

THESIS FOR THE DEGREE OF M.D.

"Bronchopneumonia in Pertussis and Morbilli"

A study of 51 cases.

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"BRONCHOPNEUMONIA IN PERTUSSIS AND MORBILLI".

The work on which this thesis is based has all been done in the wards under my charge in the City of Glasgow Fever Hospital, Ruchill. The cases numbered 51, and I have endeavoured to give a general description and analysis of these, entering into some portions with more detail, especially so in the examination of the blood. I have arranged the work as to the aetiology, symptoms, course, diagnosis, prognosis, pathology and treatment, as this seemed to be the best and clearest method.

I. Aetiology

(a) In pertussis of 216 cases, there were 30 cases of bronchopneumonia, (13.5%). The time of onset of the disease was very variable, but in the large proportion of cases the pertussis had been in existence for several weeks prior to the advent of the pulmonary complication. The histories obtainable were, however, very unreliable.

It is interesting to note that Aufrecht (Nothnagel Diseases of Bronchi, Lungs and Pleura, 1902, p.559) says "the occurrence of a catarrhal pneumonia after whooping cough I believe to be rare". The editor, Musser, states that this is not his experience and it is certainly not so here.

In Morbilli of 202 cases there were 18 cases of bronchopneumonia (8.9%). Of these 6 occurred when the rash was bright, and 12 with a fading rash. The most frequent time appeared to be about the sixth day of illness, and the latest was the ninth day.

In morbilli and pertussis combined, of 15 cases, there were 3 cases of bronchopneumonia (20%). In one the pulmonary disease began on the third day, and the rash was delayed. In the other two, the rash was bright at the time of onset.

(b) Age

<u>Pertussis.</u>	Under 1 year	4
	1 & over	9
	2 & over	7
	3 "	2
	4 "	6
	5 "	0
	6 "	1
	7 "	1

Of two cases of lobar pneumonia which occurred in pertussis, the ages were respectively $4\frac{1}{2}$ and 5.

<u>Morbilli</u>	Under 1 year	0
	1 & over	3
	2 "	7
	3 "	4
	5 "	2
	6 "	1
	8 "	1

The frequency of the disease in the earlier years, 3 and under is notable.

- (c) Rickets. I have classified the cases as "no rickets", "slight" and "severe". The latter term is confined to well marked cases with considerable chest deformity.

	<u>No rickets</u>	<u>Slight rickets</u>	<u>Severe rickets.</u>
Pertussis	10	14	6
Morbilli	8	6	6

Thus of 50 cases, 32 shewed evidences of rickets, a proportion of 64%. The strong tendency of rickety children to bronchial catarrh is pointed out by Henoeh (Lectures on Children's Diseases, New Syd. Society's translation, Vol.I. p.379, 1889), and the importance of chest deformity is well emphasized by Eustace Smith (Wasting Diseases of Children, 6th.Ed. pp.138, 139).

- (d) Malnutrition plays a very important part. Of 51 cases, only 13 of those, who were not rickety, could be described as well nourished.

- (e) Gastro-intestinal affections have not been frequent in my cases. In 3 cases the patients had suffered from diarrhoea with green offensive stools. In one case complicating erysipelas of the neck in a child of 2, the illness began with vomiting and diarrhoea of a severe type, after eating some tinned salmon. Bronchopneumonia developed a few days afterwards.

- (f)

(f) Season. I am unable to say much regarding the influence of season, and the numbers are much too small to be of any value. The pertussis cases almost all occurred in winter and spring, when the weather was wet cold and stormy. The epidemic of measles occurred in April, May, June and July, and the occurrence of bronchopneumonia was certainly much less during the warmer weather in June.

(g) Bacteriology. The study of the bacteriology is beset with the difficulty that young children rarely expectorate. Occasionally, however, in the bronchopneumonia of pertussis, when the paroxysmal cough persists, it is possible to obtain a specimen. When so, the expectoration was received direct from the patient's lips into a sterilized test tube. Film preparations were examined, and cultures made. Cultures and films were made with all aseptic precautions, from the lungs after death.

The following results were obtained:-

Pertussis

Expectoration 7 cases examined.

Fraenkel's pneumococcus was detected in all, in two being almost pure, in two associated with staphylococcus pyogenes aureus, in one with staphylococcus pyogenes aureus and albus, and in one with streptococcus pyogenes and staphylococcus pyogenes aureus.

Cultures from Lung, 8 cases examined.

Fraenkel's pneumococcus was found in seven. Of these it was associated with staphylococcus pyogenes aureus in one, with staphylococcus pyogenes albus in three, with staphylococcus pyogenes aureus and albus in one, and with

with abundant streptococcus pyogenes in one. In one case Friedlander's pneumobacillus, with staphylococcus pyogenes albus, was detected.

Morbilli

Expectoration. One case examined, and shewed Fraenkel's pneumococcus with numerous Bacillus Coli Communis.

Cultures from Lung. Three cases examined. In all Fraenkel's pneumococcus was detected, associated in one with staphylococcus pyogenes aureus and streptococcus pyogenes, in another with streptococcus pyogenes, and in the third with staphylococcus pyogenes albus.

Thus it will be seen, from an examination of the above results, that of 19 cases in all examined, the pneumococcus of Fraenkel was found in 18, the infection, however being in every case a mixed one. Osler states "that mixed infections are almost the rule", and cites 14 secondary cases examined by M.Wollstein, in which Fraenkel's pneumococcus was found pure in 2, and with other organisms in 9 (Practice of Medicine 4th.Ed. p.644).

The other organisms associated with the pneumococcus in my cases are staphylococcus pyogenes aureus, and albus, streptococcus pyogenes, and in one case B.Coli Communis. The staphylococcus pyogenes aureus was found in 6 cases, albus in 6 cases, and streptococcus pyogenes in 4. In only one case was Friedlander's pneumobacillus found.

These results agree with those given by Holt (Diseases of Infancy and Childhood, 2nd.Ed.1903, p.529), and Ashby and Wright (Diseases of Children p.361). The occurrence

occurrence of the B.Coli Communis appears to be rare, but Holt (ibid p.528) gives 4 cases in which it was the only organism present. Lindsay Steven (Lancet Sept.20th.1902 p.793) gives a case in which Fraenkel's pneumococcus was associated with B.Coli Communis, but it was suggested that the culture had been contaminated. This case moreover was a primary one.

Symptomatology.

The onset in nearly all the cases associated with pertussis was insidious. The patient had been coughing for a variable period - two to three weeks in the large majority of cases, but sometimes much later in the disease, the latest being 7 weeks. Henoeh (ibid. p.390) states that bronchopneumonia may complicate pertussis at any part of its course, and this is fully confirmed by my cases. Rarely the onset is sudden with convulsions (Osler ibid. p.645). Douglas Powell "Diseases of Lungs and Pleura, 4th.Ed.p.233). This occurred in two of my cases, one of which began in the ward while under observation. Both of these children were rickety, and their ages were $1\frac{1}{2}$ and 1 year. The frequency of convulsions in rickety children is well known (Eustace Smith "Wasting Diseases of Children, p.141, 6th.Ed.).

The onset in measles is more rapid as a rule. Bronchopneumonia may begin prior to, along with, or after the eruption. Of 21 cases, 8 occurred with the rash. Two of these, however, had been suffering from pertussis for some time previously, and the onset of the bronchopneumonia coincided

coincided with the onset of the measles. Of the other 13 cases, 7 began on the 5th.- 6th.day of illness, 2 on the 7th., 2 on the 8th., and 1 on the 9th. In the last case, one of pertussis, morbilli and bronchopneumonia, the bronchopneumonia was well established before the rash appeared, scanty and livid after a mustard bath, on the 6th. day. Eustace Smith points out that when bronchopneumonia develops when the rash is beginning to appear, the development of the rash is apt to be retarded, or the exanthem may even retrocede with great aggravation of the general symptoms (Diseases of Children, 2nd.Ed.p.26).

Most of my cases will be seen to have occurred when the rash was fading, and this coincides with the experience of Henoch (Ibid. p.390). Bartels quoted by Aufrecht (Nothnagel's Diseases of Bronchi, Lungs and Pleura 1902, p.588) gives the 7th.- 8th.day after the appearance of the rash as the commonest time. My cases occurred much earlier than this, most commonly on the 5th.- 6th.day of illness, the latest being on the 9th., or 4 days after the appearance of the rash.

In a well marked case of bronchopneumonia the patient looks very ill. The face as a rule is pallid, and the lips a little cyanosed. Cyanosis is, however, very variable, and does not appear to depend much on the extent of pulmonary involvement as in many cases it is early marked, while in others, going on even to a fatal termination, it is never a striking feature. Respiratory distress is marked, the respirations varying from 50 to 80, and even 100, or more. In rachitic children, however, the respirations may be over 50, without serious pulmonary disease

disease. The child does not cry, or speak, and as a rule, takes its feeds unwillingly. It is usually very restless, tossing about in bed, but in the later stages becomes quieter.

The temperature is very variable (Osler Ibid. p.645). In pertussis the usual range of temperature appears to be from 99° to 102.4 F., not infrequently lower and seldom higher. In only one of my cases was a temperature of 105° registered and this only on one occasion. 104.4 was attained in 3 cases. Temperatures from 102° to 103.6 are quite common, but the cases I have observed appear to point to the fact that pyrexia is not a marked feature of the bronchopneumonia of pertussis. In fact a child may suffer from a severe attack, with very little pyrexia. In one case the temperature ran between 99° and 100°, rising on one occasion only to 101°. Another case shewed a chart from 100° to 100.6. Both of these cases had fairly well marked signs of bronchopneumonia. It is well known that in very debilitated children, the pyrexia is often slight (Hench Ibid. p.387), but although both of these children were very rickety, neither could be termed debilitated.

In morbilli the pyrexia is more marked (Aufrecht in Nothnagel's Dis.of Bronchi, Lungs and Pleura 1902 p.567) Of 20 cases, 5 reached 105.2, 5 over 104°, 3 over 103° and the remainder over 102°. The temperature tends to be more continuously high, especially in severe cases, and one does not see cases with slight pyrexia similar to those met with in pertussis.

The course of temperature in both is, however, very

very irregular, and the remissions vary greatly. This is easily explainable on consideration of the pathology of the disease. None of my cases terminated by crisis. This coincides with the opinion expressed by various writers (Henoch *ibid.* p.388. Eustace Smith *ibid.* p.463). Cough of a short hard hacking nature is present at the onset, and during the course of the disease, is very distressing.

In pertussis the characteristic paroxysms as a rule subside on the onset of the complication, and may return during convalescence. This I have noted frequently and it is pointed out by Trousseau (*New Syd.Society Translation "Clinical Lectures" Vol.I. p.668*). Aufrecht (*ibid.* p.569) says "I have never had occasion to observe this", but Musser adds a note saying he has frequently observed it. Three of my cases hooped markedly at the onset for a day or two, but ceased as the condition became more marked.

In morbilli the cough is very similar and is present from the onset. As a rule it is short, hard and distressing. It may, however, assume a laryngeal character, or as in two cases I have seen, there may be a distinct laryngitis. In most cases in young children it is impossible to obtain any expectoration. In 18 cases in morbilli the expectoration was only obtained in 2, and in these was sticky and mucopurulent. In pertussis, however when the cough remains more or less paroxysmal, some expectoration is occasionally obtainable at the close of the paroxysm. This expectoration is at first mucoid, scanty and sticky, but later becomes more abundant and mucopurulent. At that stage it shews abundance of leucocytes, with large

large catarrhal cells, and numerous microbes. The bacteriology is discussed elsewhere. Not infrequently, large quantities of similar expectoration, are expelled by vomiting.

The respirations, as mentioned previously, vary greatly up to 100 or even more. They are, of course, proportionately more rapid, the younger the child. They are also more rapid in those with rachitic deformity of the chest. Such children may have respirations up to 70 or 80 per minute, and yet be in no great distress, nor their condition such as to excite much alarm. In these cases also there is often a good deal of retraction of the lower ribs and sternum. Aufrecht (ibid. p.569) says that the larger the consolidated areas at the base, the greater is the retraction. I cannot say I have ever been able to confirm this, by any of my cases.

Examination of the Lungs.

The signs found are very various. One may have a child whose appearance, pulse, temperature and respirations, at once suggest some serious pulmonary complication, and yet be unable to detect anything abnormal on examination. Sooner or later, however, signs develop, and first of all fine moist ringing [^]rales may be audible in various situations. They are often to be detected over the tongue, of the upper lobe of the left lung which overlaps the pericardium, and round into the left axilla, or at both bases. The former situation I have found especially frequently. Hensch (ibid. p.385) emphasizes this strongly, saying "I have repeatedly discovered fine sharp [^]rales there..... sooner than in any other part of the chest".

In

In 21 of my cases it was noted that the râles in this situation were abundant, fine, ringing. I have never had a case in which râles were heard at this site alone, they being usually audible in the left axilla, or at the left base, or less frequently at the right base. In 5 of the above 21 cases expiration was prolonged, and in 4 its character was bronchial. That the signs should occur so frequently, and well marked over the tongue of the left upper lobe, is rendered doubly interesting by the fact that I have noted post mortem, that this region is very often markedly affected. This, however, will be later commented on in the section on pathology.

In the later stages of the disease dulness may be detected, but very extensive areas of consolidation may be, and often are, found post-mortem without any dulness being evident during life. I have noted dulness in 14 out of 51 cases. It was present at the right base 5 times, at the left 3, and at both 3; at right apex 3, at left 3, at both 3; and in the right interscapular region in 3. Hensch (Ibid. p.385) says the signs usually appear on both sides from base to scapular spine, and not infrequently also in the region of the apices. Aufrecht (ibid. p.568) enters into an elaborate explanation shewing that the change, in the percussion note at the apex, is due to the alteration in the condition of the bases of the lungs, changing the tension of the normal tissue at the apices. He says he has verified this by autopsies, but I have not very infrequently seen distinct affection of the apices at post-mortem examinations, as will be noted on referring to the section on pathology.

Holt (Diseases of Children 1903, p.156) detected consolidation in 104 out of 156 cases.

Changes in the respiratory murmur are much more frequent, amounting either to prolongation of expiration, or distinct bronchial breathing. These have been noted in 28 cases out of 51. They are signs of much value, especially when the area is limited as it often is.

Friction is rare (Holt *ibid.* p.545). It was detected in one well marked case, complicating measles in a boy of 8. Pain was much complained of, and fine friction was audible in the left inframammary and axillary region. Signs of consolidation were marked, but the case was seen early, and was undoubtedly bronchopneumonia.

Signs of pleural effusion may appear, but this seems to be rare. It occurred in one case complicating pertussis, late in the disease, and was slight.

I cannot say I have detected any difference in the physical signs as regards the lungs in the bronchopneumonia of morbilli and of pertussis. One thing I have been much impressed with, perhaps more especially so in measles where the disease appears to be more rapid in its course, that a well marked bronchopneumonia may exist, and be confirmed post-mortem, and yet no dulness, bronchial breathing, or prolonged expiration be detected during life. Also from such slight pathological experience as I have had, I am very much inclined to believe that whenever fine moist râles are audible at all extensively or abundantly in young children, and even more so, if in different parts of the lungs with clear areas intervening, bronchopneumonic changes are occurring. Hensch (ibid.p.385) points this out.

Pulse is usually in both diseases very rapid, 140-170 per minute is quite a common average, but very few cases being below 140. The rate I have found unimportant, the quality being much more to be depended on. Henoch attaches "no special importance to the rate, but much to the quality" (Ibid. p.382).

Heart. In several cases I have noted accentuation of the pulmonic 2nd. sound, but the difficulty of examining young children, more especially a restless case of bronchopneumonia, forbids one making any positive assertion as to the condition of the cardiac sounds.

Diarrhoea was noted in 9 cases complicating pertussis. In 5 the motions were loose, in 3 loose and green, and in 1 were accompanied by a little blood and mucus. In 1 case complicating erysipelas, diarrhoea was very severe. In 6 of the measles cases there was diarrhoea, but never severe.

Spleen does not seem to be enlarged frequently. It was palpable beneath the costal margin in 3 cases in pertussis. In one case complicating measles it became palpable on the 11th. day of the disease, and in another in measles and pertussis on the 16th. day. In none of the cases was the enlargement marked.

Urine. In this as in the case of expectoration, one is again confronted with the difficulty of obtaining specimens. Of pertussal cases, 3 shewed ordinary febrile characters, but in two of these the chlorides appeared to be somewhat diminished. Of 5 cases in measles, 3 had ordinary febrile characters, 1 a heavy cloud of albumen, and in another the chlorides were distinctly diminished.

Nervous

Nervous System. In 10 pertussal cases convulsions occurred prior to death. On one of these there were numerous convulsions for 5 days prior to death. In another case a convulsion occurred 3 days before death, 3 days intervened without one, and after that the child was practically constantly in convulsions till the fatal issue. In one case the patient had several convulsions during the course of the illness, and made a good recovery.

In morbilli one child had a slight convulsion shortly before death, and another twitchings of the facial muscles. Another, in measles and pertussis, had slight twitchings of the face during sleep.

It would thus appear that convulsions are rare during the course of the disease, but common as a terminal event. This agrees with the statement of Eustace Smith (Dis. of Children, p.462), but he says that twitchings and spasmodic movements of the eyeball are often seen during sleep. These were not noted in my cases. Convulsions at the onset are treated of elsewhere.

Oedema is rare. Oedema of the feet and legs occurred towards the end in 1 case complicating pertussis. The patient had been ill for 20 days, and the oedema apparently developed from cardiac failure, the right side of the heart being markedly dilated, and the kidneys healthy at the post-mortem examination. Hensch (ibid. 9.461) mentions oedema of the hands and feet in chronic cases in pertussis lasting for months.

Blood

Blood

The blood was examined in 13 cases complicating pertussis
in 12 " " morbilli
in 3 " " pertussis
and morbilli.

(1) Methods. The blood in most cases was taken from the lobe of the ear, and in a few infants from the great toe, the part having been previously well cleaned with ether. At the first examination both red and white corpuscles were enumerated, but only the white in the succeeding ones. The Thoma-Zeiss apparatus was employed. Films were made on one or more occasions in the large majority of cases. They were fixed in a hot air oven, a temperature of 110° C. for 1 hour being found sufficient. Ehrlich's triacid mixture proved to be the most satisfactory stain and was mostly used, but in a few cases Jenner's stain was employed, previous ~~to~~ fixation, beyond drying in the air, being of course unnecessary. In the differential count of the leucocytes, 500 were estimated.

(2) When entering into the consideration of the blood many points have to be taken into account. It is well known now that the blood of infants differs from that of children in several characters. This is discussed fully in an article in Rotch's Pediatrics. Hayem (Rotch Pediatrics, 3rd.Ed. p.877) gives the average number of red corpuscles in infancy as 4,500,000 and in later childhood 4,000,000-4,500,000. Rotch (ibid. p.877) states that nucleated reds are present in small numbers at birth, but are rarely found after 6 months, but Coles. (Diseases of Blood, 2nd.Ed. 1902, p 268) says they are rarely found in the

the blood of a healthy mature child at birth. As regards the white corpuscles, it may be generally stated that their number is higher in young children, than in adults.

Rotch (ibid) gives the average from 2 weeks to 6 months at 12,000-14,000, and from 6 months to 1 year, 10,000-12,000.

Denis gives the number from 2-6 years as 9,000-10,000.

Morse (Boston Medical and Surgical Journal, May 28th. 1903) gives 10,000-14,000 as the number. Considerable difference exists in the proportion of the different forms. The uninucleated forms and eosinophiles are relatively numerous, while the polynucleated neutrophiles are diminished.

The following table compiled from Rotch (ibid) and Morse (ibid) shews this:-

	<u>Adults</u> (Rotch)	<u>Infants</u> (Rotch)	<u>Infants</u> (Morse)
Small Mononuclear	20-30%	50-70%	50-70%
Large "	4- 8%	6-14%	5-15%
Neutrophiles	62-70%	28-80%	30-40%
Eosinophiles	$\frac{1}{2}$ - 4%	$\frac{1}{2}$ -10%	1-10%

Gundobin (Rotch p.877) found that, after the beginning of the 3rd. year, the blood resembles that of adults more, the neutrophiles and mononuclear elements being present in about equal proportions.

It must also be remembered that digestion leucocytosis is unusually pronounced in children. My counts were in all cases made at the same time daily, and the patients were all fed two hourly.

Again, in many of my cases, rickets was present, a disease in which blood changes exist. Anaemia in rickets is well known. The leucocytes are usually increased. (Von Limbeck "Clinical Pathology of the Blood", New Syd. Society's Trans. 1901, p.331), and Cabot (Clinical Examination of Blood 4th. Ed. p.449) says leucocytes may occur even when no anaemia is present. He gives a case in which

which the count was 45,000. Von Limbeck (ibid) says the increase is chiefly of the polynuclear, but this will depend on the age of the child.

Myelocytes have been found by Turck (Cabot p.119) in most infectious diseases, rickets, syphilis, phthisis &c. A small number is not uncommon in the severe anaemias of adults. This like all other changes, is exaggerated in infancy.

Eosinophiles are relatively more numerous in infancy. They are increased in rickets even up to 20% (Cabot, Hock and Schlesinger, p.357), and are highest in cases with splenic tumour. Most authors place the normal percentage at 2-10.

(3) Pertussal Bronchopneumonia.

Before detailing cases it would be well to consider the blood conditions in pertussis. Meunier (Archiv. d'Maladies de l'Enfance, Apl.1898) quoted by Cabot (p.218) and Osler (p.94) shews that lymphocytosis is early and constant. In the catarrhal stage, he found the counts average 22,700, and in the paroxysmal 40,000, the maximum being 51,250. The leucocytosis was more intense under 4 years, and after 4 ran from 12,000-18,000. All varieties were increased, but the lymphocytes relatively as well as absolutely. These results were confirmed by De Amicis, Cima, and others ("Histology of Blood", Ehrlich and Lazarus, Translated by Myers, 1900 p.103.)

Case 1.

Case 1. B.P. aet.1. Poorly nourished. Slight rickets. Mild case of bronchopneumonia. Cough paroxysmal but no whoop. One examination only made.

Red corpuscles 51,000

White	"	43,500	Polynucleated neutrophiles	31%
			Large mononucleated	9%
			Lymphocytes	60%

Recovery perfect.

Case 2. H.S. aet 2⁷/12. A well nourished boy. No rickets. Severe bronchopneumonia. Whooped throughout illness.

Recovery perfect.

Red corpuscles 4,520,000

White	"	53,100	Polynucleated neutrophiles	70.4%
			Lymphocytes	24%
			Large mononucleated	5.6%

Case 3 C.D. aet 2¹/₂. Fairly well nourished, but very rickety. Well marked bronchopneumonia. Cough paroxysmal. Recovery perfect.

March 23rd.1903 Red 59,87500

White	58700	Polynucleated neutrophiles	60%
		Lymphocytes	30%
		Large mononucleated	6%
		Eosinophiles	4%

25th. White 29,000

27th. White 18,700

Case 4 C.McK. aet.4. Poorly nourished but not rickety. Ill for a fortnight prior to admission. Well marked bronchopneumonia. Cough paroxysmal. This case may be taken

taken as an uncomplicated leucocytosis.

Apl. 7th.	Red	3,825,000		
	White	27,900		
8th.	"	16,500		
9th.		26,900	Polynucleated neutrophiles	72%
			Lymphocytes	23.5%
			Large mononucleated	4.5%
			Eosinophiles	0
10th.	"	14,700		
12th.	"	17,250		
13th.	"	10,900		
14th.	"	11,700		
15th.	"	10,000		
16th.	"	11,500		
17th.	"	17,500		
20th.	"	16,250		
21st.	"	12,800		
22nd.	"	16,400		
23rd.	"	18,600		
24th.	"	17,500		
26th.	"	26,900		
27th.	"	23,100		
30th.	"	19,400		
May 4th.	"	24,000		
11th.	"	11,200		

Recovery perfect.

Case 5. A.P. aet $1\frac{1}{2}$. A rickety but fairly well nourished child with some intestinal catarrh. A case with marked symptoms, but never alarmingly ill. Cough paroxysmal.

Recovery perfect.

May 1st.	Red	4,400,000		
	White	46,900		
2nd.	"	45,000	Polynucleated neutrophiles	62.5%
			Lymphocytes	31.25%
			Large mononucleated	2.5%
			Eosinophiles	2.5%
			Myelocytes	1.25%
4th.	"	45,300		
5th.	"	25,300		
6th.	"	28,100		
8th.	"	25,300.		

Case 6. S.G. aet $1\frac{7}{12}$. Seriously ill for 3 weeks prior to admission. Poorly nourished. Slight rickets. Died suddenly 3 days after admission.

Apl. 27th.	Red	5,200,000		
	White	30,600	Polynucleated neutrophiles	70%
			Lymphocytes	27%
			Large mononucleated	3%
28th.	"	29,000		
29th.	"	27,000		

Case 7. G.C. aet 3. Well nourished. No rickets. A fairly severe case, but without much pyrexia. Admitted on 3rd. April when physical signs were present, but did not become marked till 6th. Paroxysmal cough. Recovery perfect.

Apl. 6th.	Red	529,000			
	White	52,200	Polynucleated neutrophiles	56.1%	
			Lymphocytes	40.3%	
			Large mononucleated	3.6%	
7th.	"	53,100			
8th.	"	41,900			
9th.	"	29,900			
10th.	"	35,300			
12th.	"	37,500			
17th.	"	18,800			
22nd.	"	17,500			

Case 8 H.McL. aet 4. A healthy well nourished boy. Cough paroxysmal. Bronchopneumonia well marked. Recovery perfect.

June 12th.	Red	5,200,000			
	White	47,600	Polynucleated neutrophiles	84.5%	
			Lymphocytes	9.4%	
			Large mononucleated	4%	
			Myelocytes	.6%	
			Eosinophiles	1.4%	
13th.	"	34,500			
14th.	"	24,200			
16th.	"	12,500			
17th.	"	18,000			

Case 9 T.B. 2³/12. Rickety and ill nourished. Short severe attack with convulsions. Whooped throughout. Recovery perfect.

July 1st.	Red	5,000,000			
	White	23,600	Polynuc. Lymph- Large Myel- Eosin- neuro-ocytes mono-ocytes op- philes nuc.		
			32% 59% 6.03% .9 1.17 (1 eosinophile myelocyte)		
2nd. 11 a.m.		67,800			
3.30 p.m.		61,800	33.09 58.8 6.11 1.7 .3 (2 eosinophiles myelocytes)		
3rd.		69,800			
4th.		55,400			
5th.		57,400			
6th.		54,600			
9th.		45,600			

Case 10.

Case 10. H.P. aet 4½. Ill nourished. Marked rickets. Slight attack of bronchopneumonia. Whooped throughout. Recovery

1st. July	Red	5,400,000				
	White	33,900	Polynuc.	Lymph-	Large Myel.	Eosin.
			Neutro-	ocytes	mono-	
			philes.	nuc.		
			49	39.3	4.5	6.8
						.4
						(2 eosinophiles)
2nd.	"	58,800				
3rd.	"	51,000				
4th.	"	44,200				
5th.	"	45,600				
6th.	"	48,600				
8th.	"	38,300				
10th.	"	32,600				
11th.	"	21,500				

Case 11. A.S. aet.4. Well nourished and not rickety. Ill for 4 weeks prior to admission and died 8 hours after. Post mortem a very advanced bronchopneumonic condition found.

On admission. Red 3,000,000
White 24,400

Case 12. M.P. 111/12. Tubercular peritonitis with ascites. No rickets. Bronchopneumonia began on 7th. February, convulsion on 10th., and death on 13th., after further convulsions.

Feby. 11th. Red 3,862,500
White 34,000

Case 13. J.McD. aet 4. Very rickety. Recovered from severe attack, but died in Sick Children's Hospital from bronchopneumonia some months after dismissal. During his residence there, a marked leucocytosis was also present.

One count. Red 5,143,700
White 37,500

Case 14

Case 14. L.L. aet 5. Well nourished and not rickety. Lobar pneumonia with perfect recovery.

Nov.25th.1902, Red 3,000,000

White 12,500

29th. " 15,600

Case 15. J.N. aet 4. Well nourished and not rickety. Attack of lobar pneumonia during convalescence from pertussis.

Recovery.

4th.day. Red 5,350,000

White 22,500

5th.day " 30,600

6th.day " 28,100 Crisis.

Conclusions.

It is evident on looking over the cases previously detailed, that every case of bronchopneumonia, complicating pertussis, is attended by a greater or less degree of leucocytosis. The increase may be either of the polynucleated elements or of the lymphocytes. Of 10 cases examined differentially, 7 shewed a lymphocytosis varying from 27 to 60%. The other 3 shewed an increase of the polynucleated neutrophiles, the highest count being 84.5% (Case 8). In 6 the large mononucleated, including transitional forms, shewed an increase varying from 4.5 to 9%.

As regards the relation of the proportion of polynucleated neutrophiles and lymphocytes to the age of the child, it is difficult to give a decided opinion when one compares cases 1, 5, 6 and 7. It would appear, however

however, that the younger the child, and the more paroxysmal the cough at the time of onset of the bronchopneumonia, the more likely is it that the lymphocytes, rather than the polynucleated forms, will be increased.

Eosinophiles were noted in 5 cases, the maximum being 4% and the minimum .4. They appear to be of no importance.

Myelocytes were found in 4 cases, in one case numbering 6.8%. This was an extremely rickety child (Case 10). The maximum leucocyte count was 69,800 (Case 9) This although high is a long way behind the leucocytosis of 236,000 in Steven's case (Lancet Sept.20th.1902, p.792) or Cabot's case of 94,600 (ibid. p.114).

The minimum count (during the course of the illness) was 10,000, but this case shewed much higher counts (Case 4). All the other counts were much higher. The three fatal cases (6, 11, 12) all shewed considerable leucocytosis - 24,400 to 30,000. From this it seems that the presence of a leucocytosis is not of any great prognostic value. Its diagnostic value in the differentiation of bronchopneumonia from acute miliary tuberculosis, may be greater, as illustrated by the following case.

E.L. aet $1\frac{1}{2}$. No rickets. Clinical aspect of bronchopneumonia, but post mortem found to be acute miliary tuberculosis.

On admission March 12th.	Red	4,737,500
	White	5,300
13th.	"	10,300
15th.	"	9,700
16th.	"	5,000

Died on 19th.

Cases 14 and 15 (Lobar Pneumonia) I have quoted for

for comparison. In neither case is the leucocytosis greater than is usual in the cases of bronchopneumonia. The cases, however, are older, 4 and 5 years respectively.

(4) Bronchopneumonia in Morbilli.

In discussing the changes in the blood in the bronchopneumonia of measles, certain points regarding the blood in measles have to be taken into consideration. Cabot (p.119) says that in mild cases of measles there is no change in the blood, and that in others there is often a leucopaenia during the eruptive stage. The eosinophiles are diminished during the fever, and in convalescence the lymphocytes, and especially the large mononuclears are increased. When there is a catarrhal affection of the mucous membrane, or bronchitis, the leucocytes as well as the fibrin are increased. The multinucleated elements are relatively increased (Von Limbeck, Rieder, Pée, quoted by Coles *ibid.* p.243).

Case 1. E.A. aet 3. A very rickety child. Bronchopneumonia began on 7th. day of the disease with fading rash. Condition well marked at post mortem examination.

8th. day	Red	375,000	
	White	5,000	
9th. "	"	5,800	
10th. "	"	11,500	
11th. "	"	10,000	Died.

Case 2. J.McG. aet.3. Slight rickets but well nourished, otherwise. Bronchopneumonia began on 6th. day, with fading rash.

8th. day	Red	3,000,000	
	White	6,600	
12th. "	"	15,600	
13th. "	"	13,800	
15th. "	"	10,600	

Improved from this and recovered.

Case 3. F.C. aet 2½. Slightly rickety and anaemic. Slight bronchopneumonia, commencing on 5th.day with rash beginning to fade.

8th.day	Red	3,187,500	
	White	4,400	
10th.	"	"	12,000
17th.	"	"	6,000. Improving.

Recovery complete.

Case 4. E.Y. aet 3½. Very rickety. Admitted on 5th.day with well marked but fading rash, and bronchopneumonia. Complete recovery, after severe illness, almost dying on 10th.day.

6th.day	Red	5,300,000	
	White	10,300	
7th.	"	"	10,000
10th.	"	"	14,000
11th.	"	"	12,200
12th.	"	"	16,000
14th.	"	"	14,400
			Polynucleated neutrophiles 77.6%
			Lymphocytes 19.6%
			Large mononucleated 2.8%
			Eosinophiles 0
			One normoblast in one film
16th.	"	"	13,300
17th.	"	"	8,400
20th.	"	"	6,900 Rapid improvement.

Case 5. H.H. aet 6. No rickets, but very poorly nourished. Admitted on 8th.day of illness with faded rash and well marked bronchopneumonia.

8th.day	Red	5,400,000	
	White	16,500	
9th.	"	"	24,400
			Polynucleated neutrophiles 85%
			Lymphocytes 10%
			Large mononucleated 3.6%
			Eosinophiles 1.4%
10th.	"	"	31,300
11th.	"	"	33,100
12th.	"	"	39,000
13th.	"	"	41,300 Improving
14th.	"	"	24,000
15th.	"	"	10,600
16th.	"	"	14,400 Much better

Convalescence uninterrupted.

Case 6.

Case 6. K.McG. aet 1½. Poorly nourished rickety child. Severe bronchopneumonia on 7th.day.

8th.day	Red.	5,000,000			
	White	7,300			
9th.	"	"	11,900	Polynucleated neutrophiles	61.4%
				Lymphocytes	24.5
				Large mononucleated	10.6
				Myelocytes	2.5
				Eosinophiles	1
10th.	"	"	14,000		
11th.	"	"	16,900	Dying	
12th.	"	"	16,600	Died.	

Case 7 S.McC. aet 5. Well nourished and not rickety. Bronchopneumonia began with appearance of rash on 4th.day. Severe attack with complete recovery.

8th.day	Red	5,300,000						
	White	11,900	(ated	Poly-nucle-	Lympho-	Large	Myelo-	Eosino-
)70.75	cytes	cytes	mononu-	Cytes	philes.
						cleated		
9th.	"	"	13,100			5.8	1.75	1.1
10th.	"	"	20,000					
11th.	"	"	12,500	74.5	12.7	9	1.9	1.9
12th.	"	"	16,200					
13th.	"	"	13,100					
15th.	"	"	10,600					
19th.	"	"	11,800					

Case 8 M.R. aet 2. Well nourished. No rickets. Bronchopneumonia began with appearance of rash on 4th.day.

6th.day	Red	4,400,000						
	White	7,700	52%	Poly-nucleat-	Lymph-	Large	Myelo-	Eosin-
				ed.	ocytes	mononu-	cytes	ophiles
						cleated		
7th.	"	"	6,300		31.3	16.7	0	0
8th.	"	"	5,500					
9th.	"	"	6,900					
10th.	"	"	11 a.m. 188,000					
			2 p.m. 15,600					
11th.	"	"	232,000	69.7	16.3	9.1	4.3	.6
13th.	"	"	30,200					
14th.	"	"	15,000					
15th.	"	"	12,400	died.				

Case 9.

Case 9. P.B. aet 2. Bronchopneumonia began on 7th.day with fading rash, and was slight. Well nourished. No rickets.

9th.day Red 5,200,000

	White		Polynu- cleated	Lympho- cytes	Large mono- nucleated	Myelo- cytes	Eosin- ophiles
	8,800						
10th. " "	8,100	68.4	18	10.5	.8	2.3	
11th. " "	15,600						

Steady recovery from 11th.day.

Case 10. B.McK. aet 5. Well nourished. No rickets. Broncho-
pneumonia began on 8th.day with fading rash.

11th.day Red 5,137,500

	White		Polynu- cleated	Lympho- cytes	Large mono- nucleated	Myelo- cytes	Eosin- ophiles
	34,200	77.2	14	6.1	2.1	.6	
12th. " "	17,800						
13th. " "	18,000						
14th. " "	18,800						
15th. " "	13,000						
16th. " "	18,000						

Recovery complete.

Case 11. J.McC. 11/12. Anaemic and rickety. Admitted with faded rash and bronchopneumonia on 6th.day.

6th.day Red 4,800,000

	White		Polynu- cleated	Lympho- cytes	Large mono- nucleated	Myelo- cytes	Eosino- philes
	22,600	41.3	53.4	4.2	1.1	0	
7th. " "	16,000						
8th. " "	20,400						
9th. " "	25,000						Died.

Case 12. E.McD. aet 2. Very rickety and ill nourished. Very acute bronchopneumonia beginning with rash on 4th.day.

5th.day Red 3,200,000

	White		
	7,800		
6th. " "	11,200		Died.

Conclusions

Conclusions.

On looking over the cases above detailed, the most striking fact is that leucocytosis is not nearly so constant, or so marked, as in the pertussal cases. Low counts are noted in cases 1, 2, 3, 12. Of these two had very severe attacks, one dying on the 5th. day of the bronchopneumonia (Case 1) and the other (Case 12) on the 3rd. The other two were mild cases. Case 4 was a very severe one, and yet of 10 counts, 16,000 was the maximum, and the patient recovered. The largest count was 41,300 (Case 5). Counts from 16,000 to 25,000 are common, if the patient survives some days.

Differential counts were made in 8 cases. In 5 the increase was chiefly of the polynucleated neutrophiles (Cases 4, 5, 7, 8, 10). In case 8 the leucocytes were 7,700 on the first count, of which only 52% were polynucleated neutrophiles, while 31.3% were lymphocytes, and 16.7 large mononucleated. Six days later the count was 23,200, the polynucleated being 69.7, lymphocytes 16.3 and large mononucleated 9.1. The patient was only aged 2, yet the leucocytosis due to the bronchopneumonia was chiefly of the polynucleated. The other patients were all over 3.

In case 11 the lymphocytes formed 53.4% of the leucocytes, the patient being aged 1¹/₁₂. In the other 2 cases the polynucleated were slightly decreased, while there was an increase in the mononucleated elements, the large mononucleated corpuscles in each case being over 10% (Case 6, 9). In all but 2 the large mononucleated elements were increased, the increase varying from 4.5 to 10.6%,

3 being over 10% Cabot (p.119) notes that in the convalescence from measles, the large mononucleated are increased. Eosinophiles are present in 6 cases, in small amount in all except Case 11 where they number 2.3%.

Myelocytes are noted in 5 cases, varying from a minimum of .8% to a maximum of 4%.

Neither myelocytes nor eosinophiles appear to be of any importance.

In 2 cases (4, 8) an occasional normoblast was seen in the films.

The impression, formed from a study of the cases, is, that if the patient is strong enough to survive several days, a moderate leucocytosis develops, and in some cases this may become marked, but not as a rule so marked as in pertussal bronchopneumonia. As before, the age of the child is probably the deciding factor, as to which element of the white corpuscles is increased. The increase in the large mononucleated is striking, and was not met with in the pertussal cases. The prognostic value of the leucocyte count is apparently fallacious, as witness case 8, where the count 2 days prior to death was 30,200, and Case 11 in which on the day of death the count was 25,000.

(5) Bronchopneumonia in Morbilli and Pertussis combined.

Case 1. J.H. aet.6/12. Pertussis for 6 weeks prior to admission. Well nourished and not rickety. Bronchopneumonia which was well marked post-mortem, began on 4th.day with the appearance of the rash.

4th.

Case 1.

4th.day Red 4,325,000

White 6,200

	White	Polynuc- cytes.	Lympho- cytes.	Large nucleated cytes	mono- Myelo- cytes	Eosin- ophiles
5th. "	"	4,400	46.5	47.8	5.7	0
6th. "	"	6,200				
7th. "	"	8,100	Died next day.			

Case 2. T.McE. aet.3. Poorly nourished and rickety. Broncho-pneumonia present on day of admission, patient having been 2 days acutely ill, and suffering from pertussis for some time previously. No cutaneous rash present, but eruption seen on fauces, Koplik's spots on buccal mucosa, and conjunctivitis marked. Rash appeared on the 5th.day of illness, after a mustard bath, but was faint and livid.

4th.day Red 4,325,000^k

White 6,100

	White	Polynu- cleated	Lympho- cytes	Large nucleated	mono- Eosin- ophiles	Myelo- cytes.
5th. "	"	5,800	75%	14.7	5.6	2.3
6th. "	"	5,500				1.4

Died early next morning.

Case 3. H.McC. aet 38/12. Well nourished. No rickets. Ill for 5 weeks with coughing and sickness, and whooping for one week. Rash appeared on the 4th.day, and bronchopneumonia began on the 5th.day. Patient whooped during the first 2 days of her bronchopneumonia.

6th.day Red 4,600,000

	White	Polynu- cleated	Lympho- cytes	Large nucleated	mono- Myelo- cytes	Eosino- philes
7th. "	"	7,200	68	20	7.5	4
8th. "	"	8,000				0
9th. "	"	15,000				
10th. "	"	18,300	49.8	34.2	11.6	4.2
11th. "	"	28,100				.2
12th. "	"	37,800				
13th. "	"	46,100	71.7	13.3	11.2	3.6
14th. "	"	42,600	68.8	21.1	7.8	2.1
16th. "	"	35,700				.2
17th. "	"	41,200				
17th. "	"	38,200				

From the 17th day, patient, who had been in a very precarious condition began and continued to improve. She recovered perfectly. Unfortunately I was prevented from continuing the blood counts. The whooping reappeared during convalescence.

Conclusions.

In no one of the cases, although all three had pertussis, was there a leucocytosis on admission. In fact there was rather a leucopaenia. In case 3, who recovered, a very well marked leucocytosis gradually developed. The polynucleated elements averaged ~~about~~ ^{rather less} than the normal amount, while the lymphocytes, and especially the large mononucleated, were slightly increased. In this child, although aged 3⁸/12 and well nourished, an occasional normoblast was visible in the films. The presence of a well marked leucocytosis here appeared to be of good prognosis, for after its establishment improvement although slow was steady, and recovery eventually perfect.

Duration.

This varies greatly, but appears to be much more protracted in pertussis than in morbilli (Holt *ibid.* p.548) Von Ziemssen (Nothnagel *ibid.* p.566) states that the slowest course is after pertussis. Several of my cases in morbilli seemed to be simply overwhelmed by the broncho-pneumonia, and died in a few days. These cases appeared to

to correspond to the "acute congestive form" described by Holt. This he states is especially common in measles (ibid. pp.537, 548).

Termination, in my cases has been either recovery or death.

In none have I seen anything pointing to the supervention of tuberculosis, and although several cases in pertussis cleared up slowly, the physical signs persisting for a long time, yet eventually recovery was perfect. (Holt (ibid. p.548), remarks that in pertussal cases, the physical signs may long persist. Aufrecht (ibid p.571) says. "I have not noted a single instance which would justify me in believing that a catarrhal pneumonia had terminated in caseous degeneration". This is contrary to the opinion of older writers, that tuberculosis was not an uncommon sequela. It is probable that many of the cases thus described were tubercular from the onset.

Diagnosis is from acute Lobar Pneumonia and Tuberculosis.

(1) Acute Lobar.

The difficulty is chiefly in pertussal cases, where one is apt to get large areas of consolidation. The history, if obtainable, is of great value, as broncho-pneumonia seldom has a sudden onset (vide ante). Broncho-pneumonia usually occurs below the age of 3, and lobar from 3-8 (Eustace Smith ibid. p.465, Holt p.571). Both lungs are usually affected in bronchopneumonia, and one only in lobar. If the chlorides are markedly diminished in the urine, the probability of the disease being lobar is much increased. Very often if there is much doubt as in

in very young children, the diagnosis is only settled by a critical termination, which, as previously pointed out, never occurs in bronchopneumonia. This was the case in one child aet. $1\frac{1}{2}$. Other two cases, aet. 4 and 5 respectively, presented no difficulty in diagnosis. Diminution of chlorides was marked in both.

(2) Tuberculosis

The diagnosis here is not always easy. The unusually protracted course may excite suspicion of a tubercular affection. The previous history and family history are important. Eustace Smith points out, that as catarrhal is less common than lobar pneumonia after the age of 6, if catarrhal pneumonia occurs in a child over 6, who has been previously wasting without apparent reason, we have strong evidence in favour of tubercle (Dis. of Children p.465). Dulness at the apices is more common in tubercle, and at the bases in bronchopneumonia. But I have met several cases with evident signs at the apices, which eventually cleared up. The temperature shews more marked remissions in tubercle. I have noted several tubercular cases in which the patient did not shew an amount of distress, corresponding to the respiratory rate and temperature, such as would be expected in a bronchopneumonia. Holt calls attention to the frequent disproportion between the general symptoms, and the local evidence of the disease (ibid p.1086).

Often I have noted but scanty signs in the chest, and found a well marked tubercular bronchopneumonia post-mortem.

The

The estimation of leucocytes may be of some value. It is well known that in military tuberculosis and incipient phthisis, notably the former, the leucocytes are diminished (Cabot p.112). It has been shewn in the section on the blood, that leucocytosis was present in all the pertussal cases, and in all cases in morbilli which survived for any time. In the case of E.L. previously detailed, ^(p.23) the counts were nearly all below 10,000, being 10,300 on one occasion, ^{only} Clinically the case could not be distinguished from bronchopneumonia, but post-mortem a well marked military tuberculosis was found.

Prognosis

(a) In pertussis of 30 cases, 14 died (46.6%) Holt (p.552) gives 66 cases with a mortality of 81.8%, and V.Ziemssen 16 cases with one of 55 % (ibid. p.574). The deaths according to age are distributed as follows:-

<u>Age</u>	<u>Number of Cases</u>	<u>Deaths</u>	<u>Percentage</u>
1st. year	4	3	75
2nd. "	9	6	66
3rd. "	7	2	28.5
4th. "	2	0	-
5th. "	6	2	33 1/3
6th. "	0		
7th. "	1	1	100
8th. "	1	0	

It will be very evident from the above that the disease is exceedingly fatal under 2, 9 deaths occurring out of 13 cases (69.2%) at that age. Of 14 deaths only 4 were free from rickets, and of the 4, only 2 could be described as well nourished.

The presence of rickets, especially if the chest deformity

deformity be considerable, seriously prejudices the chances of recovery. Such children, however, appear to lie more quietly, and thus exhaust themselves less than strong healthy children. This may possibly be from habit, and I am inclined to think it may assist them in making the surprising recoveries which they occasionally do. Of two cases, in which the disease was ushered in by convulsions, one recovered. One case, a mild one, which had convulsions during the course of the illness, recovered. In 10 cases convulsions occurred at a late period of the disease, all dying.

Holt (ibid p.552) had 3 cases, with convulsions at the onset, all of which recovered. He had 37 cases with late convulsions, one recovering. It will thus be seen that late convulsions are certainly of bad prognosis.

The temperature I have not found of much value in pertussis; in several fatal cases, it being but slightly elevated.

(b) In morbilli of 18 cases there were 7 deaths (38.8%). Holt (ibid.) p.552) gives 89 cases with a death rate of 62.9%.

<u>Year</u>	<u>Number of Cases</u>	<u>Deaths</u>	<u>Percentage</u>
1st.	-	-	-
2nd.	3	3	100%
3rd.	6	3	50%
4th.	1	1	100%
5th.-8th.	4	0	

Of 9 cases below the 3rd. year 6 died (66.6%), an illustration again of the great mortality in early childhood. V.Ziemssen (Nothnagel ibid. p.574) gives.

	<u>Year</u>	<u>Number of Cases</u>	<u>Deaths.</u>
	1	6	3
	2	10	3
	3	6	1
Bartels ibid	1st.	6	6
	1-5	36	14
	5-10	24	9

The mortality appears from the statistics of various writers to vary greatly in different epidemics, and this no doubt explains the comparatively low mortality in my cases.

All the fatal cases except one child of 2, who was well nourished, shewed rickets in varying degree.

As regards the time of onset of the bronchopneumonia I have classified the cases:-

Beginning with bright rash	6 cases	4 deaths
" " fading rash	12 "	3 "

From the above bronchopneumonia beginning with fading rash seems less fatal, but Henoch (p.390) asserts it is "more severe and serious".

The temperature, if 105° or over, is of serious prognosis. Holt gives a death rate of 85.5% in cases of 106° F and of 60% in cases over 105° (p.552). My hyperpyretic cases were all fatal but one which recovered perfectly. A steadily high temperature appears to be better than marked fluctuations.

In only 1 case were convulsions noted, and these were slight and just before death.

As pointed out previously the examination of the blood does not appear to be of much prognostic value.

The combination of morbilli pertussis and bronchopneumonia appears to be very fatal, 2 of my 3 cases succumbing rapidly. The third after a very severe illness, recovered. Henoch states that although the gravity of the case is increased it is not inevitably fatal (ibid.p.465).

Pathology.

The following statements are based on the results of 16 post-mortem examinations of which 6 were in measles, 9 in pertussis, and one in measles and pertussis. I have also had the opportunity of examining a case of bronchopneumonia following erysipelas, and another after diphtheria. Sections were made in each case from pieces of tissue embedded in paraffin. The stains employed were Haemalum and eosin, Haemalum and Van Gieson, Carmalum and Picric Alcohol. For the detection of fibrine the Gram-Weigert method was employed, with previous counterstaining by Carmalum.

I. Macroscopic Appearances

(a) Lungs and Pleura.

Fairly well marked pleurisy with a little straw coloured fluid was met with in 4 cases, 2 in pertussis and 2 in morbilli. The amount of fibrinous exudate was fairly abundant. The consolidation in all was well marked and extensive.

Subpleural ecchymoses were noted in 6 cases, 2 in pertussis, 3 in morbilli, and 1 in morbilli and pertusses. V.Ziemssen (Nothnagel *ibid.* p.556) points out, that they are especially found in the bronchopneumonia of whooping cough and measles.

With regard to the lungs the appearances are very various. I have found all degrees, from a single area of consolidation the size of a large pea, to areas involving the greater part of the lung. The consolidated areas stand out from the rest of the tissue, and are usually

usually of a dark bluish colour, but some are reddish brown. In my experience the small disseminated areas are usually of the latter colour, but when the consolidation is of any size, its surface colour is dark blue, or reddish blue. Sims Woodhead describes both the consolidated and collapsed areas as being of a purplish colour (Practical Pathology, 3rd.Ed.1892 p.366). Whole lobes, and sometimes almost an entire lung may be solid, but the consolidation is seldom so regular as in lobar pneumonia, and usually intervening crepitant portions can be found. The consolidated areas feel solid, sink when removed, and cannot be inflated by the blow pipe. They are most frequent in the lower lobes, and the process is usually more advanced there, but in well marked cases they occur in all the lobes. In my cases the lobes were thus affected.

Right Lung	(Upper lobe	9	
)		
	(Middle lobe	10	(On one occasion the only area affected in the right lung)
)		
	(Lower lobe	7	
Left Lung	(Upper lobe	4	
)		
	(Lower lobe	10	(in 1 case the only part attacked in left lung)

The apices were affected four times, the right in 2 cases, the left in 1, and both in 1 case. In the latter the consolidation extended down through the posterior third of the lung from apex to base. In another case the entire right upper lobe was solid.

The tongue of the left upper lobe which overlaps the pericardium was affected in no fewer than 11 cases. I have been so much struck with the condition of this part, that I have classified it separately. In most cases it has

has been very markedly affected, and the pathological process has been more advanced there, than in other parts of the lung. In 7 cases it is described as being of a greyish colour, in 2 dark blue, and in 2 reddish blue. It feels solid, and when removed sinks. On section the cut surface is usually greyish or pinkish white, the bronchi are dilated, and their walls thickened, and on pressure a drop of purulent fluid exudes. I have often noted, the consolidated area continuous with it, extending into the root of the lung at the lower portion of the upper lobe. The frequency with which this tongue of lung is affected is extremely interesting, more especially as the condition is often advanced, the part being evidently early affected. In discussing the physical signs it has already been pointed out that they are often intense and noted earlier in this situation.

On section of the affected portions of lung, very various appearances may be noted. The cut surface may be bright red, if the affection is not advanced. More usually it is reddish brown or reddish grey. The surface is rarely granular. Only two cases shewed this, and in neither was it marked. Aufrecht states that it never has the characteristic appearance of that in lobar pneumonia (Nothnagel *ibid.* p.554). The bronchi are dilated, and if the case has lasted some time the walls are thickened. In one case this thickening was a marked feature. On pressure there may be but little fluid exude, but as a rule a drop of purulent fluid exudes from the bronchi. Small collections of pus were noted in 2 cases ("graines jaunes" or abscesses peribronchique of French writers, Ashby and Wright *Diseases of Children* p.361). If the solid patch be small, it

it may be surrounded by emphysematous lung tissue.

Emphysema of the edges is frequent, and areas of collapse, dark blue and depressed, inflatable, and reddish on section are often present. They are much more frequent and constant in pertussis, than in morbilli. Emphysema is also more frequent in pertussis (Rotch ibid p.696)

- (b) Bronchial Glands were enlarged in 12 cases out of 16. They were red in surface colour, and on section, in 6 cases in pertussis, 3 in morbilli and 1 in morbilli and pertussis. In 2 cases, in morbilli, caseous glands were noted. Rotch states that the bronchial glands are always enlarged in bronchopneumonia (Pediatrics p.693), and this appears to be true, if the disease has existed for any time.
- (c) Heart. In 5 cases the pericardial fluid was increased, the amount present varying from one to three ounces. In 12 cases the right side of the heart was markedly dilated and full of clot, and in 2 slightly dilated. In several cases the tricuspid valve was incompetent. Thus in nearly all the cases the failure of the right side of the heart was evident.
- (d) Spleen was enlarged from passive hyperaemia in one case, but the enlargement was slight.
- (e) Liver. Fatty changes were present in 4, slight in 3 and marked in 1. In 1 case passive hyperaemia was noted.
- (f) Kidneys. Fatty changes were present in 1 case and passive hyperaemia in another. In 1 case an acute parenchymatous nephritis was present, and a similar condition, with abundant

abundant haemorrhages, was noted in a case following diphtheria.

(g) The Brain was examined in 4 cases in pertussis, all of whom had had convulsions prior to death. In one there was some increase of fluid over the convolutions, and in another congestion of the cortex. In a third the meningeal vessels were injected, the fluid over the convolutions increased, and the cortex congested. In the fourth case there was marked congestion of the meninges.

In 2 cases in morbilli, neither having had convulsions, nothing abnormal was found.

II. Microscopic Appearances.

(a) Lungs.

On examining a favourable section the process is seen to be round one of the finest bronchi. The bronchus is dilated, and its lumen is occupied by a plug, composed chiefly of leucocytes, and the detached epithelium of the bronchial mucosa. The epithelium is usually greatly proliferated, and in many cases completely detached. The capillary vessels in the submucous coat shew marked dilatation, and are full of blood. Aufrecht (ibid p.551) asserts that "the finding of turgescient bronchial vessels, reaching into the capillary system, absolutely confirms the diagnosis of catarrhal pneumonia". I certainly have seen it as a prominent feature in all my cases.

The bronchial wall shews varying degrees of infiltration with leucocytes. This is sometimes very striking, and especially so in those cases, where thickening is visible macroscopically. The surrounding alveoli, nearest

nearest the bronchus, are full of leucocytes, and large catarrhal cells. The capillaries in the alveolar wall are dilated. There is thus not only a bronchitis and a peribronchitis, but also an inflammation of the alveoli. Degenerative changes can be noted in the cells occupying the alveoli, in cases which have lasted any time. As one progresses away from the bronchus, the changes become less marked, till emphysematous vesicles may be reached. In some cases, where the process is advanced, the pulmonary tissue may be almost unrecognisable as such, being overrun with leucocytes. Of 13 cases examined for fibrine, I was able to demonstrate its presence in 12. It was moderately abundant, and forming a distinct network in 2, but only in small amount in others. It was most abundant in the alveoli next the bronchus. In none was the network marked, as it is in lobar pneumonia.

As regards the presence of fibrine in the alveoli considerable discussion appears to exist. Aufrecht (ibid p.555) says "as to fibrine, which is said by Damaschino, Henoeh, Charcot and Cadet to be present in the alveoli, neither Bartels, nor Von Ziemssen, nor myself have ever seen it. Yet Sims Woodhead (ibid p.368), Osler (ibid p.644), Coats(p.761) and Rotch (p.694) all describe it, although Rotch and Osler point out that it is often absent, and when present, is only in small quantities. It was undoubtedly present in most of my cases, but in small amount.

The areas of collapse, shew, on microscopic examination, varying degrees of bronchitis. In all I have examined, changes, similar to those described above, were noted

noted in the bronchioles. They were, however, much less marked. In several I have noted evidence of inflammatory changes in the alveoli, catarrhal cells and leucocytes in small amount being present.

(b) Bronchial Glands.

The enlargement in many cases in pertussis seems to be due to a general increase in the gland substance, if any, the cellular element predominating. In 4 cases in morbilli, 1 in pertussis, and 1 in morbilli and pertussis, the veins and capillaries of the gland were markedly dilated and full of blood, forming a striking microscopic picture. In one case after diphtheria, haemorrhages into the gland substance were present.

Tubercles were noted in two cases in morbilli.

Treatment.

I do not intend to enter into any detail with regard to treatment. The ordinary treatment for any child suffering from an acute disease is of course employed

The steam tent appears to be of great use, especially in the earlier stages of the disease. Poulticing in moderation is also useful. I have tried the iced compresses recommended by German writers, but have not found them better than poultices. They may be of use in hyperpyretic cases in which iced sponging, or the bath, is of much value.

The importance of regular feeding cannot be too strongly insisted upon, and when the child refused its nourishment, I have occasionally found nasal feeding act well.

Expectorants

Expectorants I have used but little, but in some cases Vinum Ipecacuanhae was given in small frequent doses, with apparently good effect.

Emetics are occasionally useful for the removal of retained secretion, but often fail to act, and in a weakly child one may hesitate to push them.

Stimulant is best given in the form of brandy, diluted with water, the doses being measured in minims. Sherry whey is also of considerable value, nearly all children taking it well. Strychnine given hypodermically, is I am convinced, of great benefit.

In cases with much cyanosis, oxygen has proved very useful. Even very young children, contrary to expectation, take it well, and seem to be relieved by it, their colour, at least, certainly improving.

Mustard baths, with cold douching over the chest, are useful in sudden attacks of collapse. Convulsions were treated by ordinary methods, but in the terminal form but little can be done.

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