to only one or two points in Dr. Boyd's paper, it was merely to say that he agreed with the conclusions he had arrived at.

Dr. HERBERT JONES said that this was a subject which was exercising the minds of a large number of Medical Officers of Health all over the country. He would like to add his meed of thanks to Dr. Boyd for the great trouble he had taken in connection with the paper, and especially would he like to draw attention to the trouble which he must have been at to give them the table referring to the death-rates at different age periods. It was very difficult indeed to get at the age-incidence in districts, and he considered that Medical Officers of Health ought to have more ready access to the details of the census returns than they now possessed. There was an enormous mass of information at Somerset House, which would be invaluable to them, but they could not get at it. In connection with the discussion with regard to the use or otherwise of isolating cases of scarlet fever, it seemed to him that too much dependence was placed on statistics. They should look at it from the broad common-sense point of view. If the greatest opponent of isolation hospitals had a case of scarlet fever in his own house, he would put the patient into the

top room of the house, or the spare bedroom. The isolation hospital was the spare room of the working man.

Dr. TAYLOR said he agreed entirely with the remarks made by Dr. Boyd. With reference to one remark, namely, the class of property which is chiefly infested by scarlet fever, in his experience in Chester-le-Street district, in which a large number of new houses have been built, they found scarlet fever most prevalent in new houses. Throughout the whole district of Chester-le-Street they had only one class. There were no slums, and no class of really poor people. They were all artisans, of the mining class chiefly, respectable, well-fed, and in some cases well housed. But scarlet fever did not attack out of proportion the houses where the worst areas were. Scarlet fever infested new houses in a greater proportion than it did older houses. In regard to isolation, he thought it useless to compare two towns. He thought it was absolutely useless to compare two parts of the same town. They might have a greater number of persons isolated in one area than another. The comparison ought to be with single units. His experience was that isolation in hospitals certainly reduced the chances of scarlet fever occurring in second or third cases in the same house. But they, as Medical Officers of Health, should endeavour to get their Councils to give every man a chance to protect his own children. They ought to prepare a place in which to house the infected child, so as to permit people to protect their other non-infected children; for they knew that although children escaped with their lives in scarlet fever, they might not escape with their health. He thought far too little had been done with reference to the supervision of schools. Medical Officers of Health had not been able to supervise schools, but it was to be hoped that some system would be adopted by which schools might be put under some system of supervision. He thought this an important point for school authorities to take up. He entirely agreed with Dr. Boyd, and he was very glad that he was not one of those individuals who said "abolish isolation hospitals, and you abolish scarlet fever."

Dr. STAINTHORPE said that with regard to the incidence of scarlet fever in towns, his experience was that where they had a population of people employed in the same work—take the mining districts—there was a greater community of interests, they were in the same social position; with the result that there was an enormous amount of visiting each other's houses. If he went to a house, apparently the neighbours saw him, and rushed in to see why he had been there, and that was a reason why they had an outbreak so quickly spreading in a mining district. Take another district, partly mining and partly agricultural. He did not find anything like the same ready spread of infection in such a district. Splitting up of houses did not lead to the same amount of social intercourse that took place in the mining districts. He was most strongly of opinion that unless County Councils took the action which they had the power to do, they would not progress much in the matter of isolation hospitals. What they wanted was for County Councils to urge upon their Medical Officers or their district Authorities the necessity of having hospitals built for areas which would be suitable. It would be much better for a small urban district to be included in a joint scheme, which would be worked at a much less cost.

Dr. WILSON expressed his approval of the paper.

Dr. HEMBROUGH spoke of the advantages of joint hospitals. He said the feeling in the county was to the effect that people would not go into these hospitals. He hoped in future there would be more hospitals erected. The County Council of Northumberland appeared to be un-

willing to use its powers to the full extent, or anything like their full extent. It was an enormous waste of money for each district to put up a little tin hospital, with which they could not have the amount of efficiency for the money expended, either in nursing or anything else.

Dr. WILLIS added his testimony to what had been already said in appreciation of the paper, and only hoped that many other Medical Officers of Health would follow Dr. Boyd's example, and prepare statistics upon the same lines. There was only one point on which he disagreed with Dr. Boyd, and that was with regard to the prevalence of scarlet fever in higher elevations. His experience was that the attack was much less in higher than in low-lying districts.

Dr. BOYD thanked all who had spoken for their kind remarks. There were only one or two points to which he might reply. Dr. Hill referred to the age constitution. He had dealt with that in the paper, and had taken three groups, and he thought it would come out pretty accurately. Inequalities of age would be allowed for. He thought Dr. Hill's suggestion as to the weakly being killed off by other diseases, might very likely account for a certain amount of immunity from scarlet fever shown by the population of slum districts. As regards Dr. Willis' experience that scarlet fever is less in the high-standing districts, that confirmed his opinion that elevation does not in itself seem to have any effect. Dr. Taylor did not think there was much value in comparing towns, but if they wished to show how it affected the spread in a locality, they must compare towns or parts of a town. He thought statistics were more accurate perhaps than any other form of argument, and had a certain value.

The PRESIDENT said it was impossible to make one rule for all parts of the country. Their experience was that rural districts differed from those in big towns; but their Society, acting for the general good as well as their own individual good, listened to the opinion of all experts, and tried to draw their own deductions. They had continually to watch the education question; they had already urged that the medical officer of a school should be the Medical Officer of Health; he knew the education movement was only at the beginning, and he was afraid that doctors might be considered rather impracticable. At any rate they had not to push them too much. He considered Dr. Boyd's paper a very valuable contribution to the subject they had discussed.

LEAD POISONING AMONG HOUSE PAINTERS.—Count Posadowsky, German Minister of the Interior, has submitted to the Federal Governments a schedule of "Regulations for the prevention of Lead Diseases among house painters, decorators, and varnishers." These regulations are to be binding on all employers in the house-painting and other similar trades, as well as on all industrial establishments where painters and varnishers are employed in connection with other trades and manufactures—for instance, carriage factories, furniture factories, wharves, etc. The regulations do not forbid the use of white lead for social economic reasons. They contain detailed instructions for avoiding the dangers connected with the manipulation of lead colours mixed with oil or varnish, as well as with the process of rubbing or breaking away dry coats of lead colour. Medical supervision and the keeping of a special health book are to be obligatory, and each workman is to receive gratis a leaflet enlightening him on the dangers connected with the trade, and the best methods for escaping them.—*Brit. Med. Jour.*