

THESIS

Calves - Diseases
Series

animal pathology

THE ETIOLOGY AND PATHOLOGY
OF
CALF PNEUMONIA

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CALF PNEUMONIA

THESIS

Submitted to the Faculty of Michigan State College
in partial fulfillment of the require-
ments for the degree of Master
of Science in Animal
Pathology

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June 1937

THESIS

TABLE OF CONTENTS

Introduction - - - - -	1
Review of Literature - - - - -	2
Etiological and Pathological Study - - - - -	3
Sources of materials and data	
Method of study in gross	
Method of microscopic study	
Case reports	
Discussion - - - - -	52
Summary - - - - -	57
Tables and Charts - - - - -	59
Photomicrographs - - - - -	74
Bibliography - - - - -	119
Acknowledgments - - - - -	120

INTRODUCTION

One of the diseases which has a most demoralizing effect on the dairyman is calf pneumonia, since his future production depends upon the well-being of the young stock. In the two years that pneumonia occurred in one large dairy herd, the following was noted:

The first year, thirty-six calves out of fifty developed pneumonia, thirteen of these resulting fatally. The second year, seventeen calves out of thirty-one developed pneumonia with eight terminating fatally (7). With a mortality of approximately twenty-five per cent over the two-year period, the effect on the dairyman can be easily understood.

It has been well established that any abnormal changes in the structure of an organ are usually followed by disturbances in the function of that organ. There has been considerable study of calf pneumonia from an etiological point of view and in associating it with other diseases. Yet a study in which the structural or pathological changes are the paramount thought seems to be lacking. With this thought in mind, but not ignoring the etiology of the disease, the following study was undertaken.

REVIEW OF LITERATURE

There is a small amount of literature dealing with calf pneumonia as a sequel to calf scours. A pneumonia of calves associated with white scours has been described by Nocard (1) in 1901 and 1902 although his description of this pneumonia does not compare with that of American workers; namely, Hagen (2) and Carpenter (3). In 1917, Hagen (2) described a pneumonia associated with white scours in calves at which time he stated that in some cases scouring is negligible while joint lesions and a peculiar type of bronchopneumonia may occur. He also reports the isolation of the colon bacillus from lungs of many of the cases of calf scours. Probably the most important literature (in English) in which calf pneumonia has been described as a separate disease is the work of Carpenter and Gilman (3) in 1921. They state that the lesions in the lungs vary considerably as to the type of pneumonia and the duration of the disease. Carpenter states in this work that he has isolated from the calves' lungs micrococci, *B. Pyogenes*, colon bacilli and streptococci, the streptococci predominating. Smith reports a pneumonia in fetuses and calves in which *Brucella abortus* is the causative organism. He suggested at this time that *Brucella abortus* may be a predisposing factor when pneumonia is caused by other organisms (4). In an earlier report, Smith mentions the isolation of a pleomorphic bacillus from a case of calf pneumonia (5). Hallman, Sholl, and Delez describe the lesions of fetal pneumonia associated with *Brucella* infections (6).

ETIOLOGICAL AND PATHOLOGICAL STUDY

Sources of Material and Data

The materials used in this work were obtained during the years 1935 and 1936. They were taken from cases of calf pneumonia brought to the laboratory for autopsy during the two-year period.

Method of Study in Gross

In a larger number of the cases, photographs were taken of the gross specimens to make a more complete record of the extent of the gross lesions. As far as possible, descriptions were made separately of the left and right lungs. Blocks of tissue were taken from various parts of the different lobes (11) depending on the extent of the pneumonia and gross variations in consolidated areas. The following key was used in identifying the different areas from which tissue was taken:

- #1 - Diaphragmatic lobe.
- #2 - Posterior portion of the cardiac lobe.
- #3 - Anterior portion of the cardiac lobe when
in two parts.
- #4 - Apical lobe.

These numbers were prefixed by the letter L or R to designate the left or right lung. The letter M was used to designate the mediastinal lobe. As accurately as possible, each lobe was equally divided into four planes; namely, A, B, C, and D, A being the plane nearest the hilus of any particular lobe. The four planes mentioned above were cut

at right angles to the main or central bronchial tube of the lobe from which the specimen was taken. For example, 10 R4C would be a section from Case #10, the right apical lobe, in a plane about half way from the hilus to the apex of the lobe. The mediastinal lymph nodes were designated by MLG and the bronchial by BLG. Brief gross descriptions were made at the time each block of tissue was obtained.

Method of Microscopic Study

Blocks of tissue were taken in such a way that the sections would be in the same plane as those previously described as A, B, C, and D. The number of blocks per case depended upon the extent of the pneumonia and the gross variations which could be recognized, the number of areas represented per case ranging from 6 to 27 in number and usually averaging from 12 to 15. Blocks were taken from the mediastinal and bronchial lymph nodes. All sections of tissue taken for microscopic examination were placed immediately in Zenker's solution and embedded in paraffin for sectioning. Sections from all cases were stained by the eosin hematoxylin method. Sections from some cases were also stained for bacteria.

Bacteriological Study

The lungs were cultured only in those cases which had been dead less than six hours. When postmortem changes were evident, the material was not studied either bacteriologically or histologically. Blocks of tissue for the inoculation of culture plates were taken from areas that presented decided variations upon gross examination. These

blocks were taken before those for use in the microscopic study. If the pathology was uniform throughout the pneumonic portion of the lung, a representative number of blocks were taken, usually one or two from each lobe. The inoculated plates were identified according to the location from which the blocks of tissue were taken. The same key was employed here as that used in identifying blocks of tissue for microscopic study. The contiguous lymph glands were cultured in all cases but the heart blood only in those which had died recently or had been killed.

Sterile precautions were taken as follows:

(1) The surface of the lung from which a block was to be removed was seared. This was done by using a piece of flat metal, 4 cm. in diameter, which was heated until red-hot.

(2) Using sterile forceps and scissors, a small block of tissue approximately 1 x 2 cm. was removed and three culture plates were inoculated with each block.

The media used was a dextrose blood agar. The addition of .5% dextrose tended to give a more abundant growth at the end of the twenty-four hour period. Transfers were made to blood and plain agar slants. These were used as stock cultures for the bacteriological determinations.

The bacteriological determinations shown in Tables I and II indicate, in general, the procedure followed with each culture. Many similarities based on Bergy's classification will be noted in a comparison of Tables I and II. In the following case reports, the bacteriology of each case will be briefly given.

CASE REPORTS

Case #1 (Autopsy 3028), a female Holstein, eight months old, which had shown a slight cough for four days before slaughtering in the course of an experimental project.

Gross examination:

The only gross lesions noticeable are widely scattered congested areas in the apical and cardiac lobes of both lungs. Upon section of the lobes, these are distinctly lobular in their outline. They become more numerous toward the hilus of the lobes, forming massive areas of congestion in several lobes. The mediastinal lobe shows only one congested lobule at its hilus. The mediastinal and bronchial lymph nodes are normal.

Microscopic examination:

There is a slight increase in the number of lymphocytes surrounding the small bronchi and bronchioles. Sections from the grossly involved areas show a marked congestion of the alveolar walls with considerable atelectasis. No abundant fluid or cellular exudate is present in the alveolar sacs. Considerable normal tissue is seen in this case (Figs. 17 and 18). The lymph nodes are normal.

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Case #2 (Autopsy 3036), a male Holstein, ten weeks old which had a pneumonia of one week's duration before death.

Gross examination:

There is red hepatization of the cardiac and apical

lobes of both lungs. The cardiac lobes seem slightly firmer than the apical lobes. A few grayish-yellow areas 1 to 2 mm. in diameter are seen on the pleural surface of the cardiac and apical lobes. These areas are largest toward the hilus of the lobes and upon section are more numerous on the cut surface.

The diaphragmatic lobes of both lungs show pneumonic areas in their anterior one-fourth which, upon section, appear to radiate from the hilus of the lobe. The posterior borders of the involved portion of the diaphragmatic lobes appear lobular in nature. The mediastinal and bronchial lymph nodes are enlarged and upon section a thin yellowish fluid exudes from the cut surface.

Microscopic examination:

In both lungs there is an acute bronchitis with much desquamation of the epithelium. All the bronchi and larger bronchioles which show any congestion of the mucosa contain a large number of desquamated epithelial cells in their lumina. In a number of the terminal and respiratory bronchioles there is evidence of productive tissue changes in the bronchial wall.

The majority of the alveoli are filled with a recent inflammatory exudate consisting of a coarse network of fibrin, mononuclear cells and a few polymorphonuclear cells.

The inflammatory process is of longer duration in the cardiac and apical lobes than in the diaphragmatic lobes. The apical lobe shows more evidence of a prolonged pneumonia

than the cardiac lobe. The mediastinal and bronchial lymph nodes contain large numbers of polymorphs and mononuclear phagocytes in their sinuses.

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Case #3 (Autopsy 3028), a female Holstein, three months old, which had shown clinical symptoms of pneumonia for ten days prior to death.

Gross examination:

The cardiac and apical lobes are in a state of grayish-red consolidation with very prominent interlobular septa, probably due to edema. In the left apical and cardiac lobes, there are more grayish areas than in the corresponding lobes of the right lung. The anterior one-third of the right diaphragmatic lung is in a state of red hepatization, only a few small grayish-yellow areas are seen on the pleural surface at the hilus of the lobe. The anterior one-fifth of the left diaphragmatic lobe appears the same as the cardiac and apical lobes of that lung.

The mediastinal and bronchial lymph nodes are very much enlarged with the mediastinal nodes showing numerous petechial hemorrhages on the surface.

Microscopic examination:

The pleura is practically unaltered. Considerable atelectasis has taken place. In the areas of very recent involvement, there are a large number of mononuclear phagocytes in the stroma of the bronchi and many lymphocytes in the peribronchial tissue. Proportionally, there is more mononuclear infiltration in the mucosa of the terminal

bronchioles than in the mucosa of the bronchi. In the apical lobe, and to some extent in the cardiac lobe, there is considerable evidence of productive tissue changes in the walls of the terminal and respiratory bronchioles. The alveolar walls show an increase in the number of fibroblasts and macrophages. The exudate in the alveoli consists of mononuclear phagocytes (Fig. 63) and polymorphonuclear leucocytes. The above changes are more noticeable adjacent to the bronchioles. The alveoli at a greater distance from the bronchioles do not show any evidence of thickening of the alveolar walls. In many areas, the alveoli appear as if lined with mononuclear phagocytes. Lymph nodes show only a mild congestion.

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Case #4 (Autopsy 3085), a calf which was one of a set of triplets and the first one to become sick. Just prior to the pneumonia, the calves were changed to another nurse cow and developed scours. This calf became sick on March 14, 1935, and died on April 5, 1935, at the age of one month. When the animal showed the first signs of pneumonia, (Temp. 104.8) it was given 40 cc. of calf scour antiserum. Three days of improvement followed.

On March 25, 1935, the calf was noticeably worse, (Temp. 102). Loss of weight and persistent coughing were accompanied by accelerated respiration and diarrhea. Daily injections of calf scour antiserum were made until April 5, 1935.

Gross examination:

The cardiac and apical lobes of both lungs show a grayish-red consolidation with a pleura studded by numerous reddish-brown areas ranging in size from 1 to 2 mm, in diameter which suggests necrosis. The diaphragmatic lobes are consolidated only in the anterior one-third which appear much the same as the adjacent cardiac lobes. The mediastinal lobe is similar in appearance to the cardiac lobes. Throughout the cardiac and apical lobes of both lungs, many small abscesses, 5 mm. to 1 cm. in diameter, appear just beneath the pleural surface. The abscesses seem more numerous toward the hilus of the lobe. The involved portions of the left lung show more gray areas indicative of an abundant cellular exudate. Upon section of any of the lobes, a foamy purulent exudate exudes from the smaller bronchi and bronchioles which is considerably thicker than that from the larger bronchi. Many abscesses similar to those noted on the pleural surface can be seen upon section. If a lobe of the lung showing numerous abscesses on the pleural surface is cut so that the main bronchi and some of their branches are divided lengthwise, several of the abscesses will appear at the termination of the small bronchi and bronchioles. On the cut surface of the anterior lobes, many opaque yellowish patches are observed which include an entire lobule. The mediastinal and bronchial lymph nodes are enlarged and have a distinct zone of hemorrhage around the peripheral border.

Microscopic examination:

The pleura is slightly thickened. The interlobular septa are wide and edematous and contain lymphatics distended with mononuclear phagocytes. In many of the small bronchi, the mucosa is definitely thickened by a marked congestion accompanied by considerable desquamation of the epithelium. Productive tissue changes are very much in evidence around the small bronchioles. This is accompanied by considerable mononuclear infiltration. No productive tissue changes are noted in the walls of the alveoli surrounding the bronchioles. There are many necrotic areas .5 to 1 cm. in diameter (Fig. 55). The alveolar walls are very congested, the alveoli being filled with an exudate consisting of mononuclear phagocytes and a small number of polymorphs in a network of fibrin. In many instances, there is such a mononuclear exudation that the alveolar wall is not discernible. In some areas, the alveolar walls and the cells of the exudate are necrotic. The lymph nodes contain a large number of polymorphs in their sinuses.

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Case #5 (Autopsy 3110), a male Guernsey, one month old which had a pneumonia of two weeks' duration before death. On the first day of sickness the temperature was 104°. The range of temperature during the course of the pneumonia was 104° - 106.4°. There were shallow and accelerated respirations, also a nasal discharge and cough throughout the course of the pneumonia.

Gross examination:

Upon autopsy there is a pneumonia very similar to the previous cases. There is a consolidation of the cardiac and apical lobes of both lungs, characterized by a grayish-red consolidation with many areas of an acute nature. The anterior one-third of the diaphragmatic lobes are involved in an acute pneumonia. The lymph nodes are enlarged, edematous and have many petechial hemorrhages.

Microscopic examination:

The pleura is unaltered. The interlobular septa are edematous with a slight distention of the lymphatics. There is an acute bronchiolitis with some desquamation of the epithelium. In some areas, there is considerable cellular exudate in the lumina of the small bronchi and larger bronchioles. There are many areas of a recent bronchiolitis (Figs. 19 and 20).

A large number of the alveoli are filled with a cellular exudate consisting of mononuclear phagocytes and a few polymorphs. In the sections from the more recent areas of pneumonia, the alveoli and alveolar ducts contain a fibrous exudate (Fig. 22). In these areas, the alveolar walls are very much congested. The lymph nodes show only a slight congestion and a few red blood cells in the sinuses.

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Case #6 (Autopsy 3112), a female Holstein seven months old. There were clinical indications of pneumonia for three days prior to death.

Gross examination:

There is a very marked congestion of the cardiac and apical lobes of both lungs, which extends into the anterior two-thirds of the diaphragmatic lobes. The pneumonic areas are not as firm in consistency as they appear. The lobules are clearly outlined by their edematous interlobular septa. The mediastinal lobe is uniformly congested and similar in appearance and consistency to the other pneumonic lobes. Upon section, a thin bloody fluid exudes from the cut surface. Some of the large bronchi have a very congested mucosa. The mediastinal and bronchial lymph nodes are very edematous and hemorrhagic.

Microscopic examination:

The pleura is not thickened. The bronchi show a very acute bronchitis with much injury to their mucosae. There is considerable desquamation of the epithelium (Fig. 37). The lumina are filled with a serous exudate containing many desquamated epithelial cells (Fig. 38). The majority of the terminal and respiratory bronchioles are filled with a serous exudate, yet the epithelium does not show any marked injury. There is very much congestion of the alveolar walls (Fig. 21). About five per cent of the alveoli contain air and are very much distended. Most of the remaining alveoli are partially collapsed and filled with a serous exudate. A small number of the alveoli are filled with a fibrinous exudate (Figs. 25 and 26), while still others contain many blood cells. The lymph nodes are very

hemorrhagic, the lymph sinuses being filled with blood (Fig. 71).

Bacteriological examination:

Bacteriological examination reveals a staphylococcus, probably staphylococcus aureus. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #7 (Autopsy 3115), a male Holstein, four weeks old which had shown a pneumonia for ten days prior to death.

Gross examination:

There is a grayish-red consolidation of the apical, cardiac, and the anterior one-third of the diaphragmatic lobes of both lungs. The greater portion of the pneumonic areas are in a state of atelectasis with the exception of an emphysematous area in the right diaphragmatic lobe. This area is about 3 cm. in diameter. The pleural surfaces of the pneumonic lobes are studded with grayish-yellow areas 1 to 2 mm. in diameter. These areas are more numerous in the cardiac and apical lobes. Upon section, a purulent exudate exudes from the bronchi and bronchioles. The mediastinal and bronchial lymph nodes are enlarged and upon section, a thin yellowish fluid exudes from the cut surface.

Microscopic examination:

There is no thickening of the pleura or edema of the interlobular septa. Some of the lymphatics of the pleura

are distended with mononuclear phagocytes and a few lymphocytes. The lymph nodes show no marked changes. The mucosae of the bronchi are infiltrated with large numbers of macrophages. There is no desquamation of the epithelium in the larger bronchi. The terminal and especially the respiratory bronchioles show considerable productive tissue changes in their walls. The lumina contain a large number of mononuclear phagocytes and a few polymorphs. In those lobes where the pneumonia is of longer standing, the epithelium of the small bronchioles is desquamated. The peribronchial tissues show a large number of proliferating fibroblasts and mononuclear cells. In the anterior lobes, the alveolar walls are thickened by an increased number of fibroblasts. In approximately twenty-five per cent of the alveoli, the exudate consists of polymorphs and a few macrophages. In the remainder of the alveoli, the exudate is mostly mononuclear.

Bacteriological examination:

A gram negative short rod of the colon typhoid group, probably *Bacillus coli communior*, and a hemolytic streptococcus of the beta type resembling *streptococcus pyogenes* were isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #9 (Autopsy 3135), a female Holstein four months old, which had shown a pneumonia for twelve days prior to death.

Gross examination:

There is an early pneumonia involving the cardiac and

apical lobes of both the lungs and the anterior one-third of the right diaphragmatic, also two-thirds of the left diaphragmatic. In contrast with most of the cases, the pneumonia is more acute in the left lung than it is in the right lung. The anterior lobes of the right lung are studded by grayish-white areas indicating an abundant cellular exudate. A smaller number of similar areas are noted in the apical lobe of the left lung. The mediastinal lobe is entirely consolidated with grayish areas toward the hilus of the lobe. Upon section, the grayish areas become more numerous and a grayish-yellow exudate exudes from the bronchial tubes. The lymph nodes are enlarged and covered with petechial hemorrhages. Upon section, a clear watery fluid exudes from the cut surface.

Microscopic examination:

The pleura is thickened slightly over the pneumonic areas. In the diaphragmatic lobes which are more recently involved, there are only mild changes in the bronchi and bronchioles. Some show a slight mononuclear infiltration of the stroma, while a few more contain a small amount of serous exudate. There are some recent productive tissue changes in some of the small bronchioles (Figs. 49 and 50). There is much congestion of the alveolar walls accompanied by a moderate mononuclear exudate in the alveoli. The exudate is more abundant in the alveoli surrounding the respiratory bronchioles. In the cardiac lobes, where the pneumonia is of longer standing, the bronchi are hyperemic

with slight desquamation of the epithelium. There is decidedly more desquamation of the epithelium in the terminal bronchioles than in the bronchi or the respiratory bronchioles. The alveolar exudate varies from a serous exudate to one containing many mononuclear phagocytes. The apical lobes show a pneumonia of considerably longer standing than any of the other lobes. There is evidence of productive tissue changes around the bronchioles, especially the respiratory bronchioles. The exudate in the alveoli of the apical lobe has a tendency to be more cellular than in the other lobes. No marked changes were noted in the lymph nodes.

Bacteriological examination:

Hemolytic streptococci which resemble very closely streptococcus pyogenes were isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #10 (Autopsy 3146), a male Holstein, two and one-half months old, which had a pneumonia of twelve days' duration before death.

Gross examination:

The cardiac and apical lobes and the greater part of the pneumonic areas in the diaphragmatic lobes are in a state of grayish consolidation. The right diaphragmatic lobe shows areas in which one or two lobules are consolidated but are separated to a certain extent by normal lobules. The left diaphragmatic lobe is about one-fourth

pneumonic. There are many small circumscribed grayish-yellow areas noted upon section of all the pneumonic lobes suggestive of considerable cellular exudate. A large amount of frothy, greenish-yellow purulent exudate exudes from the small bronchi and bronchioles upon section of the cardiac and apical lobes of either lung. The mediastinal lobe is entirely consolidated and has a large number of grayish-white areas on the pleural surface. The mediastinal and bronchial lymph nodes are swollen and hemorrhagic.

Microscopic examination:

The pleura is thickened. The interlobular septa are slightly edematous with some distention of the lymphatics. In the lobes most recently affected, as well as in the other lobes, there is a very marked atelectasis. In those areas more recently involved, the bronchi show recent mononuclear infiltration of their mucosa, the alveoli are in a state of atelectasis and are very congested. Lobules that show a pneumonia of longer duration show a marked mononuclear infiltration of the mucosa of the bronchi with much desquamation of the epithelium. The terminal bronchioles reveal essentially the same changes. In some instances, the respiratory bronchioles appear entirely destroyed. In a small number of the bronchioles, there is evidence of productive tissue changes in the wall. There are some respiratory bronchioles which have a mononuclear infiltration of the peribronchial tissue (Fig. 47). The alveoli in this portion of the lung are

very congested and contain a large number of mononuclear phagocytes and a few polymorphs. In a few scattered areas, a serous exudate occurs (Figs. 23 and 24). The mediastinal and bronchial lymph nodes are also very congested.

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Case #11 (Autopsy 3147), a male Holstein five months old which had a pneumonia of two weeks' duration before death.

Gross examination:

There is a marked atelectasis of all of the pneumonic lobes. It is especially noticeable in the areas of longer duration. The pneumonia involves all of the anterior lobes and approximately one-sixth of the diaphragmatic lobes. In the diaphragmatic lobes, recent red hepatization is noted. In the apical lobes, and to a lesser extent in the cardiac lobes, many grayish-yellow areas are seen on the pleural surface and upon section. The anterior lobes are considerably firmer in consistency than the pneumonic portions of the diaphragmatic lobes. The pneumonia is of longer duration in the right apical lobe than in the left apical. About three-fourths of the mediastinal lobe is consolidated. The mediastinal and bronchial lymph nodes are very enlarged and are a pale grayish-yellow color. Upon section, a yellowish turbid fluid exudes from the cut surface.

Microscopic examination:

There is considerable thickening of the pleura and in a few scattered areas, there is evidence of a fibrinous

pleurisy. The interlobular septa are edematous and the lymphatics are somewhat enlarged. The diaphragmatic lobes of both lungs present recent pneumonia with a marked atelectasis of the involved portions of the lobes. There is some desquamation of the epithelium in the bronchi and bronchioles of these lobes. In the cardiac lobes, there is evidence of chronicity, especially in the terminal and respiratory bronchioles, the walls of which show marked productive tissue changes. Polymorphonuclear leucocytes predominate in the alveolar exudate. In the apical lobes, there is some organization of the exudate in the small bronchioles and some productive tissue changes in the alveolar wall. These changes are accompanied by considerable atelectasis. The organized exudate in the bronchioles appears covered by cuboidal cells except at the point of attachment to the bronchial wall. For the most part, the alveoli are filled with a cellular exudate. The lymph sinuses of the mediastinal and bronchial lymph nodes are filled with polymorphonuclear leucocytes and some mononuclear phagocytes.

Bacteriological examination:

A hemolytic streptococcus of the beta type and a gram negative short rod of the colon typhoid group, probably *Bacillus coli communior*, were isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #12 (Autopsy 3150), a female Holstein, nine months

old which had a pneumonia of one week's duration prior to death.

Gross examination:

The cardiac and apical lobes and a small portion of the diaphragmatic lobes are involved in a very unevenly distributed bronchopneumonia. The dorsal borders of the apical and cardiac lobes are normal, pneumonia involving only the lower portions of the lobes. There are a few circumscribed grayish-yellow areas, 2 mm. in diameter, suggesting recent cellular exudate. These areas are present only in the pneumonic portion of the left apical lobe. The mediastinal lobe is entirely consolidated. The mediastinal and bronchial lymph nodes are a very light yellow with a few petechial hemorrhages on the surface. On section, a yellowish fluid exudes from the cut surface.

Microscopic examination:

The pleura is very slightly thickened. The interlobular septa do not show any marked changes. The microscopic changes in this case correspond to a certain extent with those of Case #6. There is a very acute bronchitis with much injury to the bronchial mucosa manifested by much desquamation of the epithelium, also very much congestion of the alveolar walls accompanied by marked serous exudation of the alveolar sac. In those lobules in which there is a slight congestion of the alveolar wall, there is some atelectasis of the alveoli. In the cardiac and apical lobes, there is a marked atelectasis and congestion of the

alveolar walls accompanied by a slight cellular exudation into the alveoli. Several of the bronchi show some mononuclear infiltration in their mucosa. The lymph sinuses of the lymph nodes contain many polymorphonuclear leucocytes.

Bacteriological examination:

Staphylococcus aureus and a hemolytic streptococcus of the beta type were isolated from this case (Fig. 72). For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #13 (Autopsy 3154), a male Holstein three months old, which had pneumonia of one week's duration prior to death.

Gross examination:

Neither the pleura nor the interlobular septa show any gross changes. The pneumonia involves the mediastinal, cardiac, and apical lobes, and approximately one-fifth of each diaphragmatic lobe. Immediately posterior to the areas of acute pneumonia of the anterior part of the diaphragmatic lobe, there are several large areas of emphysema. The cardiac and apical lobes are in a state of red hepatization and show no evidence of cellular exudation. The mediastinal lobe is much the same as the right cardiac. The left lung is in a more acute stage of pneumonia than the right, which is somewhat more patchy and not as evenly distributed as that of the right lung. The lymph nodes are swollen, edematous, and show evidence of an acute lymphadenitis.

Microscopic examination:

The pleura is unaltered as is the interlobular septa. The only acute bronchitis with severe injury to the bronchial mucosa is in the apical lobes. The diaphragmatic lobes show only an acute congestion of the alveolar wall with partial collapse (Fig. 30) and some with a small amount of mononuclear exudation into the air sacs. In the cardiac lobe, there is some serous exudate but more cellular exudate. There is comparatively more cellular exudate of the mononuclear type in the air sacs than in the cardiac and diaphragmatic lobes. The lymph nodes show hemorrhages into their lymph sinuses.

Bacteriological examination:

A staphylococcus very much like staphylococcus aureus was isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #14 (Autopsy 3166), a male Guernsey three months old which had pneumonia one week prior to death.

Gross examination:

There is a very acute pneumonia of the cardiac and apical lobes of both lungs. The pneumonia of the left diaphragmatic lobe is more extensive than that of the right diaphragmatic, only a small portion in the anterior part of the right lobe being affected. There are areas of very marked congestion and red hepatization which include from

three to four lobules. These are scattered throughout the consolidated portions of the various lobes. The mediastinal lobe is entirely consolidated. There are three consolidated areas 2 cm. by 4 to 5 cm. in the left diaphragmatic lobe showing a very marked congestion of, or hemorrhage into, the alveoli (Fig. 1). There are no gross changes in the mediastinal and bronchial lymph nodes.

Microscopic examination:

There is a marked distention of the lymphatics of the pleura. Those of the interlobular septa are distended only to a slight extent. There is also a moderate infiltration of mononuclear phagocytes into the mucosa of the bronchi accompanied by some congestion. The above pathology of the bronchi repeats itself in the terminal bronchioles, but with a more severe bronchiolitis which results in some desquamation of the epithelium. A number of the bronchioles contain a small amount of a cellular exudate consisting mostly of mononuclear phagocytes. In the anterior lobes, especially the right apical, there is a marked congestion of the alveolar walls accompanied by considerable cellular exudation into the alveolar sacs. There is no appreciable variation between the cardiac and diaphragmatic lobes. In these lobes, there is only a marked congestion of the alveolar walls accompanied by a serous exudate in a small number of the alveoli. The lymph nodes contain a large number of polymorphonuclear leucocytes in their lymph sinuses.

Bacteriological examination:

A hemolytic streptococcus of the beta type resembling streptococcus pyogenes and a gram negative short rod, probably Bacillus coli communior, of the colon typhoid group were isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #15 (Autopsy 3172), a male Holstein about ten weeks old, which had a pneumonia of eleven days' duration prior to death.

Gross examination:

The pneumonia involves the apical, cardiac, mediastinal, and diaphragmatic lobes of both lungs. The right cardiac and apical lobes are in a state of reddish consolidation which are studded by small gray areas 1 to 2 mm. in diameter. The anterior one-fifth of the right diaphragmatic lobe is congested. The interlobular septa appear thickened and perhaps edematous. Upon section of the apical or cardiac lobe, the grayish areas noted on the pleural surface appear more numerous. The cardiac and apical lobes of the left lung have more yellowish-gray areas on their pleural surfaces than the same lobes of the right lung. The anterior one-third of the left diaphragmatic lobe appears very much the same as the left apical and cardiac lobes. The mediastinal lobe is about two-thirds consolidated. The mediastinal and bronchial lymph nodes are very much enlarged and edematous.

Microscopic examination:

The pleura is thickened. The interlobular septa are edematous and contain lymphatics distended with mononuclear phagocytes. The apical lobes of both lungs show a pneumonia of considerably longer standing than that of the remaining lobes. There is an acute bronchitis in all the pneumonic lobes accompanied by much desquamation of the bronchial epithelium. The bronchitis is not as severe in the areas of shorter duration. The terminal and respiratory bronchioles show approximately the same pathology as the bronchi. Many of the respiratory bronchioles are filled with a cellular exudate which shows considerable necrosis in many of the bronchioles.

There is much congestion of the alveolar walls throughout all the sections. The alveoli in the anterior lobes are filled with a cellular exudate consisting mostly of mononuclear phagocytes and a small number of polymorphonuclear leucocytes. In the right diaphragmatic lobe where the pneumonia is more acute, a number of alveoli are filled with a fibrinous exudate. There are a number of widely scattered alveoli in the cardiac lobe which are filled with a fibrinous exudate which in some cases contains many polymorphonuclear cells. The lymph nodes show marked changes.

Bacteriological examination:

Staphylococcus aureus and a non-hemolytic streptococcus were isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

Case #16 (Autopsy 3200), a female Jersey ten weeks old which had a pneumonia of eighteen days' duration before death. The first symptoms noted were a dry cough and a nasal discharge. The daily temperatures are given in Chart III.

Gross examination:

The pneumonia involves the cardiac and apical lobes of both lungs, the entire diaphragmatic lobe of the left lung, and approximately four-fifths of the right diaphragmatic (Fig. 2). The pleural surfaces of the cardiac and apical lobes of both lungs and a greater part of the left diaphragmatic lobe are studded with grayish-yellow areas 1 to 3 mm. in diameter. In the right lung, these areas are present only in the anterior portion of the right diaphragmatic, the remaining part of the lobe appearing more acute. The mediastinal lobe is entirely consolidated. The cardiac and apical lobes appear more atelectatic than either of the diaphragmatic lobes. The mediastinal and bronchial lymph nodes are enlarged and upon section, a few petechial hemorrhages are noted on the cut surface.

Microscopic examination:

The pleura covering the cardiac and apical lobes shows some thickening. The interlobular septa are unchanged. The bronchi in any of the pneumonic areas of the lung show an acute bronchitis with much desquamation of the epithelium. Many bronchi show an abundant mononuclear infiltration of the mucosae. There is some evidence of chronicity in the

cardiac and apical lobes. A very large number of the terminal and respiratory bronchioles of the pneumonic areas in either lung show considerable necrosis of the cells of the exudate and walls of the bronchioles (Fig. 48). A number of alveoli show an increase of fibroblasts in the alveolar wall. In areas in which there is considerable thickening of the alveolar wall, the alveoli appear lined with cuboidal cells. The lymph nodes show no marked changes.

Bacteriological examination:

A hemolytic streptococcus of the beta type similar to streptococcus pyogenes and a short rod, probably Bacillus coli communior, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #17 (Autopsy 3198), a male Holstein, one month old, which had a pneumonia of fifteen days' duration before death.

Gross examination:

The pneumonia involves the cardiac and apical lobes of both lungs and a few scattered areas in the anterior portion of the diaphragmatic lobes. The pneumonia of the mediastinal lobe appears of the same duration as the right apical lobe. There is a grayish-yellow consolidation of the cardiac and apical lobes which appears atelectatic. Upon section of the cardiac and apical lobes, the apical lobe shows more evidence of cellular exudation. The

pneumonia in the left lung appears of longer duration than in the right lung. The scattered areas of pneumonia in the right diaphragmatic lobe are surrounded, in some instances, by a thickened interlobular septa. The mediastinal and bronchial lymph nodes are swollen and somewhat edematous.

Microscopic examination:

The pleura is slightly thickened. The interlobular septa are somewhat edematous and contain distended lymphatics. In most of the pneumonic areas there is a mononuclear infiltration of the mucosae of the bronchi which is accompanied by a varying amount of desquamation of the epithelium. Many of the respiratory bronchioles show a marked mononuclear infiltration of the stroma of the mucosa (Figs. 43 and 44). There are many areas throughout the pneumonic parts of the lungs in which there are considerable productive tissue changes in the alveolar walls. This is especially noticeable in the apical lobes of both lungs. There are numerous areas of hemorrhage in the peripheral portions of the mediastinal and bronchial lymph nodes.

Bacteriological examination:

Staphylococcus aureus and a gram negative short rod, probably *Bacillus coli communior*, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #18 (Autopsy 3203), a female Jersey, ten weeks old which had a pneumonia of three weeks' duration prior

to death. At times during the three-week period, this animal showed signs of improvement and then relapses occurred. Daily temperatures are included in Chart III.

Gross examination:

The pneumonia involves the apical and cardiac lobes of the left and right lungs. The diaphragmatic lobe of the right lung is two-thirds pneumonic while the same lobe of the left lung is only one-third pneumonic. There is a marked atelectasis of the apical lobes, the pleural surfaces of which are studded by circumscribed yellowish-gray areas 1 to 3 mm. in diameter. These areas are more numerous in the left apical than in the right. The cardiac and diaphragmatic lobes of the left lung do not show as much evidence of cellular exudation as the left apical lobe, yet they show considerably more than the corresponding lobes of the right lung. The gross appearance of the mediastinal lobe is similar to that of the left cardiac. Upon section of any of the lobes of either lung, a purulent exudate exudes from the small bronchi and bronchioles. The mediastinal and bronchial lymph nodes are swollen, whitish-yellow in appearance and upon section, a yellowish turbid fluid exudes from the cut surface

Microscopic examination:

The pleura covering both lungs is thickened (Fig. 27). In places, the interlobular septa are edematous and the lymphatics are distended with mononuclear phagocytes and a small number of lymphocytes. The bronchi of the lungs show

an acute bronchitis with a very congested mucosa and much desquamation of the epithelium. For the most part, the lumina of the bronchi contain an exudate of mononuclear phagocytes and polymorphs in which there are many desquamated epithelial cells. There is a marked congestion of the mucosa of the terminal bronchioles and some desquamation of their epithelium (Figs. 41 and 42). There is some evidence of productive tissue changes in the respiratory bronchioles of the apical lobes.

There is a marked congestion of the alveolar walls in all the sections studied. Considerable atelectasis is noted in the more anterior lobes. In one-third of the alveoli, the exudate is approximately equally divided between a serous and fibrinous exudate. In the remaining two-thirds, approximately seventy-five per cent of the alveoli are filled with varying amounts of a cellular exudate consisting of mononuclear phagocytes and a few polymorphs. The lymph nodes contain many polymorphs in their sinuses.

Bacteriological examination:

Staphylococcus aureus, a gram negative short rod, probably Bacillus coli communior, and a gram positive coccus, probably a micrococcus, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #19 (Autopsy 3209), a female Jersey three months

old which had a pneumonia of eleven days' duration before death.

Gross examination:

There is a grayish-yellow consolidation of the apical and cardiac lobes of both lungs. The anterior one-third of the left diaphragmatic lobe appears approximately the same as the apical and cardiac lobes of the same lung. The anterior three-fourths of the right diaphragmatic lobe is in a state of grayish consolidation with the exception that along the posterior border of the consolidated portion there is a zone of acute congestion varying in width from 1 to 3 cm. The mediastinal lobe is very much the same as the apical lobe of the left lung. The left lung as a whole appears of longer duration than the right lung. There are a few shreds of fibrinous exudate on the pleura. The mediastinal and bronchial lymph nodes are very enlarged and edematous.

Microscopic examination:

The pleura is slightly thickened. Lymphatics of the interlobular septa are somewhat distended. In most of the pneumonic areas, there is a bronchitis. In the more acute areas, there is a mononuclear infiltration of the mucosa with desquamation of the epithelium (Figs. 39 and 40). In the areas of pneumonia of longer duration, there is considerable desquamation of the epithelium. The terminal bronchioles show a slight desquamation of the epithelium. The respiratory bronchioles do not show any appreciable injury to their mucosa but contain a cellular exudate in

many areas. The alveoli in the areas of longer duration are filled with a cellular exudate consisting mostly of polymorphonuclear cells. In a few areas of shorter duration, the exudate consists of fibrin and a few mononuclear phagocytes. The alveolar walls for the most part are congested. There are a few polymorphonuclear cells in the lymph sinuses.

Bacteriological examination:

Staphylococcus aureus and a gram negative short rod, probably Bacillus coli communior, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #20 (Autopsy 3212), a male Holstein four months old which showed first symptoms of pneumonia forty-eight hours before death.

Gross examination:

The cardiac and apical lobes of both lungs are in a state of red hepatization. Approximately one-half of the left and right diaphragmatic lobes are consolidated. The mediastinal lobe and the left cardiac lobe have a few grayish-yellow areas on their pleural surfaces. These are the only gross lesions in either lung which suggest a cellular exudation. The mediastinal and bronchial lymph nodes are very much enlarged.

Microscopic examination:

The pleura is slightly thickened and contains many distended lymphatics. The interlobular septa are very

edematous and their lymphatics are very much distended. The pneumonia is evenly distributed throughout both lungs. The mucosae of the larger bronchi are very much congested but show only a slight mononuclear infiltration with no desquamation of the epithelium. A number of terminal and respiratory bronchioles contain a small amount of cellular exudate. The alveolar walls for the most part are very much congested and the alveoli contain a serous exudate. In a small number of widely scattered areas, there is a fibrinous or cellular exudate. The mediastinal and bronchial lymph nodes do not show any marked changes.

Bacteriological examination:

A hemolytic streptococcus of the beta type was isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #21 (Autopsy 3213), a female Jersey six weeks old which had a pneumonia of four weeks' duration prior to death. The first day, a temperature of 106.2 was recorded. Twenty-four hours before the animal died, a temperature of 101.8 was recorded. The first symptoms noticed were dyspnea, accelerated respiration and a cough. The following day, gritting of the teeth and marked depression were noted. Pneumonia mixed bacterin was given daily the first three weeks. During the first few days of the pneumonia, the calf showed considerable improvement, then for about two weeks, its condition remained at a standstill. Three days

prior to death, a decided relapse was noticed.

Gross examination:

There is a grayish-red consolidation of the cardiac and apical lobes of both lungs, also about one-third of the left diaphragmatic lobe and approximately one-half of the right diaphragmatic lobe. The mediastinal lobe appears very much the same as the right diaphragmatic lobe. The pneumonia of the left lung appears of longer standing than the pneumonia in the right lung. There is considerable atelectasis of the right lung and considerable atelectasis in the cardiac and apical lobes of the left lung. The right apical lobe appears slightly atelectatic. The interlobular septa seem thickened and possibly edematous. The mediastinal and bronchial lymph nodes are very much enlarged and upon section, a yellowish turbid fluid exudes from the cut surface.

Microscopic examination:

The pleura is slightly thickened in some of the pneumonic areas. The interlobular septa are very edematous and contain slightly distended lymphatics. In the diaphragmatic lobes of both lungs, there is an acute pneumonia with much injury to the bronchial walls. The mucosa of the small bronchi and large bronchioles is very much congested with much desquamation of the epithelium. The terminal and respiratory bronchioles do not show the extent of injury to their mucosa that the larger bronchial tubes do. In some of the respiratory bronchioles, there is evidence of organization of the bronchial exudate (Figs. 53 and 54).

The bronchioles in the cardiac and apical lobes of both lungs show productive tissue changes in their stroma, indicating a bronchopneumonia at an early date. There is a mononuclear infiltration of the stroma of the mucosa in many of the terminal bronchioles (Fig.46). This is somewhat more noticeable in the cardiac and apical lobes of the left lung. The walls of the alveoli immediately adjacent to the terminal and respiratory bronchioles are very much congested. The alveoli contain a small number of mononuclear phagocytes and in some areas a fibrinous exudate. The mediastinal and bronchial lymph nodes contain a large number of polymorphonuclear cells in their lymph sinuses.

Bacteriological examination:

A staphylococcus and gram negative short rod, probably *Bacillus coli communior*, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #22 (Autopsy 3220), a female Guernsey seven weeks old which had a pneumonia of three weeks' duration before the animal was killed, as death of the animal seemed very probable. A pneumonia mixed bacterin was given during the first two weeks of the pneumonia. Glucose was given once following the above treatment.

Gross examination:

There is a grayish-red consolidation of the cardiac and apical lobes of both lungs. The diaphragmatic lobes

of both lungs are approximately two-thirds consolidated. There is a small area on the ventral border of the right cardiac lobe which does not show any pneumonia (Fig. 3). The pneumonic portions of the left lung show considerably more evidence of cellular exudation than those of the right lung. The cardiac and apical lobes of both lungs show considerable atelectasis. The mediastinal lobe resembles the left cardiac lobe. The mediastinal and bronchial lymph nodes are very much enlarged and slightly hemorrhagic (Fig. 3).

Microscopic examination:

The pleura is thickened. The interlobular septa do not show any marked changes. The bronchi show an infiltration of mononuclear phagocytes of the mucosa (Figs. 31 and 32). In all the consolidated lobes, but to a greater extent in the cardiac and apical lobes, there is evidence of productive tissue changes in the stroma of the mucosa of the terminal and respiratory bronchioles. The mucosa of the above bronchioles are infiltrated with mononuclear phagocytes. Only a very small number show any desquamation of the epithelium. In a few scattered areas, the alveolar walls show some slight thickening. Those alveoli surrounding the terminal and respiratory bronchioles are filled with polymorphonuclear leucocytes. Those alveoli further from the bronchioles are congested and many contain a few mononuclear phagocytes. The lymph sinuses contain a few polymorphonuclear leucocytes.

Bacteriological examination:

Organisms not identified. For their morphological,

cultural, and biochemical characteristics see Tables I and II.

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Case #23 (Autopsy 3232), a female Holstein two months old which had a pneumonia for two weeks prior to death.

Gross examination:

There is a pneumonia of the diaphragmatic, mediastinal, cardiac and apical lobes of both lungs (Fig. 4). The anterior portion of the right cardiac lobe and all of the right apical appear very atelectatic. About one-half of the right diaphragmatic lobe is in a state of reddish consolidation. The anterior one-third of the left diaphragmatic lobe is in a state of grayish-yellow consolidation. All of the pneumonic areas of the left lung appear very atelectatic. Upon section of the more acute areas in the left diaphragmatic, a grayish consolidation is the most predominant (Fig. 5). The mediastinal lobe is entirely consolidated and very similar to the lobes of the left lung. The interlobular septa appear thickened and edematous. The mediastinal and bronchial lymph nodes are enlarged and edematous.

Microscopic examination:

The pleura is thickened. The interlobular septa are edematous and their lymphatics are very much distended. The apical and cardiac lobes of both lungs show a severe bronchitis with much desquamation of the epithelium (Figs. 33 and 34). In the right apical lobe, there is evidence of considerable productive tissue changes in the walls of the

respiratory and terminal bronchioles. The alveoli in the cardiac and apical lobes of both lungs are filled with a cellular exudate consisting mostly of mononuclear phagocytes and a small number of polymorphonuclear leucocytes. The areas of pneumonia in the anterior portion of the right diaphragmatic lobe do not show as many productive tissue changes as the apical and cardiac lobes. In this lobe, there is considerable congestion of the alveolar wall accompanied by an abundant serous exudate in the alveolar sacs. In a small number of alveoli, there is a fibrinous appearing exudate surrounded by cuboidal-like cells (Figs. 61 and 62). Many of the alveoli contain large numbers of giant cells (Fig. 64). There is some increase in the number of polymorphs in the lymph sinuses.

Bacteriological examination:

A streptococcus of the beta type was isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #24 (Autopsy 3235), a male Holstein ten days old which had a pneumonia of six days' duration prior to death.

Gross examination:

A purulent fibrinous exudate covers the pleural surface of both lungs (Fig. 6). This is especially noticeable in the anterior lobes of both lungs in which the fibrinous exudate is .5 to 1 cm. in thickness. This exudate adheres to the chest wall in a number of places. There are 200 to

300 cc. of a purulent fluid in the chest cavity. The cardiac and apical lobes of both lungs are in a state of reddish-gray consolidation. Upon section, a yellowish-white fluid exudes from the bronchi and bronchioles. Nearly the entire diaphragmatic lobes of both lungs are somewhat congested but are consolidated only in their anterior portion which is covered by varying amounts of a fibrinous exudate. The mediastinal lobe appears the same as the right cardiac and apical lobes. The mediastinal and bronchial lymph nodes are only slightly enlarged.

Microscopic examination:

There is a very marked fibrinous pleurisy with much thickening of the pleura (Fig. 29). The interlobular septa are very edematous and contain many distended lymphatics. Both the interlobular septa and the lymphatics contain large numbers of gram positive organisms. In a number of acute areas, there is a zone bordering on the interlobular septa in which there is a marked cellular reaction. (Fig. 60). The cells of the exudate of the bronchi and bronchioles are necrotic and the exudate contains large numbers of organisms. In many areas, an entire lobule appears necrotic (Fig. 59). In the left apical lobe, there is an abscess just beneath the pleural surface approximately 5 mm. in diameter. In several lobules, there is some hemorrhage into the alveolar sacs but for the most part, the alveoli are filled with a fibrinous or cellular exudate containing, in many instances, large numbers of organisms (Figs. 73 and 74). There are no

productive tissue changes in the walls of the alveoli. The interlobular septa surrounding necrotic lobules show considerable edema and thickening. The lymph sinuses do not show any marked changes.

Bacteriological examination:

A hemolytic streptococcus of the beta type and staphylococcus aureus were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #25 (Autopsy 3263), a male Holstein four months old which had a pneumonia of two weeks' duration prior to death.

Gross examination:

The cardiac and apical lobes of both lungs are in a state of yellowish-gray consolidation. Many of the grayish areas are 3 or 4 mm. in diameter. In the apical lobes of both lungs, these small areas tend to converge into one large area. The anterior one-third of both the diaphragmatic lobes are consolidated and are very much the same as their corresponding apical and cardiac lobes. In most of the lobes, there are scattered areas of normal parenchyma (Figs. 7 and 8). In the posterior portion of the right diaphragmatic lobe, there are several large emphysematous areas (Fig. 7). The pneumonia in the left lung seems of slightly longer duration than the right although the difference is not pronounced. The mediastinal and bronchial lymph nodes are very swollen and edematous.

Microscopic examination:

The pleura is not thickened. The interlobular septa do not show any thickening nor are the lymphatics distended. Only a very little bronchitis is noted. In some areas, there is considerable cellular infiltration of the respiratory bronchioles which is accompanied by atelectasis of the adjacent alveoli (Figs. 35 and 45). The terminal and respiratory bronchioles of the involved portions of the left lung and the cardiac and apical lobes of the right lung show considerable productive tissue changes in their mucosa. There is much thickening of the alveolar walls due to productive tissue changes. For the most part, the alveoli are filled with polymorphonuclear leucocytes and in many areas appear lined with cuboidal cells (Fig. 68). Areas in which the alveolar walls show the most thickening are for the most part adjacent to terminal or respiratory bronchioles similarly affected. In the right cardiac lobe there is an abscess 1 cm. in diameter just below the pleural surface (Fig. 57). The lymph nodes appear somewhat edematous.

Bacteriological examination:

A gram negative rod, probably *Bacillus coli communior*, was isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #26 (Autopsy 3266), a male Holstein three and one-half months old which had been reported as having pneumonia of a week's duration prior to death.

Gross examination:

There is a reddish-gray consolidation of the cardiac and apical lobes of both lungs. About one-third of the left diaphragmatic lobe is in a state of grayish consolidation while approximately two-thirds of the right diaphragmatic lobe is more of a reddish consolidation. The cardiac and apical lobes of both lungs and the consolidated portion of the left diaphragmatic lobe show considerable atelectasis. The mediastinal lobe is entirely consolidated and looks very much the same as the pneumonic portion of the left diaphragmatic lobe. The mediastinal and bronchial lymph nodes are very much congested.

Microscopic examination:

The pleura is unaltered. The interlobular septa are slightly thickened and in a number of areas contain distended lymphatics. In the pneumonic lobes, there is evidence of injury to the small bronchi and the terminal and respiratory bronchioles. There is an acute bronchitis of the small bronchi with much desquamation of the epithelium. The terminal bronchioles are practically the same. This is accompanied by a slight infiltration of mononuclear phagocytes into the mucosae of the involved bronchi and bronchioles. In several areas, there are marked productive tissue changes in the wall of the respiratory bronchioles (Fig. 52). The capillaries of the alveolar walls are very much congested and the alveoli contain many mononuclear cells. The lymph sinuses do not show any marked changes.

Bacteriological examination:

A staphylococcus very much like staphylococcus aureus was isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #27 (Autopsy 3286), a male Holstein five months old which was reported as having a pneumonia of five days' duration prior to death.

Gross examination:

The pneumonia involves the cardiac and apical lobes of both lungs. Approximately two-thirds of the left diaphragmatic lobe and about one-third of the right diaphragmatic lobe are consolidated. All the areas of consolidation are grayish-red in appearance. The mediastinal lobe shows the same gross appearance as the left cardiac. The extent of pneumonia is shown in Figs. 9 and 10.

There are a number of abscesses 4 or 5 mm. in diameter in the cardiac and apical lobes of both lungs, the majority of which are noted only upon section. The largest abscess observed in this case is in the lower posterior part of the left apical lobe (Fig. 9). Upon section, many grayish-white areas can be seen, suggesting abundant cellular exudate. A bloody purulent exudate exudes from the small bronchi when sectioned. The mediastinal and bronchial lymph nodes are slightly enlarged.

Microscopic examination:

The pleura is slightly thickened. There are productive

tissue changes in the walls of many of the bronchi and terminal bronchioles. This is accompanied by considerable cellular infiltration of the stroma of the mucosa. The predominating cell is the mononuclear phagocyte. An occasional polymorphonuclear leucocyte may be seen. Most of the bronchi and bronchioles contain in their lumina a cellular exudate of mononuclear phagocytes and some polymorphonuclear leucocytes. In the areas of longest duration, the alveolar walls are slightly thickened by an increase in number of fibroblasts. The polymorphonuclear leucocyte predominates in the cellular exudate in the alveolar sacs. The lymph sinuses of the mediastinal and bronchial lymph nodes contain many polymorphonuclear leucocytes.

Bacteriological examination:

A staphylococcus resembling staphylococcus aureus was isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #28 (Autopsy 3290), a female Holstein six months old which was reported as having a pneumonia of two weeks' duration prior to death.

Gross examination:

There is a reddish-gray consolidation of the right apical and cardiac lobes. Approximately three-fourths of the left apical and cardiac lobes are in a state of reddish-gray consolidation. An area of normal lung can be seen along the dorsal border of the left apical and cardiac

lobes (Fig. 11). In the anterior portion of the cardiac lobe and nearly at the junction of the right cardiac and apical lobes, a lighter colored, somewhat constricted area can be seen (Fig. 11).

Upon section of the lobe at this point, many abscesses appear on the cut surface (Fig. 12). The diaphragmatic lobes of both lungs are approximately one-half consolidated. There are a few areas of a fibrinous pleurisy. The mediastinal and bronchial lymph nodes are very much enlarged and upon section, a yellowish fluid exudes from the cut surface.

Microscopic examination:

The pleura is thickened. The interlobular septa are very edematous and contain many distended lymphatics. There is an acute bronchitis accompanied by considerable desquamation of the epithelium. In the terminal and respiratory bronchioles of the cardiac and apical lobes, there is some evidence of productive tissue changes in their mucosa. The alveoli contain an exudate made up of mononuclear phagocytes, polymorphonuclear leucocytes and in some areas considerable fibrin is noted. The alveolar walls are somewhat congested. The involvement of the alveoli appears to radiate from the nearest respiratory bronchiole (Fig. 36). In several small areas, there is much thickening of the alveolar wall due to productive tissue changes (Fig. 69). A large number of giant cells are present in the pneumonic areas. Several small abscesses are present in some areas. The lymph sinuses of the mediastinal and bronchial lymph nodes

contain some polymorphonuclear leucocytes.

Bacteriological examination:

A hemolytic streptococcus of the beta type, a staphylococcus, and a gram negative rod, probably *Bacillus coli* communior, were isolated. For their morphological, cultural, and biochemical characteristics see Table I and II.

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Case #29 (Autopsy 3297), a female Guernsey seven weeks old which had a pneumonia of six days' duration before death. The symptoms noticed the first day were a marked dyspnea, and accelerated respiration. At this time, 300 cc. of citrated blood were given intravenously.

Gross examination:

There is a reddish-gray consolidation of the cardiac and apical lobes of both lungs. The right diaphragmatic lobe is approximately one-half consolidated while only a small portion of the left diaphragmatic lobe is affected (Fig. 13). The mediastinal lobe shows some slight congestion toward its hilus. There is more atelectasis of the cardiac and apical lobes than of either of the diaphragmatic lobes. The pneumonic portions of the left lung appear of slightly longer duration than the same areas of the right lung. The mediastinal and bronchial lymph nodes are very much congested but are not very much enlarged when compared with other cases.

Microscopic examination:

The pleura is thickened (Fig. 23). The interlobular

septa are very edematous and contain many distended lymphatics. Occasionally in these lymphatics and the surrounding edematous septa, there are large numbers of gram positive cocci which are very similar to those of Case #24. There is considerable atelectasis in all the pneumonic portions of the lung. There is a very severe and acute bronchitis with much injury to the mucosa. A severe bronchiolitis is noted in the terminal and respiratory bronchioles. There are many patchy-like areas, which appear necrotic and contain large numbers of organisms. In many of these areas, there is a small bronchiole in the center which is usually somewhat necrotic. In a few areas, an entire lobule appears to be necrotic. In some instances where this has taken place, the interlobular septa show many productive tissue changes. The lymph sinuses of the lymph nodes contain a small number of polymorphonuclear leucocytes.

Bacteriological examination:

A streptococcus of the beta type was isolated from this case. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #30 (Autopsy 3301), a female Holstein three weeks old which had a pneumonia of two weeks' duration before the animal died.

Gross examination:

There is a reddish consolidation of the right apical

and most of the right cardiac lobe. There is only a slight congestion of the left apical lobe but a grayish consolidation of the left cardiac lobe. Only a small portion of the left diaphragmatic lobe is consolidated (Fig. 14). The consolidated area in the left lung is of decidedly longer duration than the pneumonia in the right lung. The right diaphragmatic lobe is consolidated in the anterior one-third. There are several normal lobules in this consolidated portion. The mediastinal and bronchial lymph nodes are very much enlarged and upon section are very edematous.

Microscopic examination:

The pleura is unchanged. The interlobular septa are only slightly edematous with only a few distended lymphatics. The small bronchi in many areas do not show any marked changes. In approximately one-half of the terminal bronchioles, there is a severe bronchiolitis accompanied by much desquamation of the epithelium. The terminal and respiratory bronchioles contain a cellular exudate consisting mostly of mononuclear phagocytes, a very few polymorphonuclear leucocytes and some desquamated epithelial cells. The alveoli in most of the pneumonic areas are filled with a cellular exudate consisting of mononuclear phagocytes and some polymorphs. In the more acute areas, the alveolar exudate is nearly all fibrin with some serous exudate. There is considerable atelectasis in the cardiac and apical lobes. The lymph sinuses of the bronchial lymph nodes contain many poly-

morphonuclear leucocytes.

Bacteriological examination:

A hemolytic streptococcus and a gram negative short rod, probably *Bacillus coli* communior, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

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Case #31 (Autopsy 3314), a male Holstein four months old which had a pneumonia of eighteen days' duration prior to death.

Gross examination:

There is a grayish consolidation of the apical and cardiac lobes of both lungs and anterior one-third of the right and left diaphragmatic lobes. The pleural surface is studded by many small abscesses ranging in size from 1 to 2 mm. to 1 cm. (Fig. 15). These abscesses are present both on the dorsal and ventral surfaces of the lungs as shown in Figs. 15 and 16. There are numerous areas on the pleural surface which appear necrotic. In part of the consolidated portion of the diaphragmatic lobe, there are several areas of shorter duration. The entirely consolidated mediastinal lobe has many small abscesses on its pleural surface (Fig. 16). The mediastinal and bronchial lymph nodes are very much enlarged and upon section, a yellowish fluid exudes from the cut surface.

Microscopic examination:

The pleura is slightly thickened. The interlobular

septa contain a number of distended lymphatics (Fig. 70). In the cardiac and apical lobes of both lungs, there are considerable productive tissue changes in the walls of the terminal and respiratory bronchioles. This is also noted in the walls of the alveoli (Fig. 65). A large number of the small bronchi and bronchioles contain a cellular exudate consisting mostly of polymorphonuclear leucocytes and a few mononuclear phagocytes. In several small areas, there is an organization of the alveolar exudate (Fig. 66). Many alveoli show an increase in the number of fibroblasts in the alveolar wall (Fig. 67). In the diaphragmatic lobe of the right lung where the pneumonia is more acute, there is some congestion of the alveolar walls, also some serous exudate into the alveoli. There are many small encapsulated abscesses and necrotic areas in any of the pneumonic portions of either lung (Fig. 56). The lymph sinuses of the lymph nodes contain large numbers of polymorphonuclear leucocytes.

Bacteriological examination:

A staphylococcus and a gram negative rod, probably *Bacillus coli communior*, were isolated. For their morphological, cultural, and biochemical characteristics see Tables I and II.

DISCUSSION

The frequent occurrence of calf pneumonia in a large number of calves presented for autopsy was the motive for this work. The fact that the pneumonia was a bronchopneumonia seemed well established, yet a study of calf pneumonia from a pathological standpoint appeared incomplete.

In regard to the gross lesions, there were a number of variations which should be mentioned. Nocard (1) reports a pneumonia in calves with much abscessation and cavity formation in the pulmonary tissue. In the thirty cases considered in this study, the above conditions were not encountered with the exception that in seven cases there were numerous small abscesses without cavity formation (Figs. 9, 10, 12, 15, and 16). With a few exceptions, the cardiac and apical lobes are entirely consolidated (Table IV). There was considerable variation in the extent of consolidation noted in the diaphragmatic lobes of either lung. The gross picture of pneumonia in the left lung was consistently one of longer duration than the pneumonia of the right lung. The cardiac and apical lobes of the left lung and the pneumonia portion of the diaphragmatic lobe were, in cases of longer duration, a grayish-yellow color and appeared quite atelectatic as compared with the pneumonic lobes of the right lung of the same animal. The pneumonia in the left diaphragmatic lobe in many cases does not involve as much of the lobe as the usually more acute consolidated portion of the right lobe. However, in one case, the entire left

lung was consolidated and a small portion of the right diaphragmatic lobe was not pneumonic (Fig. 2). It is of interest to note the difference between Fig. 2 and Fig. 14. In the case illustrated in Fig. 2, it was surprising that the animal lived as long as it did while in Fig. 14 only a small portion of the lobes were consolidated. In another case, there is a marked fibrinous pleurisy, the extent of which is shown in Fig. 6. The remaining cases show varying degrees of pleurisy yet not as extensive as the case mentioned above. The posterior mediastinal and bronchial lymph nodes are very much enlarged in twenty-three of the thirty cases. When numerous petechial hemorrhages are present in the lymph nodes, they are as a rule more numerous in the mediastinal nodes than in the bronchial lymph nodes which were enlarged and yellowish-white in color.

Carpenter and Gilman (3) in their study were primarily concerned with the bacteriology of calf pneumonia although some work was reported on the pathology. The bacteriological findings in this investigation compare well with the work of Carpenter and Gilman. The organisms isolated most consistently are; namely, a streptococcus of the beta type, *Bacillus coli communior*, and a staphylococcus, usually *staphylococcus aureus*. Streptococci were isolated in thirteen cases. In four of these, the streptococcus is the only organism isolated. In five cases, it is associated with the *Bacillus coli* organism and in four cases with a

staphylococcus. In eleven of the twenty-four cases cultured *Bacillus coli communior* was isolated. In five cases, it was associated with a staphylococcus and in five cases it was isolated with a streptococcus. The staphylococcus was isolated in four cases associated with a streptococcus and in five cases with the *Bacillus coli* organism. In four cases, it was the only organism isolated. A streptococcus and staphylococcus were present in the majority of cases in which many necrotic and abscessed areas occurred.

There was considerably variation in the microscopic pathology in a number of the cases studied. Nineteen cases of the thirty showed a thickening of the pleura, thirteen of which were accompanied by an edematous interlobular septum which contained many distended lymphatics. The thickening of the pleura was due to a fibrinous pleurisy and what appeared in many instances as productive changes in the pleura. Twenty-seven of the cases showed an acute bronchitis which ranged in severity from a moderate mononuclear infiltration of the mucosa to a marked congestion with much desquamation of the epithelium. Only one case showed any evidence of a chronic bronchitis. In most instances, the acute bronchitis was accompanied by much desquamation of the epithelium and congestion of the mucosa. In sixteen cases, there was evidence of a chronic bronchiolitis which was manifested by marked productive tissue changes (Figs. 51 and 52) in the stroma of the

mucosa and sometimes the peribronchial tissue. Fourteen of these cases were associated with an acute bronchitis. The above would indicate that the infectious agent probably affected the respiratory bronchioles first. The lesions in the respiratory and terminal bronchioles were similar to those mentioned by Boyd (9) and MacCallum (10) in their descriptions of bronchopneumonia especially a streptococcal pneumonia. In a streptococcal pneumonia there is usually more injury to the small bronchioles and surrounding alveoli than to the bronchi. The pathology involving the alveoli varies considerably throughout the thirty cases studied. In eight cases of pneumonia there was a very marked atelectasis although in all cases, some evidence of atelectasis was usually present. Nine cases of the thirty show productive tissue changes of variable extent in the alveolar walls. In those pneumonias of any appreciable duration productive tissue changes were more in evidence in the apical and cardiac lobes. This condition seems slightly more pronounced in the left apical and cardiac lobes. The above conditions also hold true for the productive tissue changes in the small bronchioles. The majority of alveolar walls were usually very much congested yet a few contained large numbers of polymorphonuclear leucocytes and some mononuclear cells. In those cases in which the pneumonia was of long duration, some alveoli will become lined with cuboidal cells (Fig. 68). The pre-dominating alveolar exudate was cellular as shown in

Table IV. In five acute cases, the exudate was predominantly serous. It should be understood that serous and fibrinous exudate were present even though the cellular exudate predominates. In one case, there was an organization of the alveolar exudate (Fig. 66). In seven cases out of the thirty, there was much necrosis and abscessation.

SUMMARY

1. Thirty cases of calf pneumonia were studied in gross and microscopically for pathological changes. Twenty-four of these cases were studied also from a bacteriological standpoint.
2. Three distinct variations in the pathology of these cases are brought out, (1) an acute pneumonia which progresses very rapidly and the animal dies in several days without evidence of any productive tissue changes but usually with a serous exudate filling the alveolar sacs, (2) an acute pneumonia superimposed on a previous bronchiolitis or chronic bronchopneumonia in which a large part of both lungs are consolidated (Fig. 2). This is sometimes accompanied by a marked fibrinous pleurisy as in Fig. 29, and (3) the cases in which large numbers of small abscesses are present (Figs. 9, 12, 15, 16, and 56).
3. That the pneumonia is consistently bilateral has been well established (Table IV).
4. That the pneumonia usually begins in the apical lobes has been brought out in gross descriptions and by the microscopic study.
5. Consistently the pneumonia of the left lung is of longer duration than the pneumonia of the right.
6. The suggestion is made that there is injury to the respiratory bronchioles prior to a bronchitis.

7. The isolation of a beta type streptococcus was made in thirteen of the cases which were cultured; the isolation of a Bacillus coli organism was made in eleven cases and the isolation of a staphylococcus in thirteen cases. Either of the first two organisms was considered as the probable causative agent from a bacteriological point of view.

Table I

Bacteriological Determinations

Cul No.	Grm St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Non Hemo	Agar Slant	Gelatin Stab
Case #6																	
1	+	Non		Sh			+	+	+	-	-	-	-		Non	Grayish	No Growth
		Mot		Chn											Hemo	White	7 da.
2	+	Non		Sh			+	+	+	+	+	-	-		Non	Grayish	No Growth
		Mot	SH	Chn	Coc										Hemo	White	7 da.
Case #7																	
4	-	Mot		Sg		Sh Rod									Non	Grayish	Papillate
															Hemo		
5	-	Mot		Pr		Sh Rod									Non	Grayish	Stratiform
															Hemo	Green	
6	+	Non		Sh			+	+	+	-	+	-	+			Sparse	No Growth
		Mot	ST	Chn	Coc										Hemo	Beaded	
7	+	Non		Sh			+	+	-	+	-	-	+			Sparse	No Growth
		Mot	ST	Chn	Coc										Hemo	Beaded	
8	-	Mot				Sh Rod									Non	Grayish	Stratiform
															Hemo	White	
Case #9																	
9	+	Non		Sh			+	+	+	-	+	-	+			Sparse	No Growth
		Mot	ST	Chn	Coc										Hemo	Beaded	7 da.
10	+	Non		Sh			+	+	+	-	+	-	+			Sparse	No Growth
		Mot	ST	Chn	Coc										Hemo	Beaded	7 da.
11	+	Non		Sh			+	+	+	+	+	-	+		Non	Dirty Gray	No Growth
		Mot		Chn	Coc										Hemo		7 da.

Table I Cont.

No.	St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Non	Agar	Slant	Gelatin	Stab
12	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
15	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Case #11

12	+	Non Mot	ST	Sh Chn	Coc		+	+	+	-	+	-	+	Hemo	Sparse	Beaded	No Growth
13	-	Mot				Sh	+	+	+	+	+	+	+	Non Hemo	Grayish	White	Slight
14	+	Non Mot		Sg		Rod	+	+	+	+	+	+	+	Non Hemo	Grayish	White	Slight
15	+	Non Mot	ST	Pr	Coc		+	+	+	-	+	-	+	Non Hemo	Sparse		No Change

Case #12

16	+	Non Mot	SH	Cl	Coc		+	+	+	+	+	-	-	Non Hemo	Whitish	Yellow	Surface Growth
17*	+	Non Mot	ST		Coc		+	+	+	+	+	+	+	Hemo	Sparse	Beaded	No Growth

Case #13

18	+	Non Mot		Sg	Coc		+	+	+	+	+	-	-	Non Hemo	Yellowish	Luxuriant	Stratiform
19	-	Mot				Sh	+	+	-	-	-	-	-	Non Hemo	Grayish	White	Crateriform
20	-	Mot				Sh	+	+	-	-	-	-	-	Non Hemo	Grayish	White	Crateriform

Case #14

21	+	Non Mot	ST	Sh Chn	Coc		+	+	-	-	+	+	+	Non Hemo	Sparse	Beaded	No Growth
22	+	Non Mot	ST	Sh Chn	Coc		+	+	+	+	+	+	+	Hemo	Sparse	Beaded	No Growth

Table I Cont.

Cul.	Grm.	St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Non	Agar	Slant	Gelatin	Stab
23	-	Mot		Sg			Sh	+	+	+	+	+	+	+	+	Non	Grayish	Yellow	Crateriform	
24	+	Mot		Pr			Sh	+	+	+	+	+	+	+	+	Non	Grayish	Yellow	Crateriform	
Case #15																				
25	-	Non					Rod	-	-	-	-	-	-	-	-	Non	Grayish	White	No Growth	
26	+	Non		SH	CL	Coc		+	-	+	+	+	+	+	+	Non	Yellowish	Yellowish	Stratiform	
27	-	Mot					Rod	-	-	-	-	-	-	-	-	Non	Grayish	White	Papillate	
28	+	Non					Rod	+	+	+	+	+	+	+	+	Non	Yellowish	Yellowish	No Growth	
29	+	Non		ST		Coc		+	+	+	-	-	-	-	-	Non	Csparse	Beaded	No Growth	
30	+	Non		SH	CL	Coc		+	+	-	+	+	+	+	+	Non	Gray to	White	No Growth	
Case #16																				
31	-	Non					Sh	+	+	+	+	+	+	+	+	Non	Grayish		Stratiform	
32	+	Non				Coc		+	+	+	+	+	+	+	+	Non	Grayish		Stratiform	
33	+	Non		ST	Sh	Coc		+	+	+	+	+	+	+	+	Hemo	Sparse	Beaded	No Growth	
Case #17																				
34	-	Non					Sh	+	+	+	+	+	+	+	+	Non	Grayish	White	Stratiform	

Table I Cont.

Cul. Grm.	St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Non	Agar	Slant	Gelatin	Stab
35	-	Non		Sg		Sh	●	●	●	●	-	●	●		Non	Grayish			
		Mot				Rod	●	●	●	●	●	●	●		Hemo	White			Stratiform
36	-	Non		Sg		Sh							+		Non	Grayish			
		Mot				Rod	●	●	●	●	●	●	+		Hemo	White			Stratiform
37	+	Non	SH	Cl	Coc		+	+	+	+	+	-	-		Non		Yellow		Stratiform
		Mot													Hemo				

Case #18

39	-	Mot				Sn	●	●	●	●	●	●	●		Non	Grayish			Stratiform
						Rod									Hemo	White			
40	+	Non		Pr	Coc		+	+	-	-	-	+	+		Non	Sparse			No Growth
		Mot													Hemo	Beaded			

Case #19

41	+	Mot				Sh	●	●	●	●	●	●	●		Non	Abundant			Stratiform
						Rod									Hemo				
42	+	Non	SH	Cl	Coc		+	+	+	+	+	-	-		Non				Stratiform
		Mot													Hemo	Yellow			
43	+	Mot				Rod	+	+	-	-	+	+	+		Non	Abundant			Stratiform
															Hemo				

Case #20

44	+	Non	ST	Sh	Coc		-	-	-	-	-	-	-		Non	Sparse			No Growth
		Mot		Chn											Hemo	Beaded			
45	+	Non	ST	Sh	Coc		+	+	+	+	+	+	+	Hemo		Sparse			No Growth
		Mot		Chn												Beaded			

Case #21

46	-	Mot		Sg		Sh	●	●	●	●	●	●	●		Non	Grayish			Stratiform
						Rod									Hemo	White			

Table 1 Cont.

Cul	Grm	St	Mot	SH	Cl	Coc	Chn	ST	Rod	D	L	ML	M	S	I	SL	Hemo	Hemo	Agar	Slant	Gelatin	Stab
47	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Yellow	Stratiform	
48	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Grayish	Yellow	No Growth
49	-	Mot	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Grayish	Yellow	No Growth
Case #22																						
50	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Sparse	Beaded	No Growth	
51	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Sparse	Beaded	No Growth	
52	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Whitish	Papillate	
53	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Yellow	Stratiform	
Case #23																						
54	-	Mot	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Grayish	White	No Growth	
55	+	Mot	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Yellowish	Stratiform	
Case #24																						
56	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Sparse	Beaded	No Change	
Case #25																						
57	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Grayish	White	No Growth
58	+	Mot	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Non	Yellowish	Stratiform	
Case #26																						
59	+	Non	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	Sparse	Beaded	No Change	

Table 1 Cont.

Cul. Grm		No.	St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Agar	Slant	Gelatin	Stab
Case #27																				
57	+	Non	Mot	SH	Cl	Coc			+	+	+	+	+	+	+	Non	Yellow		Stratiform	
58	+				Sh	Coc			-	-	-	-	-	-	+	Hemo	Sparse	Beaded	No Growth	
59	+	Non	Mot	SH	Cl	Coc			+	+	+	+	+	+	+	Non	Sparse	Beaded	No Growth	
60	-	Mot			Sg			Sh	+	+	+	+	+	+	+	Non	Dirty	Gray	Stratiform	
61	+	Non	Mot		Cl	Coc			+	+	+	+	+	+	+	Non	Yellow		Stratiform	
Case #28																				
62	+	Non	Mot		Sh	Coc			+	+	+	+	+	+	+	Hemo	Grayish	White	Papillate	
63	+	Non	Mot		Sg.			Rod	+	+	+	+	+	+	+	Non	Grayish	White	Papillate	
Case #29																				
64	-	Mot			Sg			Sh	+	+	+	+	+	+	+	Non	Grayish	White	Crateriform	
65	+	Non	Mot	ST	Chn	Coc			+	+	+	+	+	+	+	Hemo	Grayish		No Growth	
Case #30																				
66	+	Non	Mot	SH	Cl	Coc			+	+	+	+	+	+	+	Non	Yellow		Stratiform	

Table 1 Cont.

Cul	Grm	No.	St	Mot	ST	Chn	Coc	Rod	D	L	ML	M	S	I	SL	Hemo	Non	Agar	Slant	Gelatin	Stab
67	-	Mot															Non	Dirty			
68	-	Mot															Non	Dirty			
69	+	Non Mot															Non	Grayish			

Key to Abbreviations

Grm. St.	Gram's stain reaction	SL.	Salicin
Mot.	Motility	Sg.	Single
ST.	Streptococcus	Pr.	In pairs
Chn.	Chain; Sh. - Short	Hemo.	Hemolytic
Coc.	Coccus form	Non-Hemo.	Non-hemolytic
Rod.	Rod form	SH.	Staphylococcus
D.	Dextrose	Cl.	Clusters
L.	Lactose	Cul.	Culture
ML.	Maltose	-	Negative or no reaction
M.	Mannite	+	Positive or acid formation
S.	Sucrose	●	Acid and gas
I.	Inulin	±	Partial

* Culture #17 used in Fig. 72.

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Table II

LITMUS MILK REACTIONS FOR CULTURES

CASE #6

Cultures	24 hours	48 hours	72 hours	5 days	7 days
1	Acid but no curd	Reduction, no curd	Acid curd	Same	Same
2	No change	Acid curd	Soft curd	Reduction	Same
The reactions were not consistent until after 48 hours.					

CASE #7

4	Acid, no curd	Acid and reduction with soft curd	Same	Same	Same
5	Acid, solid curd	Acid curd, 1/2 reduction	Digestion of curd	More digestion	Digestion almost complete
6	Slight peptonization	Peptonization	Complete peptonization	Same	Same
7	Acid, no curd	No curd, slight reduction of dye	Same	Soft curd	Same
8	Acid, no curd	Partial reduction and soft curd	More reduction, soft curd	Same	Same

CASE #9

9	No change	No change	Same	Same	Same
10	No change	No change	Acid slight	Soft curd	Soft curd, slight reduction
11	No change	Peptonization	More complete	Peptonization complete	Same

CASE #11

12	No change	No change	No change	Same	Same
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Table II Cont.

Cultures	24 hours	48 hours	72 hours	5 days	7 days
13	Acid curd	Solid curd, 3/4 reduction	Acid curd, complete reduction	Same	Same
14	Acid but no curd	Solid curd, 3/4 reduction	Same	Same	Same
15	No change	No change	Slightly acid, no curd	Same	Same
CASE #12					
16	Acid, no curd	Acid, no curd	Same	Same	Same
17	Acid curd	Solid curd, 3/4 reduction	Acid curd, complete reduction	Same	Same
(Culture #17 resembles very closely #13)					
CASE #13					
18	No change	Acid curd	Acid curd	Same	Same
19	No change	Acid curd	Acid curd	Same	Same
20	No change	Acid curd	Acid curd	Same	Same
CASE #14					
21	Acid curd soft	Solid curd, 2/3 reduction of dye	Acid curd, more reduction	Same	Same
22	Acid curd soft	Solid curd, 1/2 reduction of dye	Acid curd, complete reduction	Same	Same
23	No change	No change	No change	Same	Same
24	Acid curd	Acid curd	Acid curd	Same	Same
(Culture #21 and #22 seem very similar in many respects)					

Table II Cont.

CASE #15

Cultures	24 hours	48 hours	72 hours	5 days	7 days
25	No change	Some reduction of the dye	Acid curd, complete reduction	Same	Same
26	Acid curd soft	Solid curd, 1/2 reduction	Acid curd, 2/3 reduction	Same	Same
27	Acid curd soft	Solid curd, 1/3 reduction	Acid curd solid	Same	Same
28	No change	No change	Acid curd soft	Solid curd	Same
29	No change	No change	Acid curd soft	Solid curd	Same
30	No change	No change	Acid curd soft	Solid curd	Same

CASE #16

31	No change	Slightly acid	Acid curd reduction	Same	Same
32	No change	Peptonization	Complete peptonization	Same	Same
33	Acid curd soft	Solid curd, 1/2 reduction	Acid curd, complete reduction	Same	Same

(Culture #33 resembles very closely the reactions of cultures #26 and #27)

CASE #17

34	Acid curd	Acid curd	Acid curd	Same	Same
35	Acid curd	Acid curd	Acid curd	Same	Same
36	Acid curd	Acid curd	Acid curd	Same	Same
37	Acid curd	Acid curd	Acid curd	Same	Same

CASE #18

39	Acid curd solid	Acid curd solid	Acid curd, some reduction	Same	Same
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Table II Cont.

Cultures	24 hours	48 hours	72 hours	5 days	7 days
40	No change	Peptonization	Complete peptonization (Culture #40 resembles very closely culture #32)	Same	Same
CASE #19					
41	No change	Peptonization	Complete peptonization	Same	Same
42	Acid	Acid	Acid curd	Same	Same
43	No change	Peptonization	Complete peptonization	Same	Same
(Both culture #41 and #43 resemble each other very closely)					
CASE #20					
44	No change	Peptonization	Complete peptonization	Same	Same
45	No change	Peptonization	Complete peptonization	Same	Same
(Both cultures resemble each other very closely)					
CASE #21					
46	Acid curd	Acid curd	Same	Same	Same
47	Acid curd	Solid acid curd	Same	Same	Same
CASE #22					
48	No change	Rennet curd	Acid curd	Same	Same
49	Acid curd	Solid acid curd	Acid curd, com- plete reduction	Same	Same

Table II Cont.

CASE #23

Cultures	24 hours	48 hours	72 hours	5 days	7 days
50	No change	Peptonization	Complete peptonization	Same	Same

CASE #24

51	No change	No change	Acid slight	Soft curd	Soft curd
52	Acid	Acid	Acid curd	Same	Same
53	No change	No change	Slightly acid	Acid	Acid

CASE #25

54	No change	No change	Acid curd	Acid curd	Same
55	No change	Acid curd	Acid curd	Same	Same

-70-

CASE #26

56	No change	Peptonization	Peptonization	Complete peptonization	Same
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CASE #27

57	No change	Acid curd	Acid curd	Same	Same
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CASE #28

58	No change	Peptonization	Complete peptonization	Complete peptonization	Same
59	No change	Peptonization	Complete peptonization	Complete peptonization	Same

Table II Cont.

Cultures	24 hours	48 hours	72 hours	5 days	7 days
60	Acid curd	Acid curd	Acid curd	Same	Same
61	No change	Acid curd	Acid curd	Same	Same
			CASE #29		
62	No change	No change	Acid slight	Soft curd	Soft curd
63	Acid curd	Acid curd	Acid curd	Same	Same
			CASE #30		
64	Acid curd	Acid curd	Acid curd	Same	Same
65	No change	Peptonization	Complete peptonization	Same	Same
			CASE #31		
66	No change	Acid curd	Acid curd	Same	Same
67	Acid curd	Acid curd	Acid curd	Same	Same
68	Acid curd	Acid curd	Acid curd	Same	Same

Chart III.

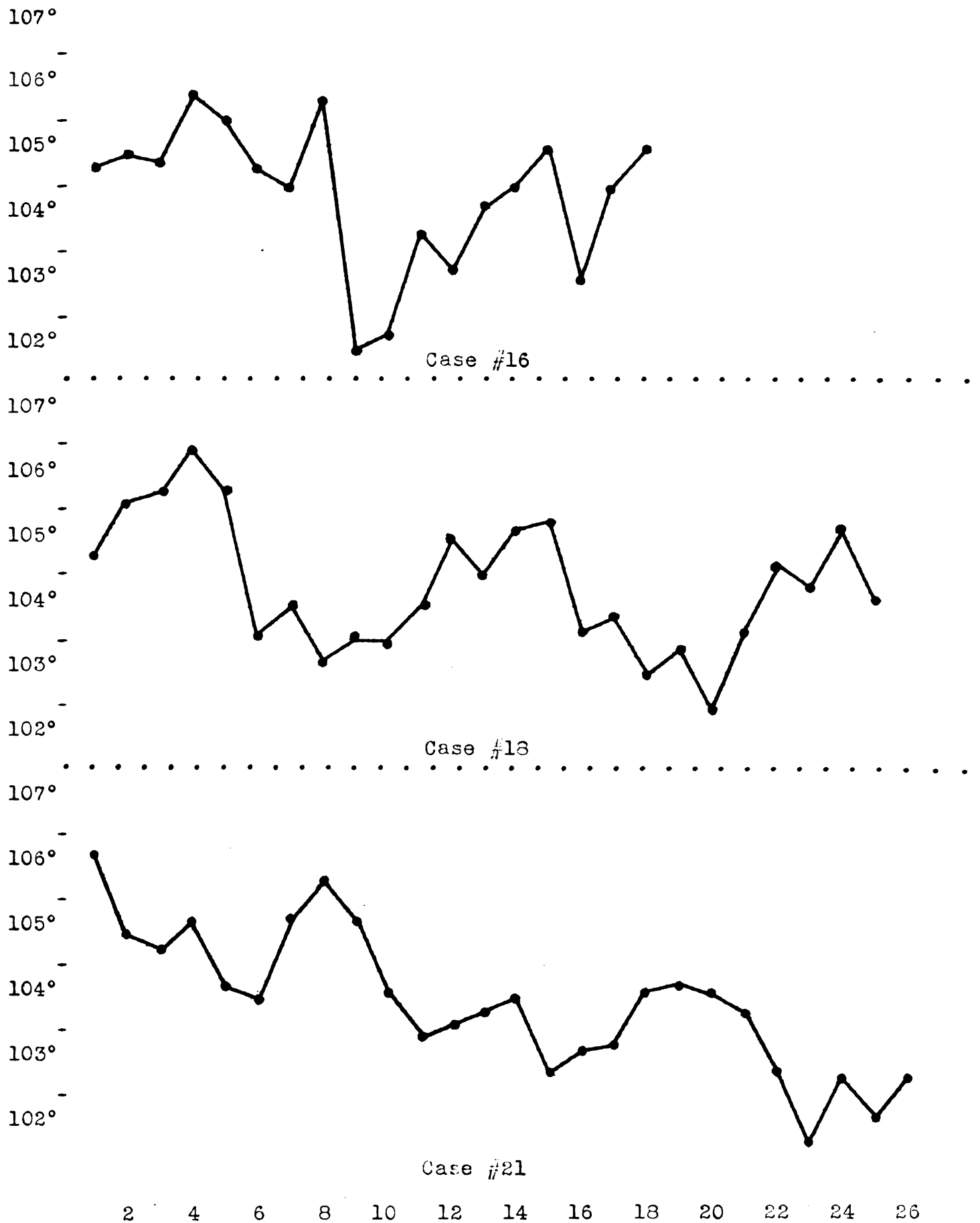


Table IV

Case numbers	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Reported duration of pneumonia prior to death. (In days).	4	7	10	20	14	3	10	12	12	14	7	7	7	11	18	15	21	11	2	28	21	14	6	14	7	5	14	6	14	18	
Bilateral or unilateral (+ or -).	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Left apical lobe (+ if entirely consolidated).	1/2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	3/4	+	+	+	
Left cardiac lobe (+ if entirely consolidated).	1/5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	3/4	+	+	+	
Left diaphragmatic lobe (+ if entirely consolidated).	-	1/4	1/5	1/3	1/3	2/3	1/3	1/3	1/4	1/6	1/5	1/5	2/3	1/3	+	1/8	1/3	1/3	2/3	1/3	2/3	1/3	+	1/3	1/3	2/3	1/2	1/6	1/6	1/3	
Mediastinal lobe (+ if entirely consolidated).	-	-	+	-	+	+	+	+	+	3/4	+	+	+	+	+	+	+	+	3/4	+	+	+	+	+	+	+	+	+	1/4	+	+
Right apical lobe (+ if entirely consolidated).	1/6	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Right cardiac lobe, anterior portion (+ if entirely consolidated).	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	3/4	+	
Right cardiac lobe, posterior portion (+ if entirely consolidated).	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Right diaphragmatic lobe (+ if entirely consolidated).	-	1/4	1/3	1/3	1/3	2/3	1/3	1/3	1/3	1/8	1/6	1/4	1/3	1/6	1/5	4/5	1/8	2/3	3/4	2/3	1/2	2/3	1/2	+	1/3	2/3	1/3	1/2	1/2	1/3	1/3
Lymph nodes enlarged or edematous (+ or -).	-	+	+	+	+	±	+	+	+	+	-	+	-	+	+	+	-	+	+	+	+	+	±	+	-	±	+	-	+	+	±
Pleura thickened (+ or -).	-	-	-	+	-	-	-	+	+	+	±	-	-	+	±	±	+	±	+	±	+	+	+	-	-	±	+	+	-	±	
Interlobular septa edematous (+ or -).	-	-	-	+	+	-	-	+	+	-	-	-	+	-	+	+	±	-	+	-	+	+	+	-	±	-	+	+	±	±	
Lymphatic of septa distended (+ or -).	-	-	-	+	±	-	-	+	+	-	-	±	+	-	+	+	±	-	±	-	+	+	-	±	-	+	+	-	+	+	
Bronchitis acute or chronic (A, C, or -; C* both A and C).	A	A	A	A	-	A	A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	-	A	C	A	A	-	A
Bronchiolitis acute or chronic (A, C, or -).	C	C	A	C	C	-	C	A	A	C	A	A	A	A	C	A	A	A	A	A	C	C	C	A	C	A	C	A	A	C	A
Productive tissue changes in alveolar wall (+ or -).	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	+	-	±	±	±	±	-	-	+	-	±	±	-	-	±	
Marked atelectasis (+ or -).	-	-	+	-	-	-	-	-	-	+	+	-	-	-	-	-	+	-	-	-	±	+	-	+	-	-	-	+	-	-	
Exudate S, serous F, fibrinous C, cellular (S, F, or C; E).	-	S	C	C	F	S	C	C	C	C	S	S	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
Organization of exudate in the alveoli (+ or -).	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	
Necrotic areas or abscesses (N, A, or -; A).	-	-	-	N	-	-	-	-	N	-	-	-	-	-	N	-	-	-	-	-	-	-	N	-	-	-	A	N	-	A	
Bacillus coli communior (+ when present).	*	*	*	*	*	*	+	*	+	*	+	*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Streptococcus (Beta type) (+ when present).	*	*	*	*	*	*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Staphylococcus (+ when present).	*	*	*	*	*	*	+	*	+	*	+	*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	

* $\frac{A}{C}$, $\frac{N}{F}$, and $\frac{N}{A}$ mean that both conditions are present but that the numerator is slightly predominant. * Not examined bacteriologically.

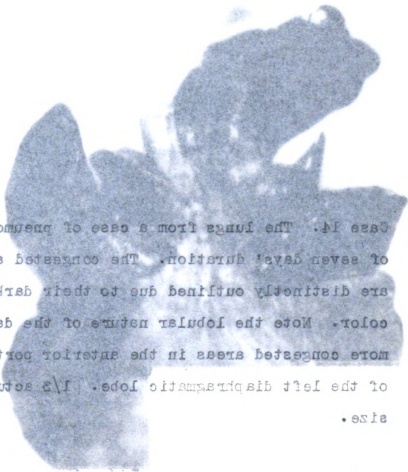


Fig. 1. Case 14. The lungs from a case of pneumonia of seven days' duration. The congested areas are distinctly outlined due to their darker color. Note the lobular nature of the darker more congested areas in the anterior portion of the left diaphragmatic lobe. (1/3 actual size.)

Fig. 1. Case 14. The lungs from a case of pneumonia of seven days' duration. The congested areas are distinctly outlined due to their darker color. Note the lobular nature of the darker more congested areas in the anterior portion of the left diaphragmatic lobe. 1/3 actual size.

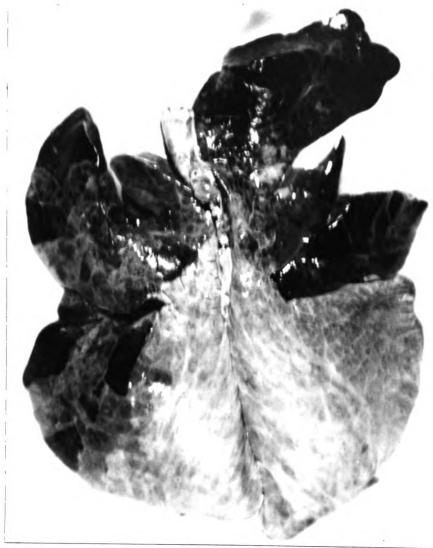


Figure 1.

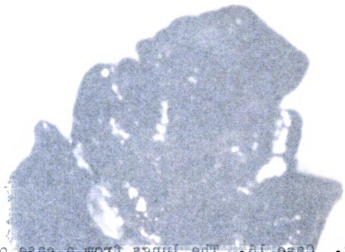


Fig. 2. Case 12. The lungs from a case of pneumonia of eighteen days' duration. Note that only a small amount of normal lung remains along the dorsal posterior part of the right hemithorax. 1/3 actual size.

Fig. 2. Case 16. The lungs from a case of pneumonia of eighteen days' duration. Note that only a small amount of normal lung remains along the dorsal posterior part of the right diaphragmatic lobe. 1/3 actual size.



Figure 2.

Fig. 5. The line from a case of pneumonia of the lower lobe of the lung. The anterior and posterior ends of the bronchus are marked. The small area of consolidation is marked in the lower part of the lung. The small area of consolidation is marked in the lower part of the lung.

Fig. 3. Case 22. The lungs from a case of pneumonia of three weeks' duration. Note the extreme enlargement of the bronchial and posterior mediastinal lymph nodes. Also note the small area of comparatively normal lung tissue in the lower part of the right cardiac lobe. 1/3 actual size.

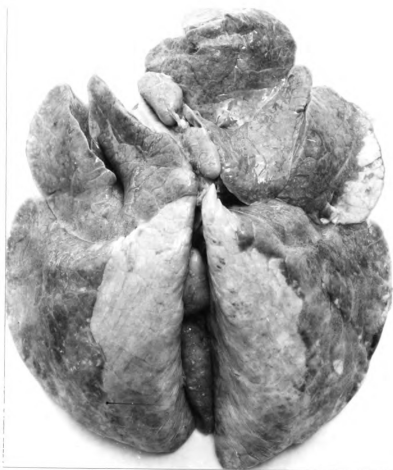


Figure 3.

1. The first step in the process of the
 2. the second step is to...
 3. the third step is to...
 4. the fourth step is to...
 5. the fifth step is to...
 6. the sixth step is to...
 7. the seventh step is to...
 8. the eighth step is to...
 9. the ninth step is to...
 10. the tenth step is to...

Fig. 4. Case 23. The lungs from a case of pneumonia of two weeks' duration. Note the enlargement of the bronchial lymph node and the lobular appearance of the pneumonia along the borders of consolidated portions of the right and left diaphragmatic lobes. 1/3 actual size.



Figure 4.

Fig. 5. Case 22. A cross section of the left diaphragmatic lobe of the case as shown in Fig. 4. Note the same congested area near the large bronchial tubes. The portion above this congested area is normal while the area below is of grayish white color, which upon close inspection shows a slightly mottled appearance. 1/3 actual size.

Fig. 5. Case 22. A cross section of the left diaphragmatic lobe of the same case as shown in Fig. 4. Note the acute congested area near the large bronchial tubes. The portion above this congested area is normal while the area below is of grayish white color, which upon close inspection shows a slightly mottled appearance. 1/3 actual size.



Figure 5.

Fig. 6. Case 24. The lungs from a case of pneumonia of six days' duration. Note the marked fibrinous pleurisy involving the cardiac and apical lobes of the right lung and scattered areas over both lungs. 1/3 actual size.



Figure 6.

Fig. 8. Diagram of the structure of the
two types of the structure. The diagram
shows the structure of the structure in the
position of the first element.
The diagram shows the structure of the
structure in the position of the first element.

Fig. 7. Case 25. Lungs from a case of pneumonia of two weeks' duration. Note the enlarged bronchial lymph nodes and emphysematous areas in the posterior part of the right diaphragmatic lobe. 1/3 actual size.

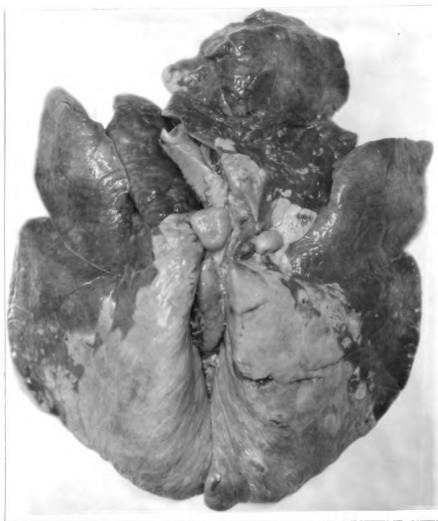


Figure 7.

[illegible]

Fig. 8. Case 25. The ventral aspect of the same lung shown in Fig. 7. Note the occasional lobules that appear normal. 1/3 actual size.



Figure 8.

Fig. 2. Case of a single phase of the
of the of the of the of the
of the of the of the of the

Fig. 9. Case 27. A case of calf pneumonia showing an abscess on the ventral margin of the left apical lobe. 1/3 actual size.



Figure 9.

[illegible]

Fig. 10. Case 27. The ventral aspect of the lungs in Fig. 9. Note the small abscesses on the pleural surface of the left cardiac lobe. 1/3 actual size.



Figure 10.

PINGPANG TO THE S OFF AGAIN ONT .06 1970 .11 .11
 SERVICE TO ALL .00100. HERE OUT TO
 ONLINE THERM OF AN NEW FUNDATION OF THE
 HONG KONG AND BERKELEY OFFICIALS .11
 .11 1970 .11 .11

Fig. 11. Case 28. The lungs from a case of pneumonia of two weeks' duration. Note the constricted and lighter colored area in the right cardiac lobe. Notice the enlarged bronchial lymph node. 1/3 actual size.

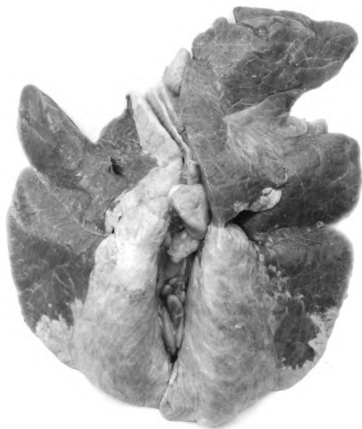


Figure 11.

Fig. 12. Case 28. Cross sections from the right
cardiac lobe of the lung shown in Fig. 11.
This includes the lighter constricted area
mentioned under Fig. 11. Note the large
number of abscesses in the cross sections.
1/3 actual size.

Fig. 12. Case 23. Cross sections from the right cardiac lobe of the lung shown in Fig. 11. This includes the lighter constricted area mentioned under Fig. 11. Note the large number of abscesses in the cross sections. 1/3 actual size.



Figure 12.

Fig. 13. Case 29. A lung from a case of pneumonia
of six days' duration. 1/3 actual size.



Figure 13.

Fig. 14. Case 30. A line from a case of pneumonia
in which there was only a small amount of
redish-gray consolidation. 1/3 actual
size.

Fig. 14. Case 30. A lung from a case of pneumonia in which there was only a small amount of reddish-gray consolidation. 1/3 actual size.



Figure 14.

along with the other staff members. . . .
The other staff members were also
in the same situation. The other staff
members were also in the same situation.
The other staff members were also in the same situation.

Fig. 15. Case 31. A lung from a case of pneumonia of eighteen days' duration. Note the numerous small abscesses and the one larger one on the pleural surface of the right cardiac lobe. 1/3 actual size.



Figure 15.

Fig. 10. The vertical axis of the line
is the same as in Fig. 9. The horizontal
axis is the same as in Fig. 9. The
vertical axis is the same as in Fig. 9.

Fig. 16. Case 31. The ventral aspect of the lung shown in Fig. 15. Note the numerous abscesses. 1/3 actual size.



Figure 16.

Fig. 17. Case 1. Section of normal lung showing
a respiratory bronchiole. 120X.

Fig. 18. Case 1. A higher magnification of Fig. 17
showing a normal respiratory bronchiole.
750X.

Now I must conclude my report. I am, Sir,
Very respectfully,
Your obedient servant,
John A. Smith

Fig. 2. Section showing recent broncho-
ectatic changes with more extensive
extensive alveolar tissue.

Fig. 19. Case 5. Section showing a terminal bronchiole with a recent bronchopneumonia. 100X.

Fig. 20. Case 5. Section showing recent bronchopneumonia with more extension into the surrounding alveolar tissue. 110X.

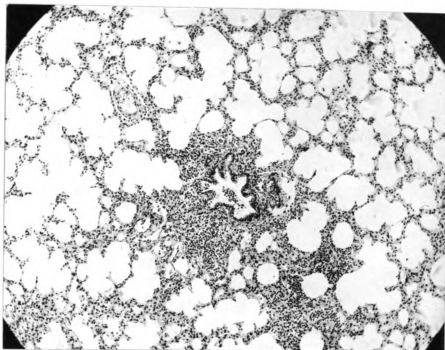


Figure 19.

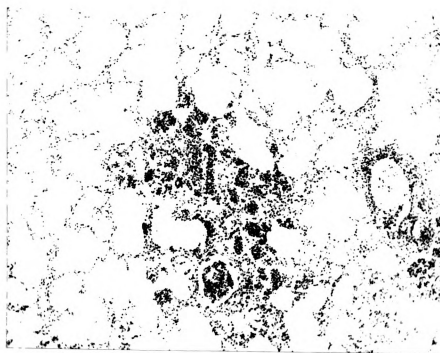


Figure 20.

Fig. 21. Case 6. An area showing acute congestion
of the alveolar walls. 130X.

Fig. 22. Case 5. Section showing recent fibrinous
exudate in an alveolar duct of a case of
acute bronchopneumonia. 130X.

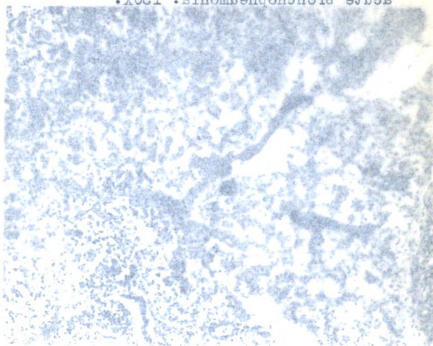


Fig. 21. Case 6. An area showing acute congestion of the alveolar walls. 130X.

Fig. 22. Case 5. Section showing recent fibrinous exudate in an alveolar duct of a case of acute bronchopneumonia. 130X.

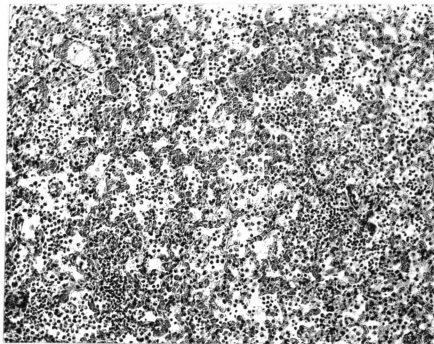


Figure 21.

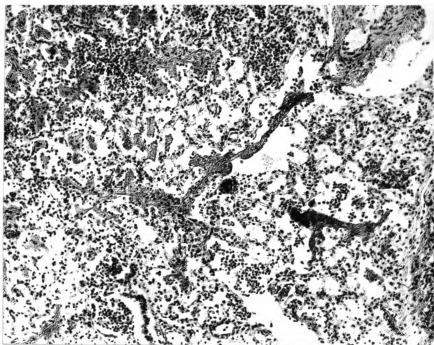


Figure 22.

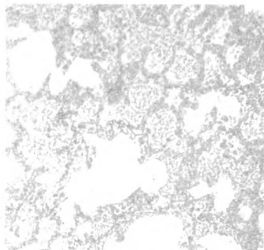


Fig. 23. Case 10. Section showing acute congestion of the alveolar wall and some serous exudation into the alveolar sac. 150X.

Fig. 24. Case 10. Same section as above but higher magnification. 375X.

Fig. 23. Case 10. Section showing acute congestion of the alveolar wall and some serous exudation into the alveolar sac. 130X.

Fig. 24. Case 10. Same section as above but higher magnification. 575X.

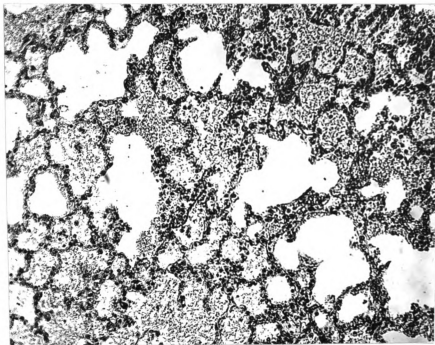


Figure 23.

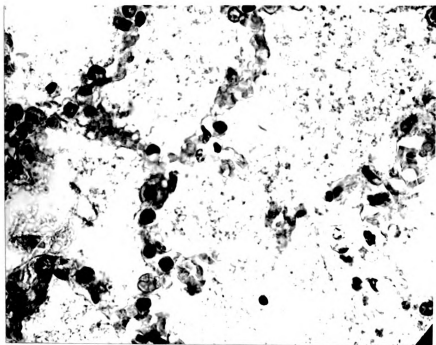


Figure 24.

11-10-68 10:00 AM

1. Find the value of x in the following:

• 1991 • 4020129 • 00000011

To the above mentioned persons . . .

[illegible]

Fig. 25. Case 6. Section showing an area in which practically all the alveoli contain a fibrinous exudate. 105X.

Fig. 26. Case 6. Same section as above but of higher magnification. 575X.

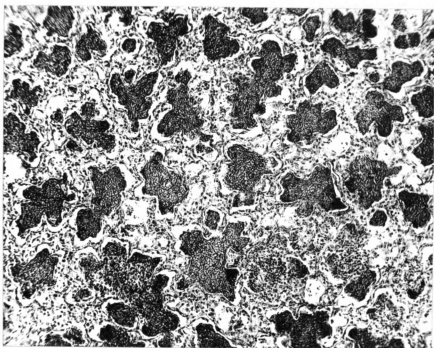


Figure 25.

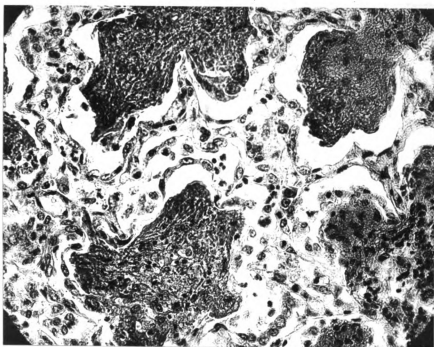


Figure 26.

Fig. 27. Case 18. Section showing a marked thick-

ening of the pleura with atelectasis of
some of the alveoli below the pleural

surface. 120X.

Fig. 28.

Fig. 28. Case 31. Section showing similar condi-

tion of the pleura as above, but more the

mononuclear cells in the alveoli below

the pleura. 250X.

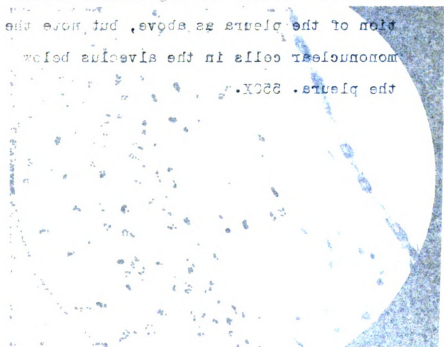


Fig. 27. Case 18. Section showing a marked thickening of the pleura with atelectasis of some of the alveoli below the pleural surface. 120X.

Fig. 28. Case 31. Section showing similar condition of the pleura as above, but note the mononuclear cells in the alveolus below the pleura. 550X.

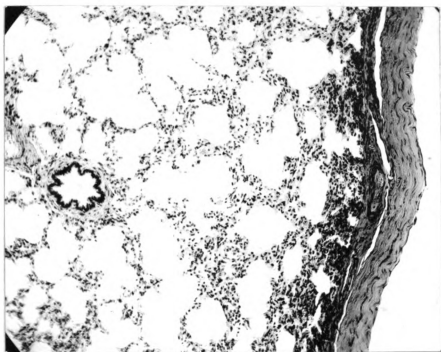


Figure 27.

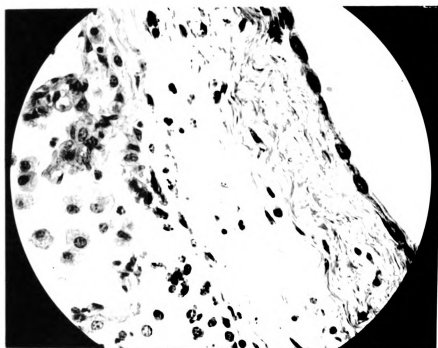


Figure 28.

Fig. 24. Section showing a typical
one piece. Compare this with the
picture (Fig. 6). 140X.

Fig. 25. Section showing a typical
one piece. 140X.

Fig. 29. Case 24. Section showing a marked fibrinous pleurisy. Compare this with the gross picture (Fig. 6). 140X.

Fig. 30. Case 13. Section showing considerable atelectasis. 160X.

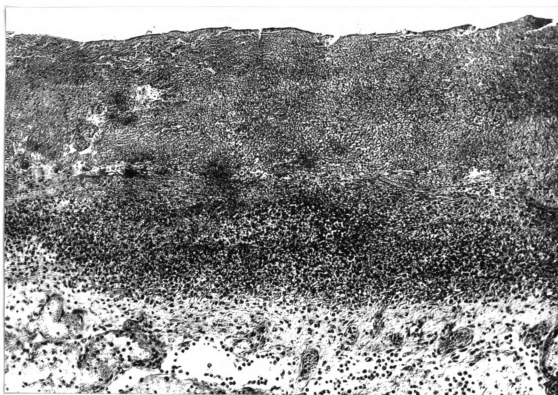


Figure 29.



Figure 30.

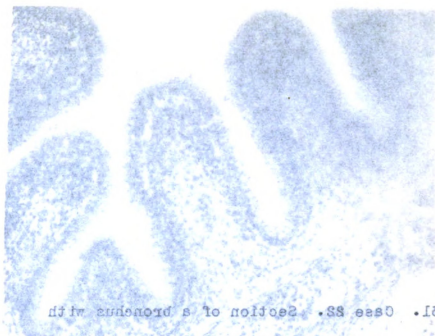


Fig. 31. Case 32. Section of a bronchus with comparatively normal epithelium but slight infiltration of macrophages into the stroma of the mucosa. 170X.

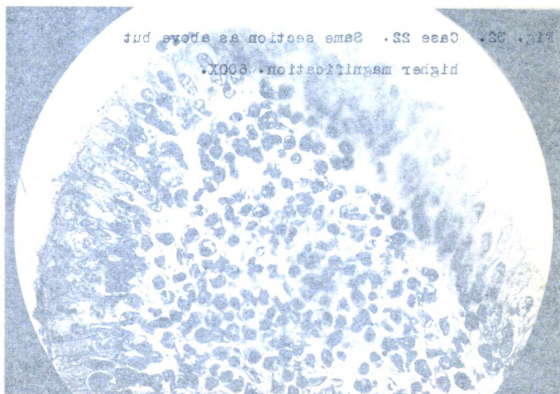


Fig. 32. Case 32. Same section as above but higher magnification. 600X.

Fig. 31. Case 22. Section of a bronchus with comparatively normal epithelium but slight infiltration of macrophages into the stroma of the mucosa. 170X.

Fig. 32. Case 22. Same section as above but higher magnification. 600X.

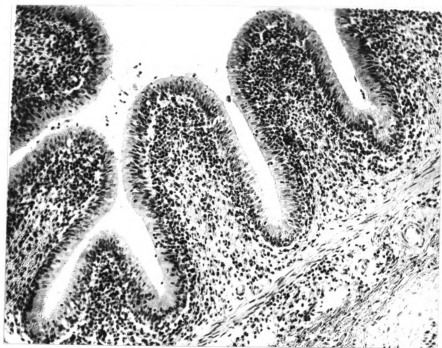


Figure 31.

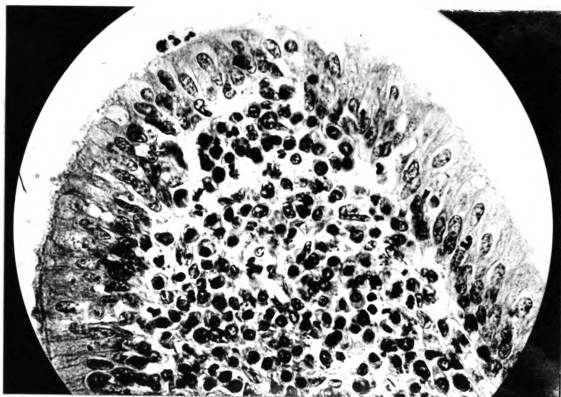


Figure 32.

Fig. 33. Case 23. Section showing an acute bronchitis with much desquamation of the epithelium. Note the congested capillaries. 140X.

Fig. 34. Case 23. Same section as above but higher magnification. 620X.

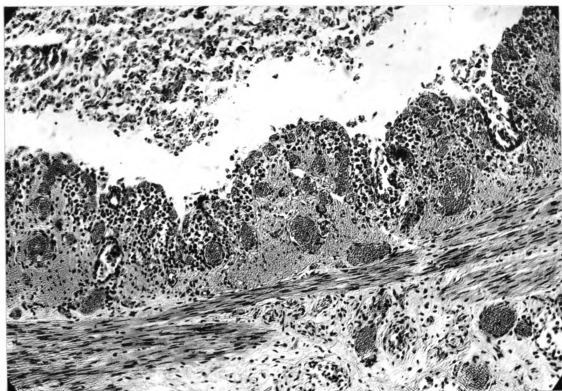


Figure 33.

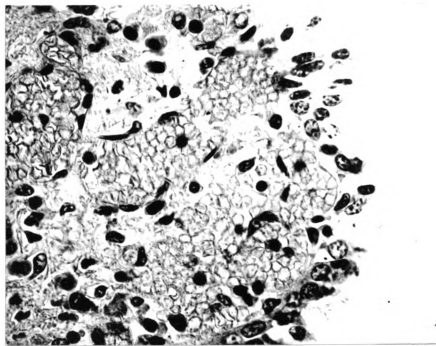


Figure 34.

Fig. 30. Case 28. Section showing a bronchopneumonia. Note the relationship between the areas of bronchopneumonia. 62X.

Fig. 36. Case 28. Section showing a recent bronchopneumonia. Note how the cellular infiltration appears to radiate from the two bronchioles. 100X.

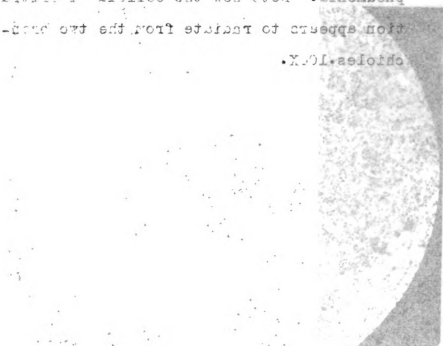


Fig. 35. Case 25. Section showing a bronchopneumonia. Note the atelectasis between the areas of bronchopneumonia. 85X.

Fig. 36. Case 28. Section showing a recent bronchopneumonia. Note how the cellular infiltration appears to radiate from the two bronchioles. 100X.

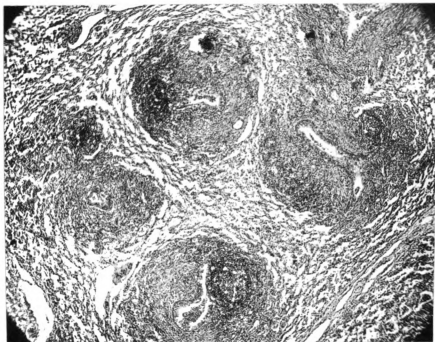


Figure 35.

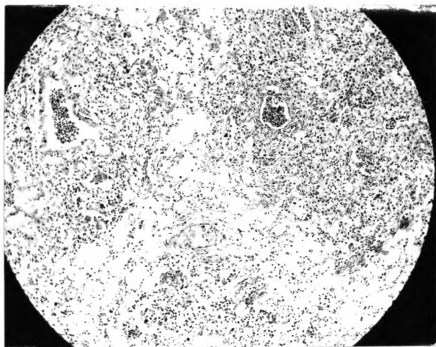


Figure 36.

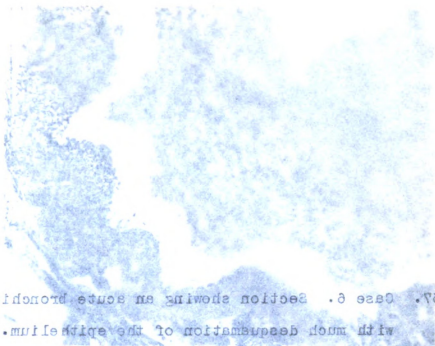


Fig. 37. Case 6. Section showing an acute bronchitis

with much desquamation of the epithelium.

Note the large number of epithelial cells

Figure 37.

in the lumen of the bronchus. 105X.

Fig. 38. Case 6. Same section as above but higher

magnification showing the desquamated

epithelial cells. 250X.

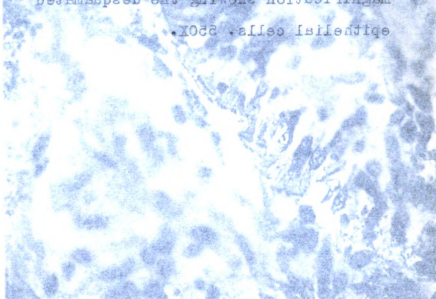


Figure 38.

Fig. 37. Case 6. Section showing an acute bronchitis with much desquamation of the epithelium. Note the large number of epithelial cells in the lumen of the bronchus. 105X.

Fig. 38. Case 6. Same section as above but higher magnification showing the desquamated epithelial cells. 550X.

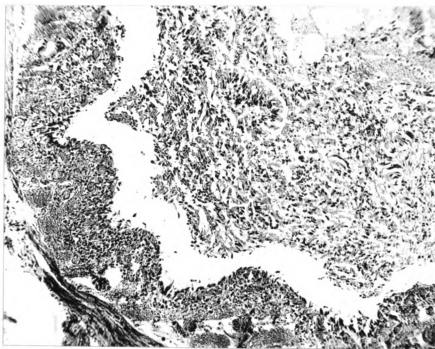


Figure 37.

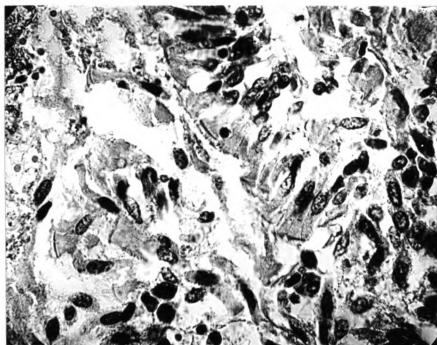


Figure 38.

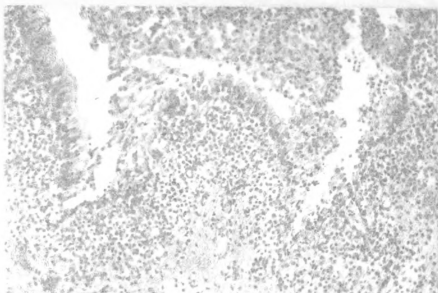


Fig. 39. Case 19. Section showing an early stage of cellular infiltration into the stroma of the mucosa. 150X.

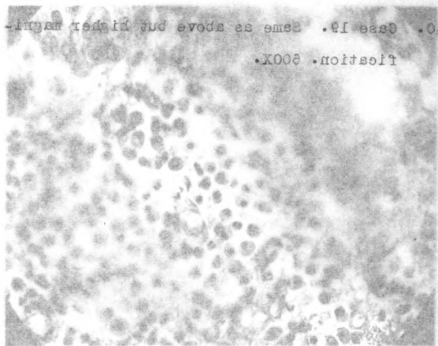


Fig. 40. Case 19. Same as above but higher magnification. 500X.

Figure 40.

Fig. 39. Case 19. Section showing an early bronchitis with considerable infiltration of mononuclear phagocytes into the stroma of the mucosa. 150X.

Fig. 40. Case 19. Same as above but higher magnification. 600X.

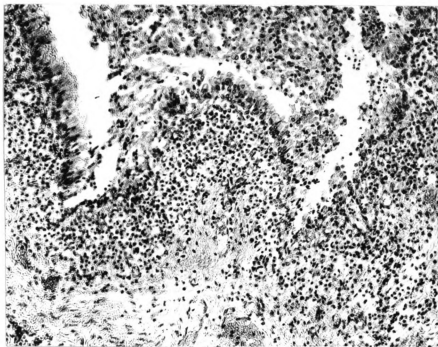


Figure 39.

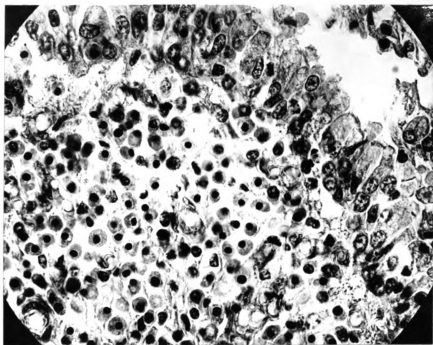


Figure 40.

also have been referred to as "mud" or "mud"
which is a very common name for the mud.
1907.

Case 1.
of the mud is very common and is very common.
1907.

Fig. 41. Case 18. Section of a terminal bronchiole with much desquamation of the epithelium. 130X.

Fig. 42. Case 18. Same section as above. Note the congested capillaries and injury to the epithelium. 600X.

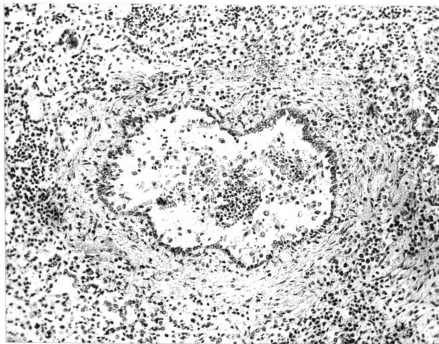


Figure 41.

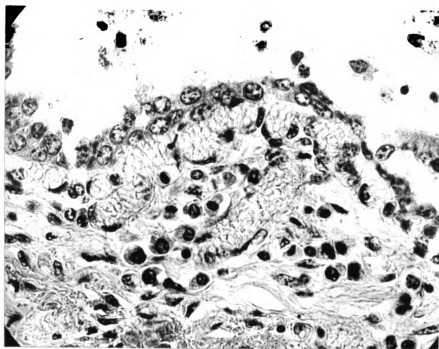


Figure 42.

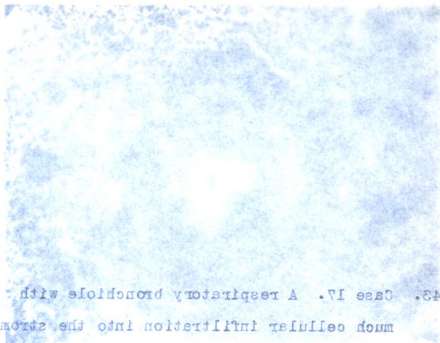


Fig. 43. Case IV. A respiratory bronchiole with much cellular infiltration into the stroma of the mucosa. 120X.

Fig. 44. Case IV. Same as above but higher magnification. 500X.

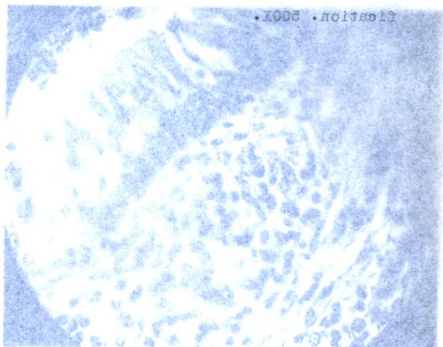


Figure 44.

Fig. 43. Case 17. A respiratory bronchiole with much cellular infiltration into the stroma of the mucosa. 120X.

Fig. 44. Case 17. Same as above but higher magnification. 500X.

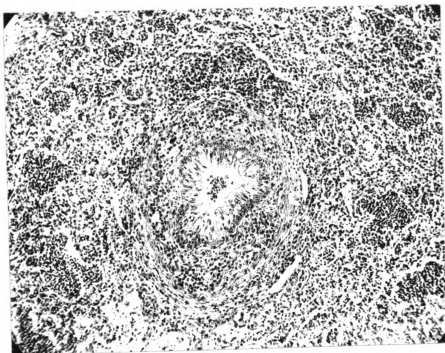


Figure 43.

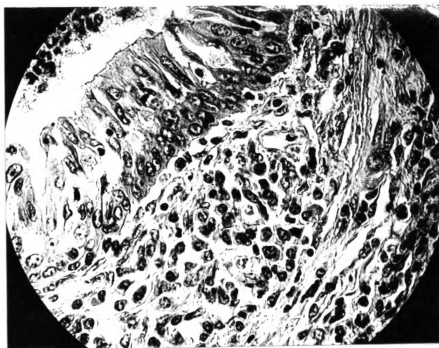


Figure 44.

Fig. 43. Case 20. Section of animal with a
-smaller animal in the middle of the
-section of the vertebral axis. 100x.

Fig. 44. Case 21. A terminal bronchiole with
-smaller animal in the middle of the
-section of the axis; also note the
-degeneration of the epithelium. 100x.

Fig. 45. Case 25. Section of small bronchiole showing considerable lymphocytic infiltration of the peribronchial area. 110X.

Fig. 46. Case 21. A terminal bronchiole with marked cellular infiltration into the stroma of the mucosa; also note the desquamation of the epithelium. 140X.

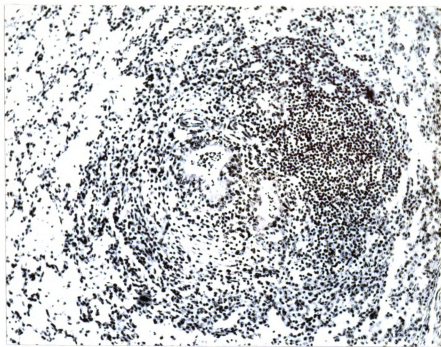


Figure 45.

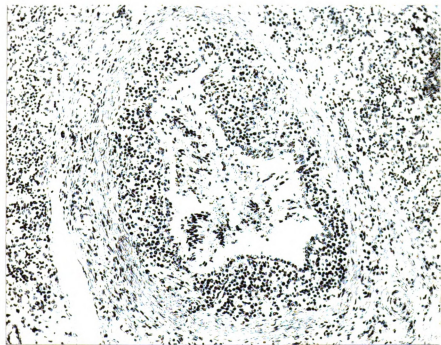


Figure 46.



Fig. 47. Case 10. Section showing a small bronchiole with a zone of marked cellular infiltration of the peribronchial tissue. 150X.

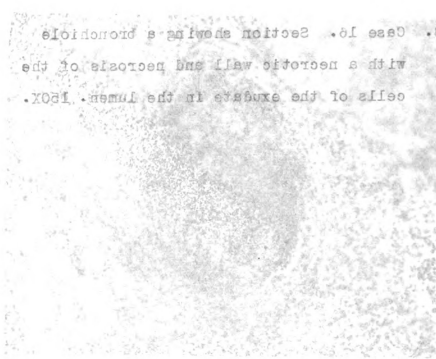


Fig. 48. Case 10. Section showing a bronchiole with a necrotic wall and necrosis of the cells of the excretory in the lumen. 150X.

Fig. 47. Case 10. Section showing a small bronchiole with a zone of marked cellular infiltration of the peribronchial tissue. 150X.

Fig. 48. Case 16. Section showing a bronchiole with a necrotic wall and necrosis of the cells of the exudate in the lumen. 150X.

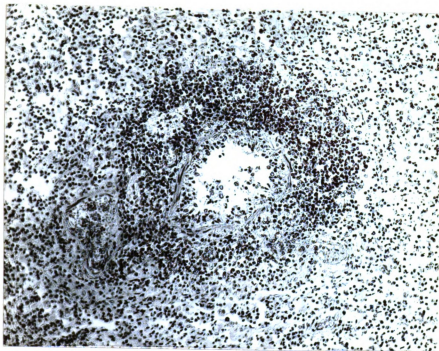


Figure 47.

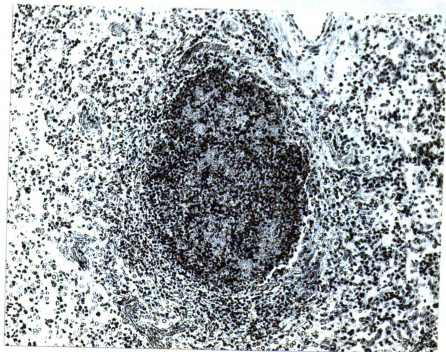


Figure 48.

From the 10th to the 12th of May 1941.

There is a small amount of rain on the 11th.

From the 13th to the 15th of May 1941.

From the 16th to the 18th of May 1941.

From the 19th to the 21st of May 1941.

Fig. 49. Case 9. Section showing recent productive tissue changes in the wall of a small bronchiole. 105X.

Fig. 50. Case 9. Same section as above but of higher magnification. 540X.



Figure 49.

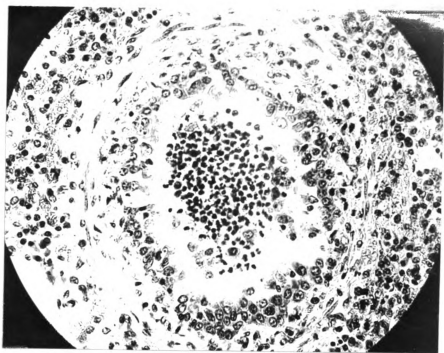


Figure 50.

11-17 .17 0000 .17 0000
11-17 .17 0000 .17 0000
11-17 .17 0000 .17 0000

11-17 .17 0000 .17 0000
11-17 .17 0000 .17 0000
11-17 .17 0000 .17 0000

Fig. 51. Case 27. Section showing marked productive tissue changes with fibrosis in the wall of a terminal bronchiole. 120X.

Fig. 52. Case 26. Section showing considerable productive tissue changes with fibrosis in the wall of a respiratory bronchiole. 130X.

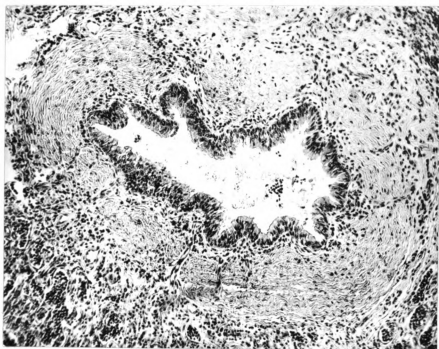


Figure 51.

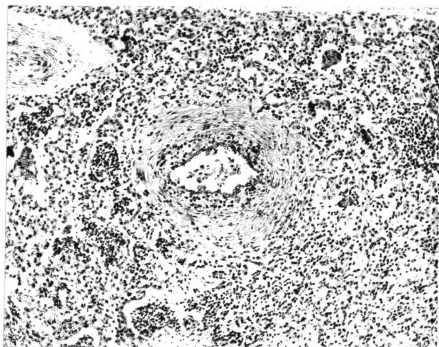


Figure 52.

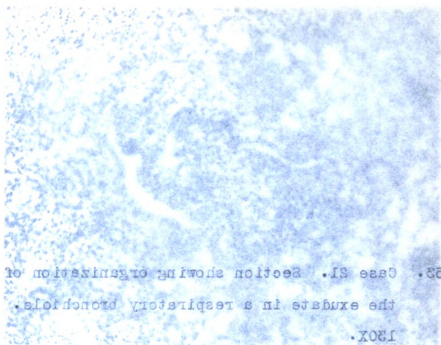


Fig. 53. Case 21. Section showing organization of the exudate in a respiratory bronchiole. 130X.

Fig. 54. Case 21. Same section as above but higher magnification. 250X.

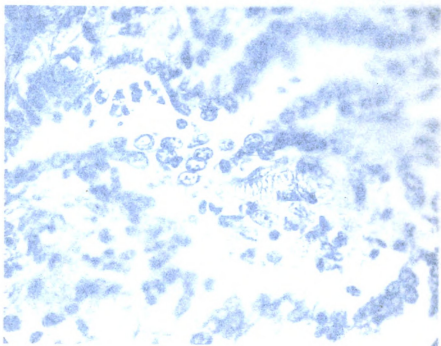


Figure 54.

Fig. 53. Case 21. Section showing organization of the exudate in a respiratory bronchiole. 130X.

Fig. 54. Case 21. Same section as above but higher magnification. 550X.

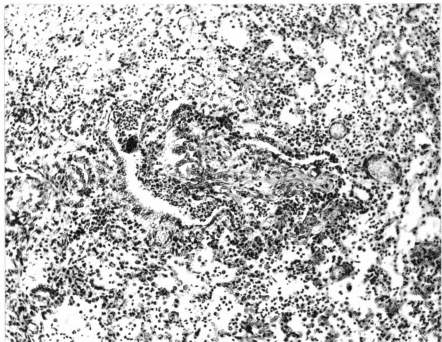


Figure 53.

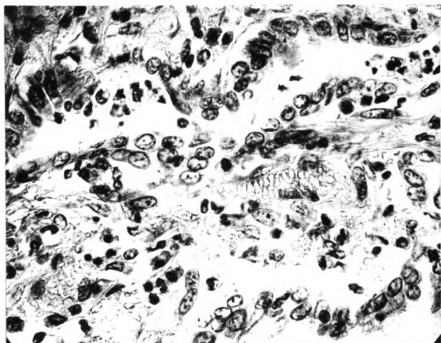


Figure 54.

Fig. 55. Case 4. Section showing necrosis of the

entire plane of a lobe. Note the

necrotic pyramidal in the center of

Figure 55.
photomicrograph. 120X.

Fig. 56. Case 31. Section showing a small abscess.

120X.

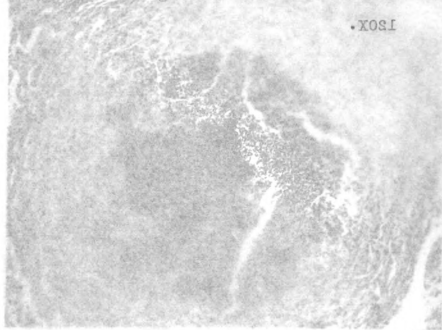


Figure 56.

Fig. 55. Case 4. Section showing necrosis of the entire plane of a lobule. Note the necrotic bronchiole in the center of photomicrograph. 120X.

Fig. 56. Case 31. Section showing a small abscess. 120X.

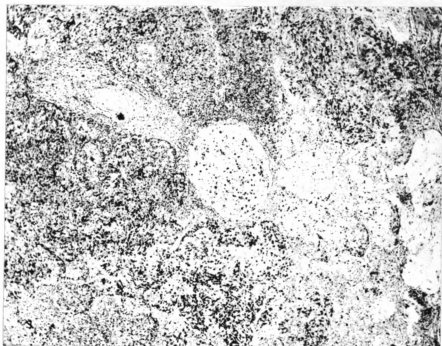


Figure 55.

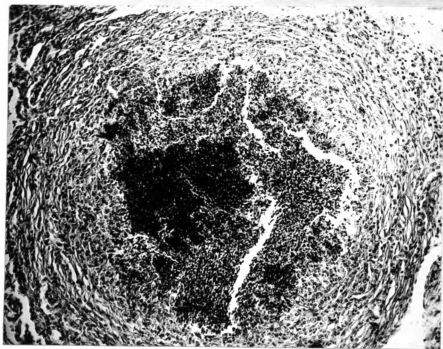


Figure 56.

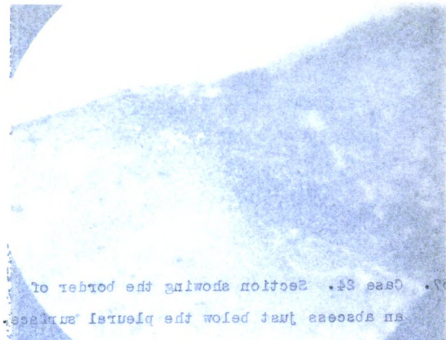


Fig. 57. Case 24. Section showing the border of an abscess just below the pleural surface.
80X.

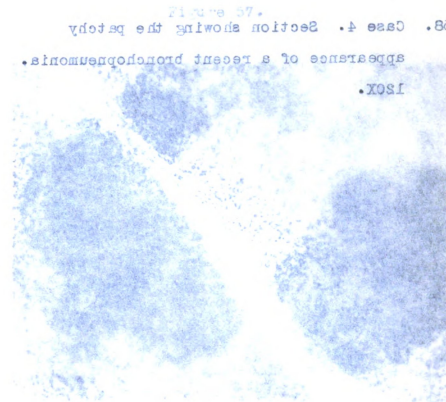


Fig. 58. Case 4. Section showing the patchy appearance of a recent pneumothorax.
120X.

Fig. 57. Case 24. Section showing the border of
an abscess just below the pleural surface.
80X.

Fig. 58. Case 4. Section showing the patchy
appearance of a recent bronchopneumonia.
120X.

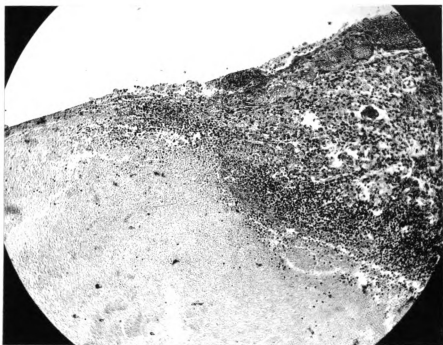


Figure 57.

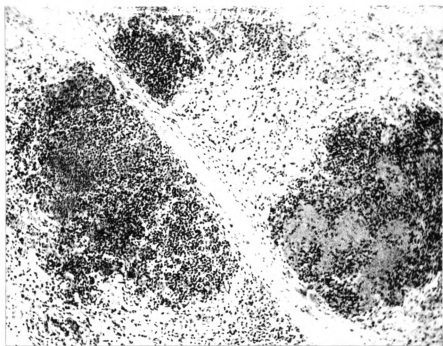


Figure 58.

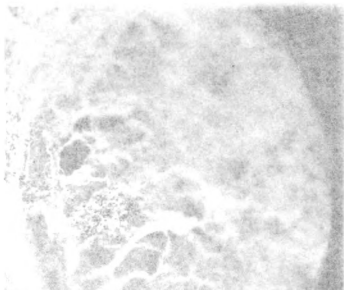


Fig. 59. Case 84. Section showing necrosis of the entire plane of a lobule. Note the edematous and thickened interlobular septum.

130X.

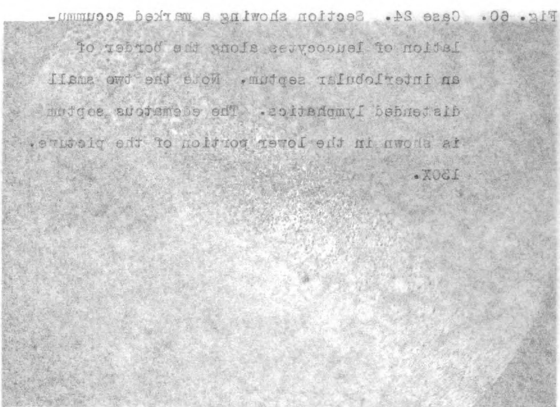


Fig. 60. Case 84. Section showing a marked accumulation of leukocytes along the border of an interlobular septum. Note the two small dilated lymphatics. The edematous septum is shown in the lower portion of the picture.

130X.

Fig. 59. Case 24. Section showing necrosis of the entire plane of a lobule. Note the edematous and thickened interlobular septum. 130X.

Fig. 60. Case 24. Section showing a marked accumulation of leucocytes along the border of an interlobular septum. Note the two small distended lymphatics. The edematous septum is shown in the lower portion of the picture. 130X.

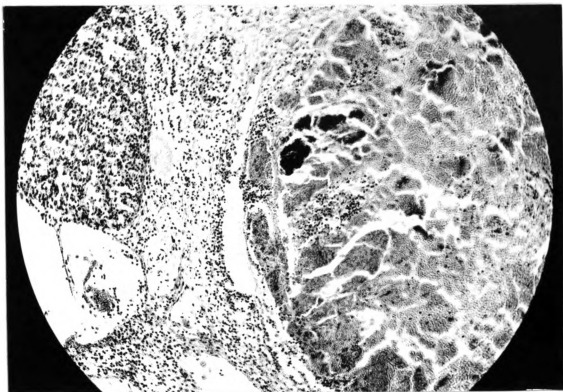


Figure 59.



Figure 60.

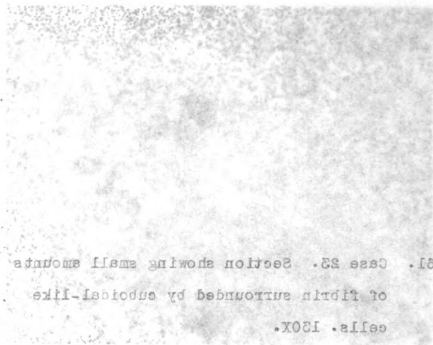


Fig. 61. Case 23. Section showing small amounts of fibrin surrounded by epithelial-like cells. 130X.

Fig. 62. Case 23. Same section as above but higher magnification. 325X.

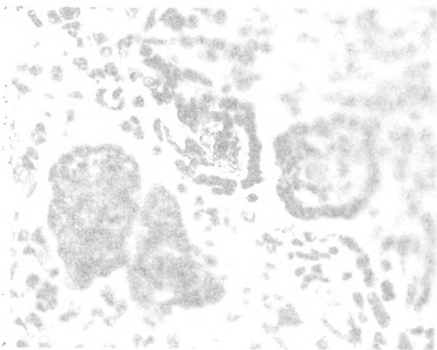


Figure 62.

Fig. 61. Case 23. Section showing small amounts of fibrin surrounded by cuboidal-like cells. 130X.

Fig. 62. Case 23. Same section as above but higher magnification. 525X.

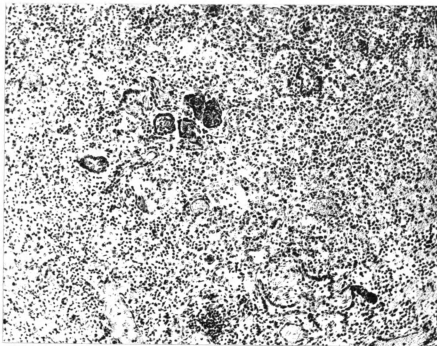


Figure 61.

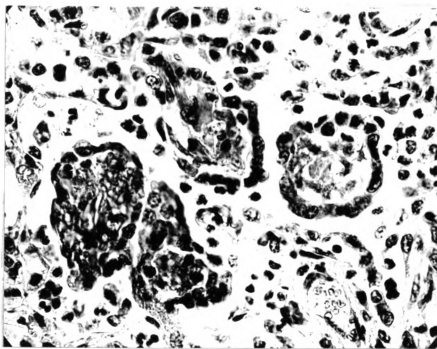


Figure 62.

Fig. 68. Case 5. Section showing a large area of
of myocardial infarction in an anterior
wall. 68X.

Fig. 69. Case 5. Section showing a large area of
myocardial infarction in an anterior
wall. 69X.

Fig. 63. Case 3. Section showing a large number of mononuclear phagocytes in an alveolar sac. 600X.

Fig. 64. Case 23. Section showing alveolus containing many giant cells. 600X.

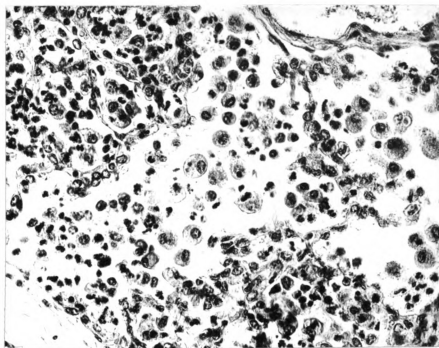


Figure 63.

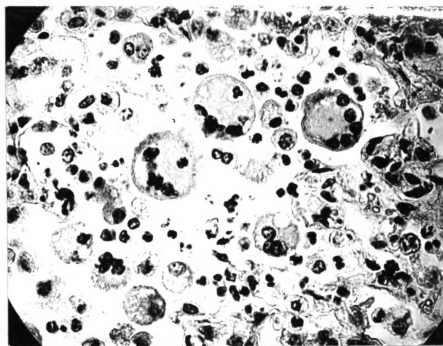


Figure 64.

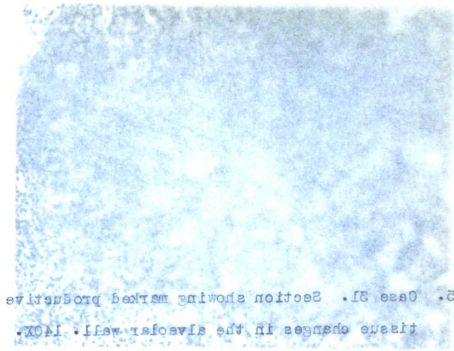


Fig. 65. Case 31. Section showing marked productive tissue changes in the alveolar wall. 140X.

Fig. 66. Case 31. Same section as above but showing an organized exudate in alveolus. 650X.

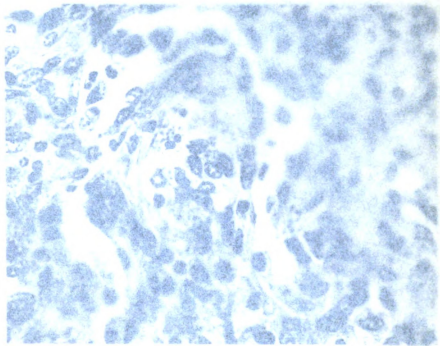


Figure 66.

Fig. 65. Case 31. Section showing marked productive tissue changes in the alveolar wall. 140X.

Fig. 66. Case 31. Same section as above but showing an organized exudate in alveolus. 650X.

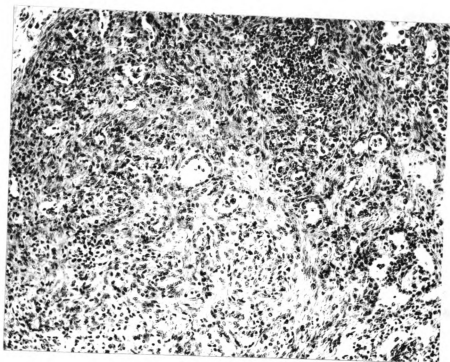


Figure 65.

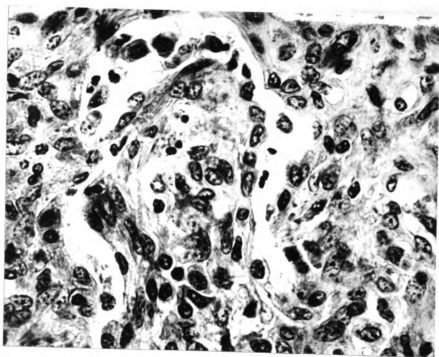


Figure 66.

Fig. 67. Case 31. Section showing an increase in the number of fibroblasts in the alveolar wall.
350X.

Fig. 68. Case 25. A section showing the alveoli

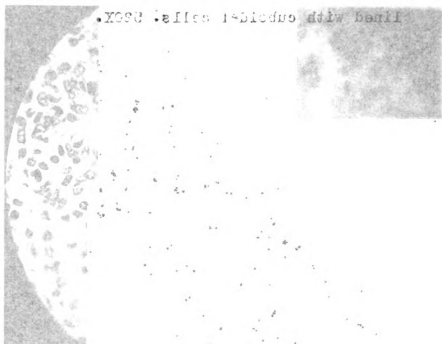


Fig. 67. Case 31. Section showing an increase in the number of fibroblasts in the alveolar wall. 550X.

Fig. 68. Case 25. A section showing the alveoli lined with cuboidal cells. 520X.

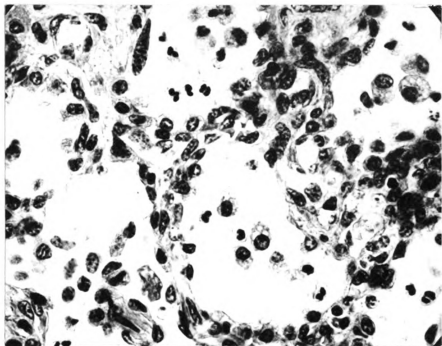


Figure 67.

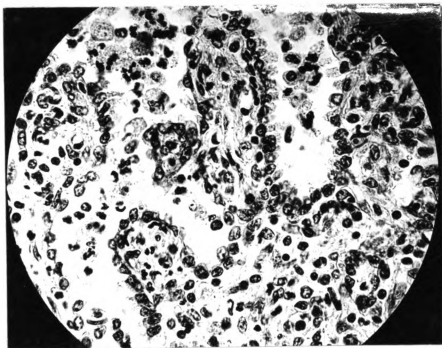


Figure 68.

Fig. 69. Case 28. Section of an alveolar wall showing considerable thickening due to productive tissue changes. 650X.

Fig. 70. Case 31. An area showing distension of one of the lymphatics of an interlobular septum with fibrin and leucocytes. 130X.

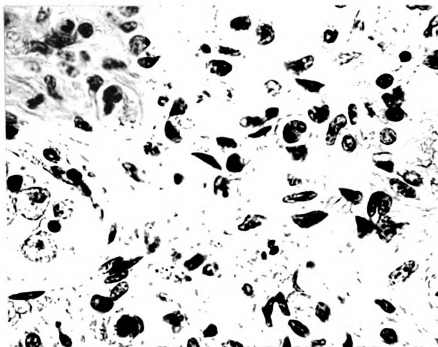


Figure 69.



Figure 70.

Fig. 71. Case 6. A section of a bronchial lymph node showing hemorrhage into the lymph sinuses.
110X.

Fig. 72. Case 12. Photograph of a smear made from a 24 hour broth culture of culture 17.

400X.

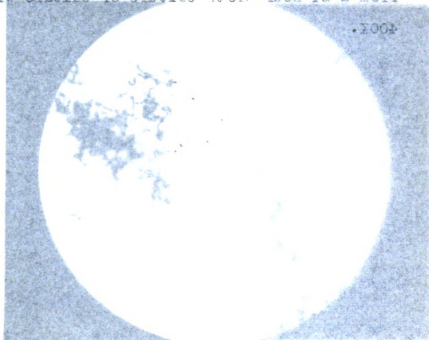


Fig. 71. Case 6. A section of a bronchial lymph node showing hemorrhage into the lymph sinuses.
110X.

Fig. 72. Case 12. Photomicrograph of a smear made from a 24 hour broth culture of culture #17.
400X.



Figure 71.

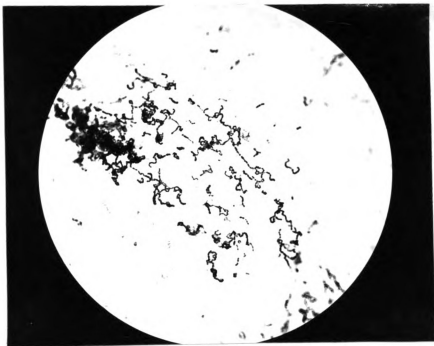


Figure 72.

Fig. 73. Transverse section of the root of the plant.

The root of the plant is shown in the figure. The root is a thick, cylindrical structure with a central axis. The outer layer is the epidermis, followed by the cortex, and the central part is the pith. The root is shown in a transverse section, revealing its internal structure.

Fig. 74. Transverse section of the root of the plant, showing the vascular bundles. The vascular bundles are arranged in a ring around the central pith. Each bundle consists of a large xylem vessel and a smaller phloem vessel. The bundles are separated by bundle sheaths.

Fig. 73. Case 24. Paraffin section of lung stained for bacteria. Note the large number of organisms in pairs and short chains in the alveolar exudate. 600X.

Fig. 74. Case 24. Paraffin section stained the same as above showing a similar condition. 600X.

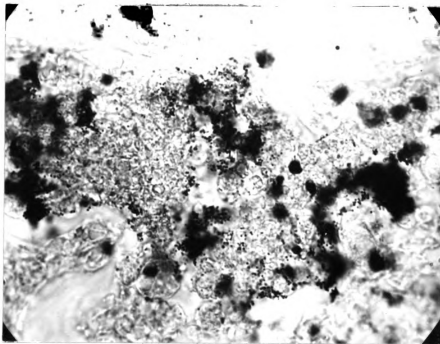


Figure 73.

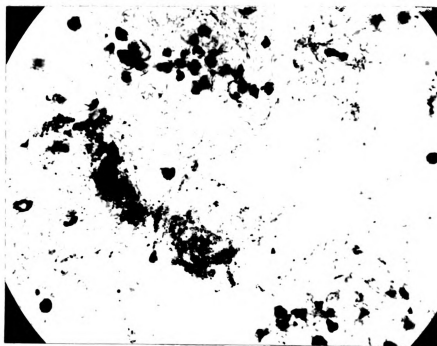


Figure 74.

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ACKNOWLEDGMENTS

It is with pleasure that the writer wishes to express his sincere gratitude to Dr. E. T. Hallman for the encouragement and invaluable assistance extended to this project. He wishes also to express his thanks to Dr. I. F. Huddleson for his most helpful suggestions pertaining to the bacteriological phase of this work, and to Dr. C. F. Clark for the loan of data regarding temperatures and other clinical material used in a number of instances. He is likewise indebted to Dr. L. B. Sholl for his cooperation in the collection of much of the gross material.

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