

## CONCLUSIONS

1. The general plan of admission is the result of observations made along the Franco-British front in 1917-1918; the details, as carried out in our hospital, and many original ideas embodied therein, should be credited entirely to Capt. J. D. Bruce, M. C.

2. If carried out, with omissions or additions suggested by divergent conditions of the battle front, the scheme will be found to be both time and life saving.

PNEUMONIA AT CAMP MEADE,  
MARYLAND

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From the opening of the base hospital, Nov. 1, 1917, to May 31, 1918, 421 cases of pneumonia have been diagnosed in the wards. Of these, 361 were diagnosed as lobar pneumonia and sixty as bronchopneumonia. We are doubtful as to the accuracy of this differential diagnosis, and in some cases such a differentiation was impossible. Cases with sudden onset, usually with a chill, rusty sputum, continuous high fever, and defervescence by crises between the fourth and tenth day were called lobar pneumonia without consideration of the distribution of pulmonary signs. In a few borderline cases the roentgen ray was of considerable help. There were undoubtedly a number of cases of bronchopneumonia or interstitial bronchopneumonia diagnosed as lobar pneumonia, and we were unable to correct this diagnosis except when the cases terminated fatally. The bacteriology was no help in making the diagnosis, for in two cases of bronchopneumonia and five cases of bronchitis, the Type II pneumococcus was isolated from the sputum. Of the sixty cases diagnosed as bronchopneumonia, only twelve followed measles (the other six measles pneumonias being entered in the record office as lobar pneumonia), and two followed scarlet fever.

Our typical and usual picture of bronchopneumonia was: gradual onset with cough and general malaise often following a bad cold; temperature running an irregular course, usually from 1 to 3 degrees higher at night than in the morning; fever lasting from one to four weeks and ending by lysis; indefinite and variable signs of consolidation in the lungs, often rapidly migratory, and purulent sputum. Most of our forty-six cases were of this description, although there were a few "abortive" cases in which there were only a few days of fever but in which, when examined, definite signs in the lungs were found both clinically and by roentgenoscopy. Such cases, if neglected, might readily have progressed to the more severe type described above. The postmeasles cases were similar except for the extraordinary degree of cyanosis and highly purulent, sometimes salmon colored sputum.

Our figures, then, are only roughly correct from this point of view, but we strongly believe that these two diseases should be considered separately.

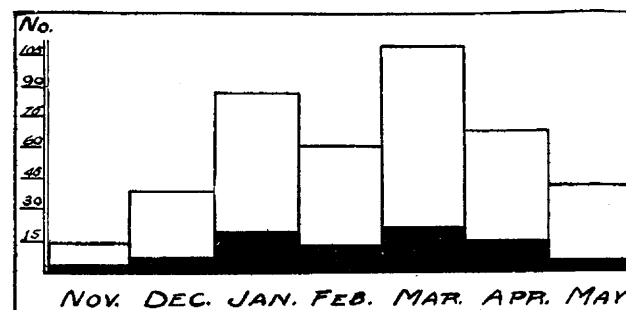
TABLE 1.—MORTALITY AMONG WHITE AND COLORED  
PATIENTS WITH LOBAR PNEUMONIA AND  
BRONCHOPNEUMONIA

	Number		Died		Mortality	
	White	Colored	White	Colored	White	Colored
Lobar pneumonia.....	127	234	28	36	22.0%	11.1%
Bronchopneumonia.....	37	23	10	5	27.0%	21.7%
Total.....	164	257	38	41	23.2%	15.9%
	421		79		18.7%	

The incidence of pneumonia among the colored troops was roughly eight times as great as among the white troops, there being only about 7,000 colored troops to 35,000 white troops in camp.

In the middle of February a different clinical and bacteriologic picture made its appearance, comprising about ten cases in all. These patients showed marked prostration early in the course, were apprehensive, and were very ill. The physical signs were those of consolidation of one or the other of the lower lobes. As the disease progressed, the percussion note was observed to become flat, and on performing thorac-

centesis, fluid in quantities varying from a few cubic centimeters to 1 or 2 liters was obtained. This fluid was thin, slightly cloudy, dirty orange colored and usually contained relatively few cells and organisms. The organisms were always found to be *Streptococcus hemolyticus*. Early operation yielded unsatisfactory results, and repeated aspiration succeeded in curing only one case. The procedure finally adopted was aspiration, followed in one or two days by rib resection low in the chest wall under local anesthesia, and the substitution of neutral solution of chlorinated soda for the pleural exudate slowly and only after any shock incident to the operation was recovered from. Four of these cases coming to necropsy showed interstitial bronchopneumonia as described perfectly by Kaufman and noted first in this country by Mathers<sup>1</sup> in his study of a series of cases of pneumonia of atypical cases occurring during and following attacks of grip in 1915-1916. He showed the presence of *Streptococcus hemolyticus* in the sputum and lungs of practically all these cases. Cole and MacCallum<sup>2</sup> have described these cases following measles in the soldiers at Fort Sam Houston, Texas. It is interesting to note that measles was not recognized in any of our cases. The sputum studied in five such cases yielded the Type IV pneumococcus in one and the streptococcus in four (hemolysis was not tested). There were other cases of atypical pneumonia in which the sputum yielded the streptococcus; but without mouse inoculation we are not prepared to say what importance this organism should be given.



Occurrence of pneumonia by months: totals in outline, deaths in black.

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1. Mathers: Tr. Chicago Path. Soc., April 1, 1916.

2. Cole, Rufus, and MacCallum, W. G.: Pneumonia at a Base Hospital, THE JOURNAL A. M. A., April 20, 1918, p. 1146.

During December the sputum of fifteen cases of lobar pneumonia was studied, after which time no more mice were available. These cases all yielded the pneumococcus and none the *Streptococcus hemolyticus*, indicating that at that time the *Streptococcus hemolyticus* was not playing an important rôle in the etiology of pneumonia.

Beginning Feb. 15, 1918, every available sputum was studied by the Avery technic. It is interesting to note that there were certain cases in which no sputum suitable for examination could be obtained, although every effort was made to procure it. We are inclined to believe that they belong to the streptococcus group. In cases in which good sputum was to be had, the Avery technic was altogether satisfactory for the determination of pneumococci when present, and in conjunction with cultures of the sputum directly on blood agar plates made fairly reliable substitute for mouse inoculation. However, mouse inoculation has proved most desirable in the study of sputum in cases in which pneumococci were not present in abundance or when other organisms were to be designated as the causative agent.

TABLE 2.—SPUTUM BACTERIOLOGY, FEB. 15 TO MAY 31, 1918

	Lobar Pneumonia				Strepto-Undeter-		
	I	II	II+	III	IV	coccus* mined†	Total
Number.....	57	26	11	0	27	25	13
Per cent.....	36.2	16.3	6.8	0.0	16.7	15.7	8.1
Died.....	3	5	2	0	6	2	2
Mortality.....	5.3	19.2	18.2	0.0	22.2	8.0	15.4
Bronchopneumonia							
Number.....	0	0	2	0	9	14	3
Bronchitis							
Number.....	0	3	2	0	4	10	0

\* Cases in which the streptococcus was the prevailing organism in the Avery tube after five hours' incubation. Hemolysis was not determined. Many of these sputum specimens were of very poor quality and probably did not yield the etiologic organism.

† For a short period, bile tests were not used, and therefore some of these cases were probably Type IV pneumococcus.

In only one case of pneumonia from which a type pneumococcus (Type I) was isolated from the sputum did streptococcus empyema develop. We take this to indicate that the coexistence of these two organisms was rare in our series.

We are unable to say in what proportion of cases *B. influenzae* occurred. It was seen several times in lobar pneumonia and bronchopneumonia, and doubtless occurred frequently; but during that time our attention was turned toward discovering and treating with serum the Type I pneumococcus cases, and our laboratory staff was not large enough to permit of extensive studies. We did not find *B. influenzae* alone in any case, and doubt its significance in the instances in which it was noted.

#### PNEUMONIA FOLLOWING MEASLES AND SCARLET FEVER

During the period covered by this report there occurred 316 cases of measles, in eighteen, or 5.7 per cent., of which, pneumonia developed. From the pleural fluid of five empyemas occurring in these cases the hemolytic streptococcus was isolated in four, and the organism was undetermined in the fifth. Of the twelve cases of measles terminating fatally, all were complicated by pneumonia and four also by empyema. In none of these cases was necropsy performed.

The sputum from four postmeasles cases was studied for the pneumococcus. A Type IV pneumococcus was found in three of them and no pneumococcus in the other one. This organism may possibly have a place in the etiology of the pneumonia, but the

hemolytic streptococcus found in the pleural exudate is much more reliable evidence. Weichselbaum<sup>3</sup> called attention to the fact that the streptococcus may be present in the lung of a patient dying from pneumonia. The thought occurred to us that very possibly a streptococcus entering the lung as a secondary invader might outgrow the pneumococcus, especially in pleural exudates, and give rise to confusion.

TABLE 3.—MORTALITY IN MEASLES AND POSTMEASLES PNEUMONIA OCCURRING DURING THE SEVEN MONTHS COVERED BY THIS REPORT

	Number		Died		Mortality	
	White	Colored	White	Colored	White	Colored
Measles.....	243	73	10	2	4.1%	2.7%
Postmeasles pneumonia.....	15	3	10	2	66.6%	66.6%

From 147 cases of scarlet fever, three cases of pneumonia developed, all of which were complicated by streptococcus empyema. The one specimen of sputum examined yielded a Type IV pneumococcus.

Four patients developed scarlet fever while convalescing from pneumonia, one of whom suffered from streptococcus empyema.

TABLE 4.—MORTALITY IN SCARLET FEVER AND PNEUMONIA FOLLOWING SCARLET FEVER

	Number		Died		Mortality	
	White	Colored	White	Colored	White	Colored
Scarlet fever.....	147		4		2.7%	
Pneumonia following scarlet fever.....	3	0	2	0	66.6%	

The incidence of pneumonia following measles and scarlet fever is of peculiar interest at the present time. Scarlet fever is characterized above all other features by its complications, which are almost invariably streptococcal infections; this organism can usually be found in the throat. Pneumonia followed scarlet fever in 2 per cent. of the cases and measles in 5.7 per cent. This would seem to throw some doubt on the importance of the presence of streptococci in the throat flora of measles-pneumonia.

#### COMPLICATIONS

Of the complications, empyema was by far the most frequently observed.

TABLE 5.—INCIDENCE AND BACTERIOLOGY OF EMPYEMA FOLLOWING LOBAR PNEUMONIA AND BRONCHOPNEUMONIA

	Number Empyema		Pneumo-	Strepto-	Unknown
			coccus	coccus	
Lobar pneumonia.....	361	22	14	5	2*
Bronchopneumonia.....	60	18	1	13	4
Unknown lung condition.....	11	11	0	11	0
Total.....	432	51	15	29	6

\* The staphylococcus was obtained from one case of empyema following lobar pneumonia.

The cases classed as of an unknown lung condition include cases in which empyema was the first chest condition noted. Two followed measles, two scarlet fever, two tonsillitis, one peritonsillar and one inguinal abscess, probably all having some changes in the lung, either bronchopneumonia or interstitial bronchopneumonia. The remarkably high percentage of empyemas following bronchopneumonia is probably due to the fact that the streptococcus was the organism causing, or at least playing a large part in, the infection.

3. Weichselbaum: Med. Jahrb., 1886, p. 550.



nia which did not follow measles or scarlet fever or general anesthesia. They presented a fairly distinctive clinical picture. Empyema was a very frequent complication, and from all but two of the pleural exudates a hemolytic streptococcus was isolated.

I wish to emphasize the importance of early recognition of mild cases of bronchopneumonia so frequently passed over as bronchitis. These patients, if not put to bed, may go on to a severe illness.

The cases of interstitial bronchopneumonia seen by us were not in measles patients. One patient had scarlet fever for six days before fluid was detected. They presented a somewhat different picture of sudden onset, generally with a chill, great prostration, nervousness and apprehension. Early and rapid accumulation of fluid which had a typical, thin, cloudy appearance was the rule. The hemolytic streptococcus was recovered from these cases.

The percentage of postmeasles pneumonia, while relatively small (5.7 per cent.), was nearly three times as large as pneumonia following scarlet fever (2 per cent.). I feel that this point is not one to be overlooked in the study of the rôle of the streptococcus in pneumonia.

Serum treatment of Type I cases apparently yielded excellent results. I believe that the mortality was lessened, the febrile period shortened and the number of complications reduced by its use.

Type II pneumococci were recovered from the sputum of several patients suffering from bronchopneumonia and bronchitis. As far as I know, these patients had not come in contact with Type II pneumococcus pneumonia cases.

## SERUM TREATMENT OF TYPE I PNEUMONIA

OCCURRING IN ASSOCIATION WITH AN EPIDEMIC  
OF INFLUENZA

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The epidemic of influenza that has passed through Camp Devens has led to a large amount of laboratory investigation, which will be the subject of a future report. It is sufficient to state that *Bacillus influenzae* of Pfeiffer has been established as the etiologic factor in this epidemic. Incident with the rise in the number of cases of the disease, pneumonia, clinically atypical from the classical acute lobar pneumonia, became very prevalent.

A small number of these were demonstrated to be due to *B. influenzae* alone. That many of them were not purely an influenzal process was shown by bacteriologic study of necropsies. Of the patients showing clinical signs of pneumonia, the usual percentage of Type I pneumococci was demonstrated in the sputum (approximately 20 per cent). Blood cultures during life revealed the same type in eight cases.

Since both the influenza bacillus and the pneumococcus were demonstrated so frequently in the sputum

of these cases, some doubt arose as to the advisability of treating this mixed infection with an anti-pneumococcus serum. It is the purpose of this report to state briefly the effect of Type I serum in these cases.

Before the epidemic, serum of low titer (Squibb's) was used in the treatment of typical Type I lobar pneumonias. In this group nineteen recovered and five died—a mortality of 20 per cent. During the epidemic, with essentially the same treatment, thirty-one recovered and twenty-three died, a mortality of 43 per cent. In the height of the epidemic, the laboratory received a supply of high titer serum (Rockefeller). Under careful administration, fourteen patients recovered or are well on the way to convalescence, and one has died—a mortality of 7 per cent. The mortality of Type II was 50 per cent. (two of four patients) before, and 62 per cent. during the epidemic (thirteen of twenty-one patients).

The accompanying table is self-explanatory:

TREATMENT AND RESULTS IN TYPE I PNEUMONIA			
Before epidemic:	Recovered, No.	Died, No.	Mortality, Per Cent.
Treated with low titer serum.....	11	4	27
Complicated by influenza epidemic:			
Treated with low titer serum .....	12	13	..
Treated first with low titer serum, high titer serum being substituted late in the disease .....	5	6	..
	17	19	53
Treated with high titer serum.....	14	1	7

It is not to be assumed that the figure of 53 per cent. represents in any sense the mortality of the pneumonia patients in this epidemic; it applies only to the more seriously ill who were selected for typing, since it was not feasible to type all the patients.

The one patient dying after treatment with high titer serum was admitted to the hospital after an illness of two weeks, in an extremely critical condition.

Not infrequently a moderate elevation of temperature (102 F.) persisted after the administration of liberal quantities of high titer serum (500 c.c.); under these circumstances the injections were usually discontinued, it being assumed that the temperature was probably due to *B. influenzae* or to some other organism than the Type I pneumococcus. A few of the patients improved promptly and definitely soon after the administration of serum; in the majority the improvement was gradual; some remained seriously ill for several days before convalescence began.

It seems inevitable that a certain number of patients must react more or less severely shortly after the injection of serum, especially if it is not carefully prepared. These reactions apparently produce more exhaustion of the patient than might conceivably be caused by moderate exercise. Such reactions can be justified only by the use of high grade serum producing definite and specific benefit to the patient.

## SUMMARY OF RESULTS

1. A normal number of Type I pneumococcus pneumonias were found complicating or following influenza.
2. The mortality in this group, when treated with serum of low titer during their entire course, or only in the last stages with high titer serum, was approximately double that similarly treated before the epidemic.