latter case the patient often passes rapidly beyond treatment, though there are instances of the most profuse hæmorrhage which must have come from a perforated artery or a ruptured aneurism in which recovery has occurred. Practically, for treatment, we should separate these cases, as the remedies which would be applicable in a case of congested and bleeding mucosa would be as much out of place in a case of hæmorrhage from ruptured aneurism as in a cut radial artery. When the blood is brought up in quantities—in mouthfuls at a time—it is almost certain either that an aneurism has ruptured or a vessel has been eroded. In the instances in which the sputa are blood-tinged or when the blood is in smaller quantities, bleeding comes by diapedesis from hyperæmic vessels. In such cases the hæmorrhage may be beneficial in relieving the congested blood-vessels.

The indications are to reduce the frequency of the heart-beats and to lower the blood-pressure. By far the most important measure is absolute quiet of body, such as can only be secured by rest in bed and seclusion. In the majority of cases of mild hæmoptysis this is sufficient. Even when the patient insists upon going about, the bleeding may stop spontaneously. The diet should be light and unstimulating. Alcohol should not be used. The patient may, if he wishes, have ice to suck. Small doses of aromatic sulphuric acid may be given, but unless the bleeding is protracted styptic and astringent medicines are not indicated. For cough, which is always present and disturbing, opium should be freely given, and is of all medicines most serviceable in hæmoptysis. Digitalis should not be used, as it raises the blood-pressure in the pulmonary artery. Aconite, as it lowers the pressure, may be used when there is much vascular excitement. Ergot, tannic acid, and lead, which are so much employed, have, I believe, little or no influence in hæmoptysis. Ergot, according to Bradford, produces distinct rise in the pulmonary blood-pressure. One of the most satisfactory means of lowering the blood-pressure is purgation, and when the bleeding is protracted salts may be freely given. In profuse hæmoptysis, such as comes from erosion of an artery or the rupture of an aneurism, a fatal result is common, and yet post-mortem evidence shows that thrombosis may occur with healing in a rupture of considerable size. The fainting induced by the loss of blood is probably the most efficient means of promoting thrombosis, and it was on this principle that formerly patients were bled from the arm, or from both arms, as in the case of Laurence Sterne. Ligatures, or Esmarch's bandages, placed around the legs may serve temporarily to check the bleeding. The ice-bag on the sternum is of doubtful utility. In a protracted case Cayley induced pneumothorax, but without effect.

Briefly, then, we may say that cases of hæmorrhage from rupture of aneurism or erosion of a blood-vessel usually prove fatal. The fainting induced by the loss of blood is beneficial, and, if the patient can be kept alive for twenty-four hours, a thrombus of sufficient strength to prevent further bleeding may form. The chief danger is the inundation of the bronchial system with the blood, so that while the hæmorrhage is profuse the cough should be encouraged. Opium should not then be used, and stimulants should be given with caution.

In the other group, in which the hæmorrhage comes from a congested area and is limited, the patient gets well if kept absolutely quiet, and fatal hæmorrhage probably never occurs from this source. Rest, reduction of the blood-pressure by minimum diet, purging, if necessary, and the administration of opium to allay the cough are the main indications.

II. PNEUMONIA

(Lobar, Croupous, or Fibrinous Pneumonia; Pneumonitis; Lung Fever).

Definition.—An infectious disease characterized by inflammation of the lungs and constitutional disturbance of varying intensity. The fever terminates abruptly by crisis. Secondary infective processes are common An organism, the *diplococcus pneumoniæ*, is invariably found in the diseased lung.

Etiology.—Pneumonia is one of the most wide-spread of acute diseases. Hospital statistics show that the ratio to other admissions is in the proportion of twenty to thirty per thousand.

It prevails at all ages Children are quite as susceptible to it as adults, and it is the special enemy of old age. Males are more frequently affected than females. Dwellers in cities and persons whose occupations are associated with exposure, hardship, and cold are most liable to the disease. Contrary to the general rule in infectious diseases, newcomers and immigrants seem less susceptible than the native inhabitants. Debilitating causes of all sorts render individuals more susceptible. Alcoholism is perhaps the most potent predisposing factor. Persons weakened by disease are especially prone to it; thus we find many cases in connection with chronic Bright's disease, diabetes, the chronic affections of the nervous system, and protracted fevers. One important predisposing cause is a previous attack. No acute disease recurs with such frequency. Instances are on record of individuals who have had ten or more attacks.

Climate does not appear to have much influence. The disease prevails equally in cold and in hot countries, but it is stated that on this continent it is more prevalent in the Southern than in the Northern States. More important is the influence of season. Statistics everywhere show that more persons are attacked from December to May than in the summer and autumn. Seitz's large statistics of 5,905 cases in Munich give 32 per cent in winter, 36·8 per cent in spring, 15·3 per cent in summer, and 15·7 per cent in autumn. Bell's statistics of the Montreal General Hospital show practically the same distribution, but it is worth noting that during January, the coldest month of the year, in which the mean temperature for ten years was 13·75° F., the percentage was compara-

tively low. January, however, is a month with very slight variations in temperature, and it seems that the sudden changes characteristic of March, April, and May are the important climatic factors which predispose to pneumonia.

Of other factors, cold has been thought to be one of the most important, and for years was regarded as the efficient cause of the disease. Undoubtedly the disease sometimes promptly follows a sudden chilling or wetting, but in a large majority of cases no such history can be obtained.

Pneumonia follows traumatism with great frequency, more particularly injury of the chest. Litten has called special attention to this so-called *contusions-pneumonia*.

A change of opinion has of late taken place as to the nature of pneumonia, which is now almost universally regarded as a specific infectious disease, depending upon a micro-organism. Among general circumstances favoring this view, is the occurrence of pneumonia in *epidemic form*, a fact recognized by Laennec and by Grisolle. Many house epidemics have been described within the past twenty years. On several occasions I have known two, three, and even four persons admitted to hospital from the same house. In 1887, I saw, with Graham, of Toronto, a local outbreak in which three members of a family were consecutively attacked with the most malignant pneumonia. There are instances on record in which as many as ten residents in one house have been attacked. Of late years many epidemics in towns have been reported. Still more striking are the epidemics which have been described in prisons and garrisons, of which one of the most remarkable is that reported by W. B. Rodman, of Frankfort, Kentucky. In one year there occurred in a prison population of 735, 118 cases, with 25 deaths. The prison was much overcrowded at the time. Similar epidemics have been described in Europe. At the penitentiary at Amberg, from the 1st of January to the 1st of June, there were 161 cases of pneumonia with a mortality of over twenty-eight per cent.

The *diplococcus pneumoniæ* of Fraenkel is the most constant organism in lobar pneumonia and is now believed by many competent authorities to be the specific agent of the disease. It is identical with the micrococcus which Pasteur and Sternberg found in the saliva of certain individuals and which produces septicæmia in the rabbit. It occurs occasionally in the nose, the larynx, and the Eustachian tube. According to Netter's observations, it is present in the buccal secretion in twenty per cent of healthy persons. It persists for months or even years in the saliva of persons who have had pneumonia. The researches of Fraenkel, Weichselbaum, Gamaleia, and others show that it is by far the most constant organism in pneumonia and that it occurs in the secondary processes of the disease, such as pleurisy, endocarditis, pericarditis, and meningitis. In ten cases recently examined at the pathological laboratory of the Johns Hopkins Hospital by my colleague Welch, this organism was present in all; in

six as pure cultures in the lung, in four together with pus organisms. In the sputum it may be demonstrated by treating the ordinary cover-glass preparations with glacial acetic acid and then, without washing off the acid, dropping on aniline oil and gentian-violet, which is to be poured off and renewed two or three times. The organism is seen to be a somewhat elliptical lance-shaped coccus occurring in pairs, hence the term diplococcus. It is usually encapsulated.

According to the dominant view, pneumonia is an infective disease caused by this diplococcus, which has its seat of election in and produces its chief effects on the lung, and which can, under favoring circumstances, invade other parts of the body—the pleura, meninges, and endocardium This microbe may possibly attack these parts without the intervention of inflammation of the lung, as it has been found in meningitis and pleurisy independent of pneumonia. It is a wide-spread organism, at times present, as before stated, in the buccal secretions of healthy persons. It is not improbable that the various predisposing causes, such as cold, exhaustion, and debility, lower the vitality and render the individual susceptible, thus changing the character of the tissue-soil so that the virus can grow and produce its specific effects.

On this view, pneumonia may be regarded as a local disease, produced by micro-organisms which induce, as in other local diseases, such as erysipelas and diphtheria, constitutional disturbance of varying degrees of intensity, or even, by the further invasion of the parasites, secondary infective processes in other organs.*

Recently from Leyden's clinic very interesting studies have been issued by the brothers Klemperer on the production of immunity and upon the cure of pneumonia. Immunity is readily obtained in animals either by subcutaneous or intravenous injections of large quantities of the filtered bouillon cultures, or by the injection of the glycerine extract. The immunity, though rarely lasting more than six months, was transmitted to the offspring born within this period. Still more interesting are their observations upon the cure of the experimentally produced disease. They found that the serum and fluids of the body of an animal which had been rendered immune had the property not only of producing immunity when introduced into the circulation of another susceptible animal, but actually of curing the disease after infection had been in progress for some time. In infected animals with a body temperature of from 40° to 41° C., the fever fell to normal in twenty-four hours after the injection of serum of another animal which possessed immunity. They believe that the pneumococcus produces a poisonous albumen (pneumotoxin) which when introduced into the circulation of an animal causes elevation of temperature and the subsequent production in the body of a substance

* See on the question of etiology the elaborate essay of Wells, Journal of the American Medical Association, 1889.

(antipneumotoxin) which possesses the power of neutralizing the poisonous albumen which is formed by the bacteria. In man they hold that during the pneumonic process there is a constant absorption into the circulation of this poisonous albumen produced by the bacteria in the lungs. This continues until eventually the same antidotal substance is produced in the circulation that has been seen to occur experimentally. It is then that the crisis occurs. The bacteria are neither destroyed nor is their power to produce the poisonous albumen lessened, but the third factor, the antitoxic element, now exists and neutralizes the toxic substances as they are produced. They demonstrated that the serum of the blood of patients after the crisis of pneumonia contained the antitoxic substance and was capable, in a fair number of cases, of curing the disease when injected into infected animals. They have made preliminary observations upon patients with a view of inducing the crisis by the injection of the blood serum of persons convalescent from pneumonia, and which consequently contains the antitoxic body. In six pneumonic patients the results were promising. In all there was a decided fall of temperature in from six to twelve hours after subcutaneous injections of from four to six c. c. of the serum. The pulse and respirations were also diminished in frequency. In two cases the temperature fell to 37° C. Twice it fell and remained at normal. In the other cases it fell only temporarily. In two typhoid cases the injections were negative. The serum has no effect when injected into healthy individuals.

Morbid Anatomy.—Since the time of Laennec, pathologists have recognized three stages in the inflamed lung—engorgement, red hepatization, and gray hepatization.

In the stage of *engorgement* the lung tissue is deep red in color, firmer to the touch, and more solid, and on section the surface is bathed with blood and serum. It still crepitates, though not so distinctly as healthy lung, and excised portions float. The air-cells can be dilated by insufflation from the bronchus. Microscopical examination shows the capillary vessels to be greatly distended, the alveolar epithelium swollen, and the air-cells occupied by a variable number of blood-corpuscles and detached alveolar cells. In the stage of *red hepatization* the lung tissue is solid, firm, and airless. If the entire lobe is involved it looks voluminous, and shows indentations of the ribs. On section the surface is dry, reddish brown in color, and has lost the deeply congested appearance of the first stage. One of the most remarkable features is the friability; in striking contrast to the healthy lung, which is torn with difficulty, a hepatized organ can be readily broken by the finger. Careful inspection shows that the surface is distinctly granular, the granulations representing fibrinous plugs filling the air-cells. The distinctness of this appearance varies greatly with the size of the alveoli, which are about 0·10 mm. in diameter in the infant, 0·15 or 0·16 in the adult, and from 0·20 to 0·25 in old age. On scraping the surface with a knife a reddish viscid serum is

removed, containing small granular masses. The smaller bronchi often contain fibrinous plugs. If the lung has been removed before the heart, it is not uncommon to find solid moulds of clot filling the blood-vessels. Microscopically, the air-cells are seen to be occupied by coagulated fibrin in the meshes of which are red blood-corpuscles, polynuclear leucocytes, and alveolar epithelium. The alveolar walls are infiltrated and leucocytes are seen in the interlobular tissues. Cover-glass preparations from the exudate, and thin sections show, as a rule, the diplococci already referred to, many of which are contained within cells. Staphylococci and streptococci may also be seen in some cases. In the stage of *gray hepatization* the tissue has changed from a reddish-brown to a grayish-white color. The surface is moister, the exudate obtained on scraping is more turbid, the granules in the acini are less distinct, and the lung tissue is still more friable. Histologically, in gray hepatization, it is seen that the air-cells are densely filled with leucocytes, the fibrin network and the red blood-corpuscles have disappeared. A more advanced condition of gray hepatization is that known as *purulent infiltration*, in which the lung tissue is softer and bathed with a purulent fluid.

The stage of gray hepatization appears to be the first step in the process of *resolution*. The exudate is softened, the cell elements are disintegrated and rendered capable of absorption. When the purulent infiltration of the lung tissue reaches the grade sometimes seen post mortem, it is probable that resolution could not take place. Small abscess cavities may arise, and by their fusion larger ones. Often in one lung, or even in one lobe, the various stages of the process may be seen, and the passage of the engorgement into red hepatization and of the latter into the gray stage can be readily traced.

The general details of the morbid anatomy of pneumonia may be gathered from the following facts, based on 100 autopsies, made by me at the General Hospital, Montreal: In 51 cases the right lung was affected; in 32, the left; in 17, both organs. In 27 cases the entire lung, with the exception, perhaps, of a narrow margin at the apex and anterior border, was consolidated. In 34 cases, the lower lobe alone was involved; in 13 cases, the upper lobe alone. When double, the lower lobes were usually affected together, but in three instances the lower lobe of one and the upper lobe of the other were attacked. In three cases also, both upper lobes were affected. Occasionally the disease involves the greater part of both lungs; thus, in one instance the left organ with the exception of the anterior border was uniformly hepatized, while the right was in a stage of gray hepatization, except a still smaller portion in the corresponding region. In a third of the cases, red and gray hepatization existed together. In 22 instances there was gray hepatization. As a rule the unaffected portion of the lung is usually congested or œdematous. When the greater portion of a lobe is attacked, the uninvolved part may be in a state of almost gelatinous œdema. The unaffected lung is usually congested, particularly

at the posterior part. This, it must be remembered, may be largely due to post-mortem subsidence. The uninflamed portions are not always congested and œdematous. The upper lobe may be dry and bloodless when the lower lobe is uniformly consolidated. The average weight of a normal lung is about 600 grammes, while that of an inflamed organ may be 1,500, 2,000, or even 2,500 grammes.

The bronchi contain, as a rule, at the time of death a frothy serous fluid, rarely the tenacious mucus so characteristic of pneumonic sputum. The mucous membrane is usually reddened, rarely swollen. In the affected areas the smaller bronchi often contain fibrinous plugs, which may extend into the larger tubes, forming perfect casts. The bronchial glands are swollen and may even be soft and pulpy. The pleural surface of the inflamed lung is invariably involved when the process becomes superficial. Commonly, there is only a thin sheeting of exudate, producing slight turbidity of the membrane. In only two of the hundred instances the pleura was not involved. In some cases the fibrinous exudate may form a creamy layer an inch in thickness. A serous exudation of variable amount is not uncommon.

Lesions in other Organs.—The heart is distended with firm, tenacious coagula, which can be withdrawn from the vessels as dendritic moulds. In no other acute disease do we meet with coagula of such solidity and firmness. The distention of the right chambers of the heart is particularly marked. The left chambers are rarely distended to the same degree. The spleen is often enlarged, though in only 35 of the 100 cases was the weight above 200 grammes. The kidneys show parenchymatous swelling, turbidity of the cortex, and, in a very considerable proportion of the cases —twenty-five per cent—chronic interstitial changes.

Pericarditis is not infrequent, and occurs more particularly with pneumonia of the left side and with double pneumonia. In 5 of the 100 autopsies it was present, and in 4 of them the lappet of lung overlying the pericardium with its pleura was involved. Endocarditis is more frequent and occurred in 16 of the 100 cases. In 5 of these the endocarditis was of the simple character; in 11 the lesions were ulcerative. Fatty degeneration of the heart is not common except in protracted cases.

Meningitis is not infrequently found, and in many cases is associated with malignant endocarditis. It was present in 8 of the 100 autopsies. Of twenty cases of meningitis in ulcerative endocarditis fifteen occurred in pneumonia. The meningeal inflammation in these cases is usually cortical.

Croupous or diphtheritic inflammation may occur in other parts. A croupous colitis, as pointed out by Bristowe, is not very uncommon. It occurred in 5 of my 100 post-mortems. It is usually a thin, flaky exudation, most marked on the tops of the folds of the mucous membrane. In one case there was a patch of croupous gastritis, covering an area of 12 by 8 cm., situated to the left of the cardiac orifice.

The liver shows parenchymatous changes and often extreme engorgement of the hepatic veins.

Symptoms.—Abruptly, or preceded by a day or two of indisposition, the patient has a severe chill, lasting from ten to thirty minutes. In no acute disease is an initial chill so constant or so severe. The fever rises quickly. There is pain in the side, often of an agonizing character. A short, dry, painful cough soon develops, and the respirations are increased in frequency. When seen on the second or third day the patient presents an appearance which may be quite pathognomonic. He lies flat in bed, often on the affected side; the face is flushed, particularly the cheeks; the breathing is hurried; the alæ nasi dilate with each inspiration; the eyes are bright, the expression is anxious, and there is a frequent short cough which makes the patient wince and hold his side. The expectoration is blood-tinged and extremely tenacious. The temperature rises rapidly to 104° or 105°. The pulse is full and bounding and the pulse-respiration ratio much disturbed. Examination of the lung shows the physical signs of consolidation—blowing breathing and fine râles. After persisting for from seven to ten days the crisis occurs, and with a fall in the temperature the patient passes from a condition of extreme distress and anxiety to one of comparative comfort.

The fever of pneumonia rises abruptly with the chill, during which the rectal temperature may be high. In children and in cases without chill the rise is more gradual. The temperature reaches 104° or 105° and is continuous, with a variation of a degree to a degree and a half. If a two-hour record is kept the diurnal variations are seen to follow the normal type. In children and healthy adults the fever is usually higher than in old persons and drunkards. After continuing for from five to nine days the temperature falls abruptly, forming what is known as the *crisis*, so characteristic in a large proportion of the cases. In from five to twelve hours the temperature may fall eight degrees. The crisis may occur as early as the third day or as late as the twelfth or fourteenth. A *pseudo-crisis* may occur on the fifth day or earlier. Defervescence may take place gradually by lysis. In cases of delayed resolution the fever may persist for weeks.

Respiratory Symptoms.—Pain of an agonizing character is an early and distressing symptom. It is usually referred to the nipple or axillary regions of the affected side. In exceptional cases it may be in the abdomen or flank, or even beneath the shoulder-blade. Deep inspiration and cough aggravate it. Dyspnœa is a very prominent feature. The respirations may be from forty to sixty in the minute and in exceptional cases and in children may rise to eighty. To produce this shortness of breath many factors combine—the fever, the loss of function in a considerable area of lung tissue, and the excessive pain in the side, which makes it impossible to draw a deep breath. There may be nervous factors at work, as with the crisis the number of respirations may fall nearly to normal,