

THE PUBLIC HEALTH ASPECT OF PNEUMONIA.*

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FOR a considerable number of years past there has been an increasing tendency to regard the disease known as pneumonia as one capable of spreading from person to person, with occasional extensions of such degree as to merit the terms epidemic, contagious, or infectious being applied to it. As a consequence, it is assuming an increased importance to those engaged in preventive medicine, since the question is raised, to what extent, if any, is it preventible? In the following outline some of the details relating to this disease which are of interest to Medical Officers of Health have been classified, in the hope that the subject will prove sufficiently attractive to interest you.

The term pneumonia is a general one, which indicates an inflammation of lung tissue, and conveys no suggestion of any ætiological factor. The inflammation may differ widely both in its anatomical and clinical aspects. Until 1901 all the varieties of pneumonia were classified in the Returns of the Registrar-General under the one heading "Pneumonia," which, in its turn, was given a place among "Local Diseases" and more specifically among "Diseases of the Respiratory System." In the Report for 1901 pneumonia was removed from this group, and "in recognition of its infective character," it was classed with those conditions to which it is more generally allied, viz., the diseases known as "General Diseases," among which are placed the zymotic diseases. In addition, the disease was subdivided into lobar, broncho-, and epidemic pneumonia, and "pneumonia not defined" as belonging to one of the above three classes. This subdivision, from a statistical point of view, is of considerable value; but the possibility of anything like accurate classification is still remote, since each year the number of cases registered as "not defined" is equal to the combined total of the other three subdivisions. There is, however, a tendency to improve each year, which it is to be hoped will be maintained, though at a more rapid rate.

Epidemic pneumonia, so-called, has displayed a rather peculiar distribution, inasmuch as during the year 1904 no deaths were registered from this type of the disease. During 1901 there were 94 deaths, and it is interesting to note that they were distributed among no fewer

* Presidential Address read at the meeting of the Birmingham and Midland Branch of the Society, October 11th, 1906.

than twenty counties, the largest number, 21, being registered in Lancashire; in London there were 14 deaths, and in Warwickshire 10 deaths. Even these small totals diminished to one each in Surrey, Devonshire, Worcestershire, Lincolnshire, and Northumberland. In 1902 the total of 10 deaths was distributed amongst five counties, the North Riding claiming 6. In 1903, 7 deaths occurred in six counties, Worcestershire claiming 2 of them. It is difficult to appreciate the association of the word "epidemic" with these few deaths from a disease with a mortality which may reach 18 per cent of attacks; possibly in several instances they were so called on account of a sequence of deaths occurring in a limited community, or from one or more deaths occurring among members of the same family who had been subjected to coincidental attacks.

It has been stated, and rightly so, that during recent years the mortality from pneumonia has shown a tendency to increase, and the following have been suggested as causes contributing to that end: (a) The continued tendency of the urban communities to increase at the expense of the rural, with the result that more persons are exposed and succumb to attacks of pneumonia than would be the case with a more equal distribution of the population; (b) The continued prevalence of influenza since 1890; (c) The transference between cases of pneumonia, bronchitis, and phthisis; (d) The tendency of the disease to show an increase in virulence, the variable nature of which is characteristic of infectious diseases; and (e) The diminution of resistance which individual members of the community show to the disease chiefly as a result of diminished vitality.

The suggestion of increased virulence is difficult of proof or disproof, but some consideration will be given to the question of increased individual susceptibility, as there would appear to be reasons in favour of such a cause being in operation if only as a result of urbanization. With reference to the other suggested causes the annexed Table contains some necessary details.

It will be seen that during the three decades preceding the advent of influenza in 1890, the highest death-rate from pneumonia was in the first of these periods, but that since 1890 there has not been a single year in which the rate recorded has been as low as that of any three decennial averages, with the exception of the year 1894, when it fell to 1,082, a figure slightly below the decennial rate of 1861-70. This increase, it will be observed, has corresponded with the continued prevalence of influenza. On the other hand, bronchitis, which showed a tendency to increase up to 1891, has since displayed an irregular though undoubted tendency to decrease. (The distribution of the

mortality into age-periods for the last decade is not yet available.)

The importance to be attached to the transference between pneumonia, phthisis, and bronchitis is not easy to decide; the Registrar-General suggests that deaths which in former years have been ascribed to capillary bronchitis are now returned as pneumonia. Dr. News-holme has also made reference to this subject, and in contrasting the rates from these two diseases in the decades 1861-70 and 1881-90, he found that pneumonia had decreased to the extent of about 1 per cent, which decrease was confined to the first quinquennium of life, the decline at this age-period actually amounting to 31 per cent, but that in the subsequent years there was an increase varying from 10 per cent at the age-period five to ten, to 86 per cent at ages thirty-five to forty-five. In the case of bronchitis there was an actual increase in

DEATH-RATES PER MILLION FROM PNEUMONIA, BRONCHITIS,
AND INFLUENZA.

Disease.	Decades.			1890	1891	1892	1893	1894
	1861-70	1871-80	1881-90					
Pneumonia ...	1089	1004	1066	1404	1471	1250	1285	1082
Bronchitis ...	1760	2288	2138 For 1889	2333	2593	2266	1905	1640
Influenza ...	—	—	2	157	574	533	325	220

Disease.	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Pneumonia ...	1169	1146	1118	1125	1250	1374	1147	1407	1220	1281
Bronchitis ...	1967	1535	1503	1479	1606	1692	1365	1323	1112	1246
Influenza ...	423	122	195	330	389	504	174	223	189	168

the later decade of 22 per cent, which was chiefly accounted for by an increase of 58 per cent in the first quinquennium, this being associated with a decrease in bronchitis mortality at ages ten to fifty-five, so that a decrease in the deaths from pneumonia at the early period is associated with an increase in the deaths from bronchitis, and the increase in pneumonia mortality in the later years with a decrease in bronchitis mortality. There has also been a decline in the phthisis mortality, the decline of 44 per cent under five years being perhaps due in part to transference to bronchitis; at the later ages the decline is probably in great part real and not due to transference to pneumonia.

With reference to the excess of deaths in urban communities over rural the Registrar-General has shown that the excess is distributed

over every age-period, and that in both urban and rural districts males show a preponderating death-rate compared with females. Taking all ages together, the excess of mortality among males amounts to nearly 50 per cent, the period fifteen to sixty-five showing the greatest incidence of the excess. The classification previously referred to as adopted by the Registrar-General in 1901 enables this incidence of pneumonia on the urban districts to be strongly emphasized by permitting a comparison of the death-rates recorded in each county to be made. For this purpose, I have averaged the county rates for the years 1901-4, and it will be seen that the county with the highest death-rate has a rate more than three times that of the lowest, among both males and females. For comparative purposes, similar information relating to bronchitis, a chest ailment of non-specific origin, has also been worked out and placed in parallel columns. The results are shown on the opposite page.

It will be observed that the mortality among females practically follows that recorded among males, and that as a rule a high pneumonia mortality is associated with a high bronchitis mortality, the two chief exceptions being in the North Riding and Northumberland, in which counties a relatively low mortality from bronchitis is associated with a pneumonia mortality considerably above the average.

The converse, viz., that a low mortality from pneumonia is associated with a comparatively low mortality from bronchitis does not so regularly obtain; in the case of Huntingdonshire, for instance, the bronchitis mortality is nearly twice that from pneumonia among males and more than twice among females. In Rutlandshire the bronchitis mortality among females is disproportionately high compared with pneumonia. The same holds good, though to a less degree, in the case of Norfolk, Buckinghamshire, Bedfordshire, and Dorsetshire. It is interesting to note that although in only a few instances is the death-rate from pneumonia among males less than the death-rate from bronchitis, this is the rule among females with only a few exceptions, the reason for which is not to be found in a marked increase in the number of deaths from bronchitis, but to the decrease in the number of deaths from pneumonia among females. There are two other points of comparison which should be noted, viz., there is not the same disparity between the highest and lowest mortalities from bronchitis among either males or females as is observed in the case of pneumonia, nor between male and female mortality from bronchitis in the same county. On the contrary, the rates in the latter instance closely approximate each other; thus Lancashire has a male mortality

DEATH-RATES PER MILLION 1901-1904 IN THE VARIOUS
REGISTRATION COUNTIES AMONG MALES AND FEMALES FROM
PNEUMONIA AND BRONCHITIS.

MALES.			FEMALES.		
County.	Pneumonia.	Bronchitis.	County.	Pneumonia.	Bronchitis.
Lancashire ...	2100	1670	Monmouthshire	1575	1358
Monmouthshire	2097	1436	Lancashire ...	1428	1633
North Riding ...	1973	1007	South Wales ...	1311	1167
Durham ...	1728	1440	Durham ...	1292	1351
South Wales ...	1721	1247	North Riding ...	1260	1015
London ...	1689	1397	London ...	1204	1419
West Riding ...	1639	1445	Northumberland	1200	1009
Warwickshire ...	1618	1423	Warwickshire ...	1172	1389
Northumberland	1583	965	West Riding ...	1168	1354
Cheshire ...	1580	1187	Nottinghamshire	1147	1196
Nottinghamshire	1549	1330	Staffordshire ...	1103	1471
Staffordshire ...	1496	1667	Cheshire ...	1073	1177
England & Wales	1485	1282	England & Wales	1057	1244
Cumberland ...	1464	1137	Cumberland ...	1030	1046
Shropshire ...	1398	999	Shropshire ...	948	899
North Wales ...	1355	1044	Essex ...	918	1113
Gloucestershire	1277	1273	East Riding ...	912	1279
Essex ...	1257	1141	Middlesex ...	907	907
Devonshire ...	1255	1223	Gloucestershire	903	1279
Middlesex ...	1252	887	Devonshire ...	893	1166
Worcestershire...	1222	1204	Worcestershire...	879	1010
Derbyshire ...	1207	1247	North Wales ...	878	1092
East Riding ...	1172	1303	Derbyshire ...	878	1127
Herefordshire ...	1136	1077	Cornwall ...	794	1004
Somersetshire ...	1094	1011	Hertfordshire ...	786	1033
Cornwall ...	1063	1014	Herefordshire ...	753	947
Surrey ...	1054	840	Wiltshire ...	741	1110
Hampshire ...	1000	1037	Surrey ...	738	785
Kent ...	993	863	Lincolnshire ...	733	1028
Lincolnshire ...	984	1114	Kent ...	727	899
Sussex ...	934	817	Oxfordshire ...	722	1002
Cambridgeshire	934	906	Somersetshire ...	719	996
Berkshire ...	931	870	Leicestershire ...	699	1092
Leicestershire ...	917	1154	Cambridgeshire	680	939
North'mpt'nshire	914	1035	Hampshire ...	675	977
Oxfordshire ...	896	1135	Sussex ...	664	798
Hertfordshire ...	895	996	North'mpt'nshire	657	996
Dorsetshire ...	882	985	Dorsetshire ...	637	1015
Norfolk ...	882	1057	Berkshire ...	627	938
Suffolk ...	869	937	Bedfordshire ...	626	1111
Westmoreland ...	863	727	Buckinghamshire	620	1076
Wiltshire ...	861	1091	Suffolk ...	613	950
Buckinghamshire	807	1122	Norfolk ...	609	1162
Bedfordshire ...	805	1005	Rutlandshire ...	605	1259
Huntingdonshire	720	1308	Westmoreland ...	509	693
Rutlandshire ...	685	708	Huntingdonshire	477	1163

from pneumonia of over 2,000, as compared with a female mortality from the same ailment of 1,428, whilst the corresponding rates for bronchitis are 1,670 and 1,633. Unless the male case mortality is for some reason markedly higher than the female, this wide variation between the rates tends to prove that males are more exposed to the infection, or to conditions predisposing to attacks than females. This point will receive subsequent attention.

With respect to the actual exciting cause of the disease, there is practically no doubt that the pneumococcus of Fraenkel stands to the majority of cases of fibrinous lobar pneumonia in the relation of cause and effect, but whether it is the only organism which is capable of producing this particular type of disease is, I think, doubtful. Netter is quoted in the *Practitioner* as stating that "there is no pneumonia (lobar) without pneumococci," and further, "that the constant presence of the pneumococcus of Talamon-Fraenkel in lobar pneumonia and the plurality of microbes causing broncho-pneumonia are the distinctive elements which bacteriology permits us to recognize in the history of pulmonary inflammations." This observation seems to suggest a precise ætiological differentiation between the two types of pneumonia according to the anatomical seat of the inflammatory lesion, the lobar invariably due to the pneumococcus, and the lobular to a variety of organisms of which the pneumococcus may be one.

From the preventive point of view it is important that numerous cases are on record where the *Bacillus coli communis*, or some variety of colon organism which is not capable at the present time of further differentiation, has given rise to undoubted epidemics, and that in these instances the pneumococcus, although searched for, has not been found. The pneumobacillus of Friedländer has been found alone in cases of pneumonia, and although it is true that this organism is most frequently found in cases of lobular pneumonia, it has been found in practically pure culture in the lungs in lobar pneumonia and has, at the same time, given rise to a generalized infection. The bacillus of influenza has been frequently mentioned as giving rise to pneumonia. The various pus organisms have also been discovered in cases of pneumonia, but they are as a rule secondary to some general blood ailment which has origin in a remote part of the body, or to some septic process in the respiratory tract. Another method of their introduction is the ingrafting of these organisms, which are practically ubiquitous, on a lesion commenced by the pneumococcus. The overwhelming presence of the pneumococcus in cases of lobar pneumonia is not observed in lobular pneumonia, and Netter found

that the organisms most frequently present in cases of lobular pneumonia were the pneumococcus, streptococcus, pneumobacillus, and the staphylococcus pyogenes. He concluded that they were each capable of giving rise to this type of the disease.

Diseases which are communicable are characterised at frequent or occasional intervals by epidemic prevalence, and this has been the case with pneumonia. The epidemics of this disease are apparently capable of a rough classification as follows: (1) Epidemics of a more or less anomalous type of illness in which pneumonia is a frequent complication; (2) Epidemics apparently dependent upon the *Bacillus coli communis*; (3) Epidemics occurring during excessive influenza prevalence; and (4) Outbreaks dependent upon the pneumococcus.

1. Numerous epidemics of so-called pneumonia have been recorded, particularly on the continent and less frequently in this country. In many instances the symptoms have suggested other illness than pneumonia. Thus, some have rather indicated enteric fever, from the association of diarrhoea and changes in the intestinal follicles; others cerebro-spinal meningitis, and one outbreak described as intermittent broncho-pneumonia, occurring in a marshy district and yielding to quinine, rather indicates a malarial condition. In more recent years two outbreaks of an anomalous illness, in which pneumonia was a frequent though not constant complication, were investigated by Dr. Bruce Low, in Northamptonshire in 1890, and in Laxfield, Sussex, in 1894. These were symptoms common to both, and possibly cerebro-spinal meningitis was the real cause. An outbreak of pneumonia in Flint was investigated by Dr. Reece in 1895, in which there was a suspicion that the disease might have been typhus fever. The interest which these cases have for persons engaged in public medicine is that fairly extensive outbreaks of disease of an infectious nature may occur in a district to which the diagnosis of pneumonia may be given, and that such an outbreak may have obtained rather a formidable hold before the unusual incidence of pneumonia becomes a striking feature, thus directing attention to the real nature of the malady present.

2. There have been some most interesting outbreaks investigated which have been said to be due to the *Bacillus coli communis*. The first of these was the pleuro-pneumonic fever in Middlesbrough and neighbourhood investigated by Dr. Ballard. There is practically no doubt that the actual cause of the disease was what Klein, who investigated the bacteriological conditions, termed the *Bacillus pneumoniae*, but which has more recently been recognized as a variety of the *Bacillus coli communis*. Klein definitely states that neither

Friedländer's bacillus, nor the *Bacillus pneumoniae* of Fraenkel and Weichselbaum was obtainable. Infected food and infection from individual to individual were considered to account for the epidemic.

This increase of 1888 was followed by one of greater degree in 1900. This was reported on by Dr. Dingle, the Medical Officer of Health, who observed that the outbreak of 1888 was sudden, and that the high rate of 1900 had been preceded for several years by high pneumonia rates. The infectious nature of the disease is illustrated by examples, and the origin was attributed to the *Bacillus coli communis*, in respect to which Dr. Dingle states: "There are many ways in which this bacillus may gain access to the air of Middlesbrough in considerable quantities." The bacteriological examination was conducted on this occasion by Dr. Foulerton, Medical Officer of Health for East Sussex, who states that none of the cases were of the nature of ordinary pneumococcal pneumonia. There was strong evidence that several of the cases had suffered from an infection by one and the same bacillus, and that this bacillus was identical with the *Bacillus coli communis*.

Associated with the Middlesbrough outbreak one naturally recalls the pneumonias reported in association with the various deaths from "food poisoning"; thus, in investigating the Welbeck cases more or less severe pneumonia was one of the conditions produced in animals by feeding or inoculating with the Welbeck poison material; also a man who died at Nottingham in 1881 from symptoms similar to those in the Welbeck outbreak, and which followed the ingestion of pork purchased at a shop in that town, suffered from pneumonia, whilst severe pneumonia was also an incident in the fatal case of food poisoning at Chester.

Secondary pneumonia referable to the *Bacillus coli communis* has been reported as following operative peritonitis, strangulated hernia, and other lesions of the intestines, and Dr. Foulerton informs me that at the Middlesex Hospital he has examined at least two cases of pneumonia after death in which he was unable to discover any other organism than the *Bacillus coli communis* to account for the condition.

Dr. Parsons investigated an outbreak of pneumonia, or pleuropneumonic fever at Scotter and certain associated villages during the year 1890. In Scotter 16 cases of pneumonia, with other illnesses suspected to be of the same nature, had in the course of three months occurred in a population of 700 to 800 persons; 12 proved fatal. A prevalence of pneumonia had also occurred in the same place in the spring of 1896. Outbreaks also occurred subsequently. Investigations were made by Dr. Klein, who found in the blood of mice that died after being fed on pneumonic sputum, a bacillus identical with

that found by him in the Middlesbrough cases reported on by Dr. Ballard. One point of interest in this outbreak was that the community of occupation would probably lead to occasional migrations to these villages from Middlesbrough, and in this way a specific disease might be introduced from the latter place.

3. The association of pneumonia with outbreaks of influenza has already been shown in the mortality returns which have been submitted, and it is within the recollection of most medical men that at the height of the influenza epidemic attacks of pneumonia were numerous and fatal, and instances of multiple attacks in houses were fairly common. In some instances the prevalence of pneumonia was so marked as to justify the medical men of the district terming it an epidemic, and two typical instances were those reported at Yeadon by Dr. Russell McLean, and Sheffield by Dr. Gwynne. In the former instance the *Bacillus influenzae* (Pfeiffer) was found in several cases. Instances of apparent direct infection are given in each case. I think if one had time to go through the records of the great towns that many others would be shown to have suffered from an excessive mortality about that time. I am not quite sure whether it has been established that the pneumonia is actually due to the influenza bacillus, or whether a patient suffering from influenza displays a lessened resistance to infection by the pneumococcus; this latter suggestion seems feasible and probable.

4. Notwithstanding the fact that the pneumococcus is so frequently discovered in the sputum of patients suffering from croupous pneumonia there seem to be very few records which would indicate that the type of pneumonia due to this particular infection is capable of any considerable extension. Where even minor epidemics have occurred they have been on a limited scale and localized to houses in a particular district, or have occurred among a group of individuals who pass a considerable part of their time in common, as in institutions, barracks, etc. An excellent example of this type with other interesting features is reported as having occurred in the Leavesden Asylum in 1901. These were briefly the circumstances: A male patient sickened with pneumonia in November, 1901; pneumococci were found in the sputum. In January, 1902, indefinite illness was reported among the members of the staff, the symptoms being those of ordinary catarrh; influenza was suspected. No influenza bacilli were discovered, but pneumococci were found in large numbers. This influenzal type of illness next appeared among the female attendants, who suffered more from cough than had the males, and in one instance a nurse developed typical apical pneumonia. Again the

expectoration of these cases swarmed with pneumococci. At the end of January six of the female patients developed illness in which cough, frothy sputum, and coarse crepitation at the bases of the lungs were the chief symptoms. Three cases of illness the next week showed patchy consolidation of the lung, and another suffered from true lobar pneumonia. In the following week there were 15 new cases of true lobar pneumonia, 12 of which proved fatal, and 5 other persons suffered from a short pyrexial illness, with pain in the back and bronchial catarrh. There were 13 women attacked the following week, 9 with true lobar pneumonia, of whom 4 died. During these weeks there were several attacks among the male patients, 6 of whom died from pneumonia. The epidemic subsided suddenly at the end of February. The apparent increase in the virulence of the infection and the sudden cessation which might have been due to exhaustion of the virulence are most interesting points in the outbreak, as also is the fact that there may be infection of the lungs or air passages sufficient to cause marked constitutional symptoms without the characteristic clinical signs of pneumonia being developed.

A consideration of the recorded outbreaks of pneumonia indicate that epidemics are far from common, and that it is against the endemic prevalence of the disease that preventive measures should be adopted. That type of pneumonia which is due to the *Bacillus coli communis* appears to have quite a local incidence, whilst the type due to the pneumococcus is generally distributed over the country. Instances of direct infection by the latter organism among persons who have been in contact with a patient are on record, but compared with the frequency of attacks the number does not seem to be considerable. Dr. H. Pye Smith records only three instances of direct infection out of 434 cases which were observed by him in his private and hospital practice, two being of children and one of a lady who sickened after nursing her husband who had recently convalesced. Direct infection from person to person is strongly suggested when members of a household are attacked, not simultaneously or nearly so, but more or less consecutively. Such a series of cases was reported by Dr. Callender in the *British Medical Journal* of 1904. A child suffered from what was considered to be a pneumococcal infection of the left antrum. Three days after the child came under medical treatment the father complained of feeling ill, and was found to be suffering from pneumonia, from which he died. He went to his office on the day he commenced to be ill, and there had an interview with a gentleman who three days later had a sharp rigor and passed through an indefinite illness, which terminated by crisis on the eighth day. A domestic servant who had

been in the sick room of the fatal case twice during the illness was invalidated three days after with sore throat, dysphagia, prostration, and feverishness. She rapidly improved on the seventh day. A relative of the fatal case entered the sick room two days before death ; she assisted the nurses and fell asleep on a couch at the foot of the bed. On the third day following she went home, was taken ill in the train, and died of acute pneumonia three days afterwards. If the cases were due to infection by the pneumococcus, the risks from an infection not necessarily derived from pneumonia are emphasized, and it makes a knowledge of the various pneumococcal lesions a matter of some importance ; for although the pneumococcus most frequently causes a fibrinous pneumonia, and although such may be the only recognizable lesion of a systemic infection, it may cause such diverse conditions as peritonitis, pericarditis, endocarditis, salpingitis, otitis media, keratitis and other inflammatory conditions, and such may exist either in association with pneumonia, or as the only lesion, and without pneumonia.

The suggestion of suitable preventive measures in any case is rendered easier and more certain when the life-history of the organism against which they are directed has been well ascertained. The life-history of the pneumococcus has been carefully investigated during recent years, and the following points are the most important from the public health point of view. It has been found in the dust of different places, such as hospital wards, by several observers ; but what is of greater import is the fact that the organism is found in the mouth and naso-pharynx of healthy individuals. The number of observations to this end is now so large as to place the fact beyond doubt, the percentage of successful searches ranging from 20 to 80. Among the latest of these observations is that of Professor His, who examined the saliva of 15 healthy persons and found typical pneumococci in 7, or 46·6 per cent. In the case of 7 of the remainder, repeated tests were made extending over weeks or months, and the pneumococcus was found once or more in six of these, which is equal to 85·7 per cent ; the conclusion he arrives at being that practically every individual, at least once during the winter, when exposed to environmental conditions such as those existing in New York City, acts as the host at some time or other, and probably at repeated intervals, of organisms of the true pneumococcus type. Experiments conducted with the idea of ascertaining whether there is any difference between the virulence of organism discovered in the mouths of healthy persons and those isolated from cases of lobar pneumonia have been undertaken by Buerger for the New York State Board of Health. He

examined the organism found in the mouths of 38 healthy persons, and of these found that 30 were virulent and 8 avirulent, percentages of 79 and 21. Of the organisms taken from 13 cases of pneumonia, 10 were virulent and 3 avirulent, or percentages of 77 and 23. Apparently, therefore, there is the same proportion of virulent pneumococci among those discovered in the mouths of healthy persons as among those taken from pneumococcic sputum. The experiment is wanting to the extent that the test of the relative pathogenicity of these organisms is made on animals, and it is an open question whether such pathogenicity indicates in any way the degree of pathogenicity of the organism for man. Experimental variation of virulence has been attained by different observers, the late Dr. Washburn among others having shown that the passage of the organism through rabbits results in an extraordinary increase in its virulence for those animals; and in this respect it is interesting to compare the course of events at the Leavesden Asylum already referred to.

The persistence of the pneumococcus in the mouth of normal persons has also been worked out by Buerger, and he details among others the following interesting results. One case was examined eleven times during 19 days, with 6 positive results; another six times in the course of 12 days, 6 positive results being obtained; and in another instance seven examinations were made in the course of 22 days, with the result that on 5 occasions the pneumococcus was discovered. There are numerous other results of a similar nature, but these given are sufficient to emphasize the persistent association which the pneumococcus shows to some mouths. After an attack of pneumonia the pneumococcus was found in one instance 9 days after the crisis, and in other cases 11, 16, and 23 days after.

Observations on the viability of the organism show that it is easily killed by chemical and physical agencies, but it is rather in relation to natural conditions that we are interested. In this respect several observers have shown that it remains active for a considerable time in sputum, and Dr. Wood, who conducted observations on this point for the New York report, states that in moist sputum kept in the dark at room temperatures the average life of the pneumococcus is 11 days, and at 0° C., 35 days. In sputum at room temperature in a strong light it lives less than five days. In dried sputum in the dark the pneumococcus lives, on an average, 35 days; in diffused light, 30 days; in sunlight, less than four hours. In powdered sputum, even when kept in the dark, the organism dies in from one to four hours, and within an hour if exposed to sunlight. In sprayed sputum the cocci rarely survive more than one hour; they die in even less

time if the infected spray is exposed to sunlight: in such a case the destruction of the pneumococcus takes place in half an hour.

Having in view the fact that the pneumococcus has such an extended range, there must be some conditions which are powerfully operative in preventing attack, or some particular condition of the human body or peculiarity of the infecting organism which determines an attack. The presence of the bacilli in the mouths of normal individuals can obviously be regarded, as pointed out by His, from two different points of view: (a) The facility which it would offer for general dissemination, in which event preventive measures would assume very great importance; and (b) The possibility that the mouths of normal persons may be a common and permanent habitat of this organism, in much the same way that the *Bacillus coli communis* is a regular inhabitant of the intestinal tract, and under ordinary conditions gives rise to no symptoms; in this latter case the existence of the pneumococcus in healthy mouths assumes a diminishing importance. Which of these two conditions is to be regarded as the normal one is not yet decided. There is the possibility that varying degrees of virulence of the organism may have some influence in determining an attack, and Netter suggests that during March, April, and May the virulence of the pneumococcus increases. He arrived at this conclusion as a result of a weekly examination of the saliva of a patient who always showed pneumococci, and he observed a correspondence between the virulence and the death-rate. Other observers have suggested that during the winter months the pneumococcus has a wide distribution, and at that time a large number of healthy individuals harbour virulent pneumococci in their buccal cavity. These months precede those in which pneumonia is most prevalent. These do not appear to be very strong reasons to account for the absence of a more general infection resulting from an organism which has such a universal distribution, and the enquiry naturally follows: Is there any condition of the human body which helps to determine an attack? Two points are clear from the statistical returns, viz., that increased density of population is associated with an increase of pneumonia mortality, and that this increase is observed among both males and females. Although the mortality among females is higher in urban than in rural districts, it is invariably considerably lower than the male mortality in either district. This would seem to indicate that in urban districts the females are exposed to more frequent risks of infection than are females in rural districts, but that they are not exposed to the risk in the same degree as are the males in the respective districts. This difference in the death-rates of males and females is

not due to the greater fatality of the disease among males than among females. It is due entirely to the greater incidence of attacks on males. This is clearly shown by the following table prepared by Dr. Hector Mackenzie, who has divided the mortality among the cases treated at St. Thomas' Hospital and the series collected by Dr. Fox from different sources, into the rates observed at different age-periods among both males and females. It will be seen that at some age-periods the rate among females is higher than among males, notably from 10-30, 50-60, and 70 upwards. Between 30 and 40 the mortality is exactly the same.

RATE OF MORTALITY PER 100 CASES AT VARIOUS AGES FROM PNEUMONIA.

	0-	5-	10-	20-	30-	40-	50-	60-	70 upwards.
Persons ...	12'8	2'9	7'5	12'2	20'4	29'7	37'1	47'9	71
Males ...	—	—	6'5	11	20'4	31'6	36'6	48'6	69'8
Females ...	—	—	8'7	14'5	20'4	26'6	38'1	47	73

The chief differences between males and females in these urban districts are perhaps those relating to work and habits, and two considerations seem to be suggested which would result in an increased predisposition of the males to attack; they are, that dust—which has been shown to diminish the activity of the respiratory mucous membrane, and which is inhaled during many occupations—may facilitate the passage of the infection to the lower air vesicles; and secondly, that prolonged breathing of air vitiated by human emanations, in consequence of insufficient ventilation, may result in a diminished power of vitality, and therefore, resistance to this particular disease. These two factors will frequently be found acting in combination, and are probably contributory to the increased mortality. As to habits, although it may not be the only factor, the alcoholic tendency—which I believe is more prevalent among males than females, and in urban than rural communities—must result in an increased number of enfeebled constitutions, with the natural result, an increase in pneumonia mortality. Chills have been suggested as an exciting cause, and no doubt in many cases they have been so; the arguments which have been advanced being the evidence that the primary localization of the pneumococcus is in the lungs in the large percentage of cases, the frequency with which pneumonia has been observed to follow rapidly on a chill, and the limitation of the disease to a single lobe. Against this theory it is stated that the disease is not most

prevalent during the coldest months of the year, but during March, April, and May; but I question whether this is a sound objection, as during the latter months there would be probably more variability in the weather and hence more careless exposure to the risk of chill. Perhaps a more valid reason for the seasonal incidence of the disease, i.e., greater prevalence during the months of March, April, and May, is again to be found in lowered vitality. It seems probable that during the winter season, with its short days, long nights, and diminished outdoor exercise, a combination operating in conjunction with more pronounced vitiation of the air of homes and workshops, an organic depression and weakness is engendered, which will be at its worst at the end of winter and early spring. This suggests that the human body becomes vulnerable to attacks by the pneumococcus in much the same way that it does to attacks by the tubercle bacillus, viz., as a result of a created predisposition, to which indifference to house and workshop sanitation are most important factors.

In conclusion, I can only briefly indicate the general direction which preventive measures should take. They are as follows :—

The public should be educated to recognize the infectious nature of the disease, and to appreciate the fact that persons with impaired constitutions, whether the result of defective home hygiene, or pernicious habits, are those upon whom the pneumococcus can most readily exhibit its pathological effects.

The diffusion of knowledge as to how best to improve the physique of individuals, and the essentials of a healthy home—as is being attempted in the case of phthisis—can only result beneficially.

The ventilation of work-rooms and similar places subject to inspection is an essential of prime importance.

Dust not only harbours bacilli, but interferes with the efficient working of the respiratory tract if present in the air in excessive amount. Therefore, dustless streets and less dust-raising methods of scavenging should be aimed at, whilst every endeavour should be made to prevent dust reaching the respired air in occupations where such is produced.

Care should be exercised in the disposal of infected sputum and other discharges likely to contain pneumococci.

The hygiene of the sick-room, particularly with reference to the admission of sunlight and fresh air, is of great importance in this disease, having in mind the influence of both on the pneumococcus, and persons attending to patients suffering from pneumonia should be carefully instructed as to the precautions necessary to be taken to avoid becoming themselves infected.

The bacteriological examination of the sputum in all cases of pneumonia should be encouraged. It would also be an advantage if investigations were made as to the frequency of the pneumococcus in the mucopurulent secretions following common colds. At the present time the diagnosis of the various types of pneumonia is a matter of great difficulty, but the accumulation of knowledge resulting from these bacteriological examinations would help in the more ready recognition of the different infections, and at the same time would, I am sure, act as a direct stimulus to the formulation of schemes directed against the heavy mortality caused by one of the most fatal diseases to which the people of this country are subjected.

SODIUM CITRATE IN INFANT FEEDING.—Cotton (*Jour. A. M. A.*, Oct. 6, 1906) believes that sodium citrate is of much value in the feeding of infants through its inhibition of dense coagulation of cow's milk in the presence of an acid and rennin. He has found that infants will tolerate a larger proportion of the milk in the feeding mixture when citrated than of any other modification. His experience extends over 112 cases embracing nearly all conditions from simple dyspepsia to marasmus, and ranging in age from the new born to adults who have suffered from milk dyspepsia. He uses an aqueous solution containing from one to five grains to the drachm, and enough of this solution is added to the bottle immediately before feeding to represent one, two, or even three grains of the citrate to each ounce of the milk in the feeding mixture, according to the requirements. The feeding mixture may consist of varying dilutions of milk with water or gruels, with the addition of cane or milk sugar, with or without cream. No alkalies are added to the sodium citrate used, it being a neutral salt.

A most noticeable feature in this method of feeding is the large proportion of milk in the feeding that the infant will tolerate without evidences of gastric disturbance, or the appearance of any considerable amount of undigested casein in the stools.

In no case has the author seen any harm resulting from the use of the citrate, although at times the period of use was quite prolonged. The following shows the result of his experiments:—

1. Sodium citrate in .25 per cent or more retards, and in high percentages will inhibit coagulation.
2. The presence of HCl hastens coagulation.
3. Diluting milk generally retards coagulation.
4. Gruels appear to have little or no effect in retarding coagulation when the citrate is used.
5. The coagula of citrated milk are softer, smoother, and more jelly-like, or more flocculent, than those of milk not thus treated.

The author believes that the simplicity of this method furnishes an additional reason for its employment.