while the consolidation of the lung still persists. The type of breathing in pneumonia is peculiar and almost distinctive. The inspirations are

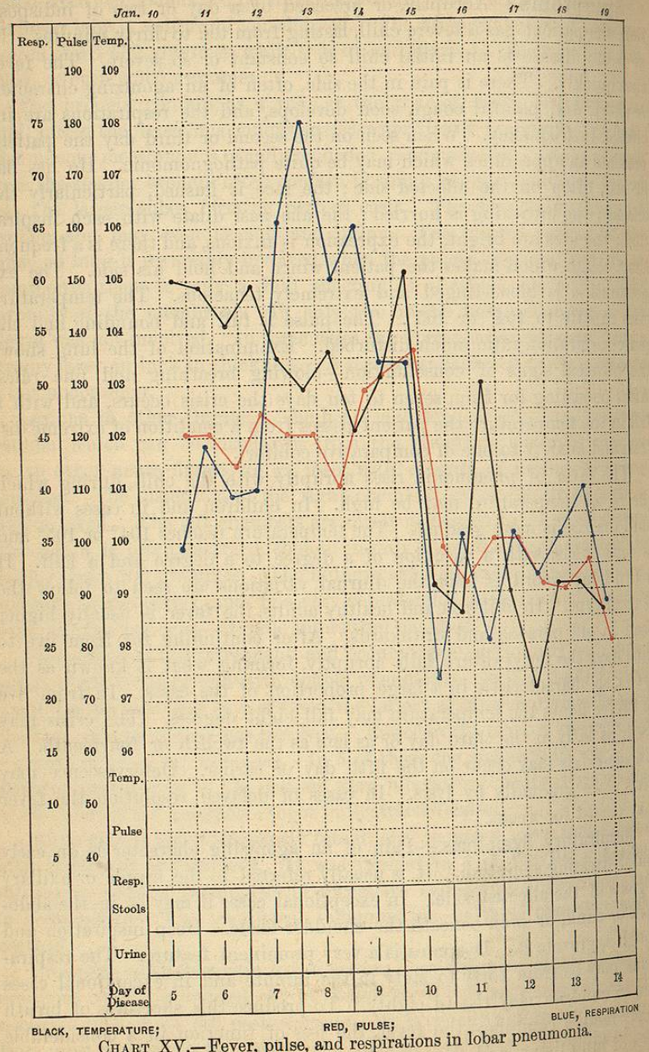


CHART XV.—Fever, pulse, and respirations in lobar pneumonia.

short and superficial. Expiration is often associated with a short grunt. The ratio between the respirations and pulse may be 1 to 2, or even 1 to



1·5. In no other disease do we see such marked disturbance in the pulse-respiration ratio, and this is sometimes an aid in diagnosis.

The cough is also very characteristic—frequent, short, restrained, and associated with great pain in the side. It is at first dry, hard, and without expectoration. In old persons and drunkards and in those debilitated by long illness there may be no cough. The sputum is mucoid at first, but within twenty-four hours shows special features. A brisk hæmoptysis may be an initial symptom. Pneumonic sputum is viscid, tenacious, and blood-tinged. The gummous viscidity, together with the red blood-corpuscles in various stages of alteration, give pathognomonic characters to the sputa, unknown in any other disease. The rusty tinge becomes more marked as the disease progresses, and so tenacious is the expectoration that it has to be wiped from the lips of the patient, and a spit-cup, half full, may be inverted without spilling. Toward the close it becomes more liquid and is more readily expelled. In low types of the disease the sputum may be fluid and dark brown, resembling prune juice. The amount is very variable. In children and old people there may be none; ordinarily, however, there are from 100 to 300 c. c. daily. After the crisis the quantity is variable; abundant in some cases, absent in others. Microscopically, the sputum contains red blood-corpuscles in all stages of degeneration, alveolar epithelium, diplococci and other micro-organisms, cell-moulds of the alveoli, and, in some cases, small fibrinous casts of the bronchioles. The latter are sometimes plainly visible to the naked eye.

**Physical Signs.**—*Inspection* may not at first show any difference between the two sides, though usually if the lower lobe of a lung is involved the movement is less on the affected side. Later, when consolidation has occurred, particularly if it is massive, this deficient expansion is very marked. Mensuration may show a definite increase in the volume of the side involved. The intercostal spaces are not obliterated. Palpation indicates still more clearly the lack of expansion, and a pleural friction may be felt. Tactile fremitus is increased. These signs are all more marked when consolidation is established.

*Percussion.*—In the stage of engorgement the note is higher pitched and may have a somewhat tympanitic quality, the so-called Skoda's resonance. This can often be obtained over the lung tissue just above a consolidated area. When the lung is hepatized, the percussion note is flat, the quality of the flatness varying a good deal from a note which has in it a certain tympanitic quality to absolute dulness. There is not the wooden flatness of effusion and the sense of resistance is not so great. During resolution the tympanitic quality of the percussion note may return. For weeks or months after convalescence there may be a higher-pitched note on the affected side.

*Auscultation.*—Quiet, suppressed breathing in the affected part is often a marked feature in the early stage, and is always suggestive. Very early there is heard at the end of inspiration the fine crepitant râle, a series of

minute cracklings heard close to the ear, and perhaps not audible until a full breath is drawn. Whether this is a fine pleural crepitus or is produced in the air-cells and finer bronchi is still an open question. At this stage, before consolidation has occurred, the breath-sounds may be, as before mentioned, much feebler than in health, but on drawing a long breath they may have a harsh quality, to which the term broncho-vesicular has been applied. In the stage of red hepatization and when dulness is well defined, the respiration is tubular, similar to that heard in health over the larger bronchi. With this blowing breathing there may be no râles, and it may present an intensity unknown in any other pulmonary affection. It is simply the propagation of the laryngeal and tracheal sounds through the bronchi and the consolidated lung tissue. The permeability of the bronchi is essential to its production. Tubular breathing is absent in certain cases of massive pneumonia in which the larger bronchi are completely filled with exudation. When resolution begins mucous râles of all sizes can be heard. At first they are small and have been called the *redux-crepitus*. The voice-sounds are transmitted through the consolidated lung with great intensity. This bronchophony may have a curious nasal quality to which the term ægophony has been given.

**Circulatory Symptoms.**—During the chill the pulse is small, but in the succeeding fever it becomes full and bounding. In cases of moderate severity it ranges from 100 to 116. It is not often dicrotic. In strong, healthy individuals and in children there may be no sign of failing pulse throughout the attack. With extensive consolidation the left ventricle may receive a very diminished amount of blood and the pulse in consequence may be small.

In the old and feeble the pulse may be small and rapid from the outset. The heart-sounds are usually loud and clear. During the intensity of the fever, particularly in children, *bruits* are not uncommon both in the mitral and in the pulmonary areas. The second sound over the pulmonary artery is accentuated. Attention to this sign gives a valuable indication as to the condition of the lesser circulation. With distention of the right chambers and failure of the right ventricle to empty itself completely the pulmonary second sound becomes much less distinct. When the right heart is engorged there may be an increase in the dulness to the right of the sternum. With gradual heart-failure and signs of dilatation the long pause is greatly shortened, the sounds approach each other in tone and have a fœtal character (embryocardia).

*Blood.*—The number of red corpuscles is reduced, but, in consequence of the comparative shortness of the attack, we rarely see the anæmia associated with other febrile disorders. No special changes occur in the corpuscles themselves. The colorless corpuscles are increased in number from about 6,000 per c. mm., the normal number, to 10,000, or even more. This leucocytosis disappears as soon as crisis occurs. Its absence during the fastigium is considered to indicate an unfavorable prognosis. A striking



feature in the blood-slide is the richness and density of the fibrin network. This corresponds to the great increase in the fibrin elements, which has long been known to occur in pneumonia, the proportion rising from four to ten parts per thousand. Hayem describes the blood-plates as greatly increased. The diplococci can very rarely be demonstrated in the blood.

The *gastro-intestinal symptoms* are those associated with an ordinary sthenic fever. Vomiting is not frequent at the outset. There is naturally loss of appetite. The tongue is white and furred, and, in cases of a low type, rapidly becomes dry. Constipation is more common than diarrhœa, which does prevail, however, in some epidemics. The spleen is usually enlarged, and the edge can be felt during a deep inspiration. Except in cases of extreme engorgement of the right heart, the liver is usually not increased in volume.

Among *cutaneous* symptoms one of the most interesting is the association of herpes with pneumonia. Not excepting malaria, we see labial herpes more frequently in this than in any other disease, occurring, as it does, in from twelve to forty per cent of the cases. It is supposed to be of favorable prognosis, and figures have been quoted in proof of this assertion. It may also occur on the nose or on the genitals. Its significance and relation to the disease are unknown. It is scarcely necessary to mention the theory which has been advanced, that it is an external expression of a neuritis which involves the pneumogastric and induces the pneumonia. At the height of the disease sweats are not common, but at the crisis they may be profuse. Redness of one cheek is a phenomenon long recognized in connection with pneumonia, and is usually on the same side as the disease.

The *urine* presents the usual febrile characters of high color, high specific gravity, high density, and increased acidity. The nitrogenous elements, urea and uric acid, are notably increased. The chlorides are absent, or greatly reduced, during the height of the fever—due, it is supposed, to the amount exuded in the hepatized lung. At the crisis there may be marked increase in the amount of urine, which is heavily laden with urates and extractives. When jaundice occurs there is bile-pigment. A trace of albumen is present in a large proportion of the cases. It is rarely of serious significance, and seldom associated with tube-casts.

**Cerebral Symptoms.**—As an initial symptom, headache is common. Consciousness is usually retained throughout, even in severe cases. In children convulsions are common, and in at least one half the cases usher in the disease. There may be violent maniacal symptoms in the adult. I once performed an autopsy in a case of this kind in which there was no suspicion whatever that the disease was other than acute mania. In drunkards the symptoms from the outset may be those of delirium tremens, in which disease it should be an invariable rule, even if fever is not present, to examine the lungs. These patients are apt to wander about, and must

be carefully watched. The preliminary excitement and delirium may give place to hebetude, which deepens to coma. It is not possible to decide in these cases whether meningitis is present or not, since it is usually cortical, and there are no symptoms of pressure on the nerves. In only one of eight instances was there involvement of the base, rendering clear the diagnosis of meningitis. These cases of so-called cerebral pneumonia are frequently associated with very high fever. In senile and alcoholic pneumonia, however, the temperature may be low and yet brain symptoms very pronounced. Mental disturbance may persist during and after convalescence, and insanity develops in a few cases. It is currently stated that apex pneumonia is more often complicated with severe delirium, but it has not been so in my experience.

**Complications.**—Many of these seem to depend directly on the invasion of the body by the diplococci.

As already mentioned, *pleurisy* is an inevitable event when the inflammation reaches the surface of the lung, and thus can scarcely be termed a complication. But there are cases in which the pleuritic features take the first place—cases to which the term pleuro-pneumonia is applicable. The exudation may be sero-fibrinous with copious effusion, differing from that of an ordinary acute pleurisy in the greater richness of the fibrin, which may form thick, tenacious, curdy layers. Pneumonia on one side with extensive pleurisy on the other is sometimes a puzzling complication to diagnose and an aspirator needle may be required to settle the question. The bacteriological examination of the fluid has demonstrated, in a large number of cases, the presence of the pneumococcus. Of late, special attention has been paid to the frequency with which empyema complicates pneumonia. Effusion may not have been suspected during the height of the disease, but after the temperature has been normal for some days a slight rise occurs and the irregular fever persists. Dulness continues at the base, or may have extended. The breathing is feeble and there are no râles. Such a condition may be closely simulated, of course, by the thickened pleural layers which are so commonly found after the pneumonia. The question should be settled at once by the introduction of the needle. It is by no means an uncommon complication, and many cases of empyema supposed to be primary are in reality secondary to a slight pneumonia.

*Pericarditis* is more common in the pneumonia of children, particularly when double, and it is said with the pneumonia of the left side. It was present, as I stated, in five of my one hundred autopsies. Though usually plastic, there may be much serous effusion. There is rarely any difficulty in the diagnosis, but when the pneumonia involves the portion of lung covering the pericardium, there may be difficulty in determining, by physical signs, the existence of fluid. The increase in the dyspnœa, the greater feebleness of the pulse, and the gradual suppression of the heart-sounds will give the most valuable indications. In some instances



the fluid is purulent. Though a very serious event, it is surprising how often recovery takes place even in the most desperate cases of pneumonia complicated with pericarditis. I remember that the late Dr. Murchison some years ago commented upon this feature in a case at St. Thomas's Hospital.

*Endocarditis* is still more frequent, and in my one hundred autopsies was present in sixteen. I called attention in the Gulstonian lectures for 1885 to the great frequency of this complication. Of 209 cases of malignant endocarditis collected from the literature, 54 cases occurred in this disease. Subsequent observations have fully confirmed this statement. It may be said that with no acute febrile disease is endocarditis so frequently associated. It is much more common in the left heart than in the right. It is particularly liable to attack persons with old valvular disease. There may be no symptoms indicative of this complication even in very severe cases. It may, however, be suspected in cases (1) in which the fever is protracted and irregular; (2) when signs of septic mischief arise, such as chills and sweats; (3) when embolic phenomena appear. The frequent complication of meningitis with the endocarditis of pneumonia, which has already been mentioned, gives prominence to the cerebral symptoms in these cases. The physical signs may be very deceptive. There are instances in which no cardiac murmurs have been heard. In others the development under observation of a loud, rough murmur, particularly if diastolic, is extremely suggestive.

Changes in the myocardium are not uncommon, rarely more, however, than cloudy swelling of the fibres; but in some instances there is fatty change.

Ante-mortem heart-clots are rare in pneumonia, even in the extreme grade of dilatation of the right chamber. In not a single instance of my autopsies were there globular thrombi in the auricles or in apices of the ventricles. In protracted cases thrombi occasionally form in the veins. A rare complication is embolism of one of the larger arteries. I saw an instance in Montreal of embolism of the femoral artery at the height of pneumonia, which necessitated amputation at the thigh. The patient recovered.

By far the most important complication is the pneumonic *meningitis*, which varies much at different times and in different places. My Montreal experience is rather exceptional, as eight per cent of the fatal cases had this complication. It usually comes on at the height of the fever and in the majority of the cases is not recognized unless, as before mentioned, the base is involved, which is not common. Meningitis may develop later in the disease and is then more easily diagnosed. Associated as it so often is with ulcerative endocarditis, there may be embolism of the cerebral arteries, inducing hemiplegia. Among rare complications may be mentioned *peripheral neuritis*, of which several instances have been described. I saw one well-marked instance, following pneumonia and influenza, in the

spring of 1890. There was neuritis of the left arm with considerable wasting.

Serious *gastric complications* are rare. A croupous gastritis has already been mentioned. The *croupous colitis* may induce severe diarrhœa. *Jaundice* is one of the most interesting complications of pneumonia and occurs with curious irregularity in different outbreaks of the disease. It sets in early, is rarely very intense, and has not the characters of obstructive jaundice. There are cases in which it assumes a very serious form. The mode of production is not well ascertained. It does not appear to bear any definite relation to the degree of hepatic engorgement and it is certainly not due to catarrh of the ducts. Possibly it may be, in great part, hæmatogenous.

*Parotitis* occasionally occurs, commonly in association with endocarditis.

A rare complication of pneumonia is an *arthritis* resembling rheumatism, which may come on gradually during the disease or in the convalescence.

*Bright's disease* does not often follow pneumonia. Peritonitis is exceedingly rare.

*Relapse* in pneumonia is so uncommon that some good observers have doubted its occurrence. I have never seen an instance in which I was certain that there was a definite relapse. There are cases in which from the ninth to the eleventh day the fever subsides, and after the temperature has been normal for a day or two, a rise occurs and fever may persist for another ten days or even two weeks. Though this might be termed a relapse, it is more correct to regard it as an instance of an anomalous course of delayed resolution. Wagner, who has studied the subject carefully, says that in his large experience of 1,100 cases he met with only 3 doubtful cases. When it does occur, the attack is usually abortive and mild.

*Recurrence* is more common in pneumonia than in any other acute disease. Rush gives an instance in which there were twenty-eight attacks. Other authorities narrate cases of eight, ten, and even more attacks.

Formerly it was much disputed whether ordinary lobar pneumonia ever terminated in pulmonary phthisis. These are really cases of tuberculo-pneumonic phthisis the onset of which may resemble acute pneumonia.

**Clinical Varieties.**—A number of different forms of pneumonia have been recognized, such as malignant, adynamic, bilious, malarial, rheumatic, and the like, but they scarcely require a full description. A malarial pneumonia is described and is thought to be very prevalent in some parts of this country. Although I have seen during the past seven years several hundred cases of malaria and am familiar with the bronchial trouble so commonly associated with it, I have yet to see an instance of pneumonia which seemed in any way connected with paludism. The so-called



rheumatic pneumonia has, so far as I know, no peculiarities; nor has rheumatism, I think, any special relation to the disease. The term typhoid pneumonia is commonly used to designate cases with adynamic symptoms and it is to be distinguished from those cases in which typhoid fever begins with a definite pneumonia, the so-called *pneumo-typhus* of foreign writers.

Epidemic pneumonia is, as a rule, more fatal and may display minor peculiarities which differ in different epidemics. In some the cerebral complications are marked; in others, the cardiac. There may be diarrhœa. The pneumonia which occurs with influenza, and was so common in the last epidemic, presents no special features other than the peculiarities of onset. Perhaps, also, it was more severe and more fatal. In diabetic patients pneumonia runs a rapid and severe course, ending sometimes in abscess or gangrene. In the subjects of chronic alcoholism the onset of pneumonia is insidious, the symptoms may be masked, the fever slight, and the clinical picture may be that of delirium tremens. So latent is the disease in some of these cases that the thermometer alone may indicate the presence of an acute disease.

At the extremes of life pneumonia presents certain well-marked features. It is sometimes seen in the new-born. In *infants* it very often sets in with a convulsion. The summit of the lung seems more frequently involved than in adults and the cerebral symptoms are more marked throughout. The torpor and coma, particularly if they follow convulsions, and the preliminary stage of excitement, may lead to the diagnosis of meningitis. Holt has recently published figures which indicate that lobar pneumonia is not uncommon in infants under two years of age. Pneumonic sputum is rarely seen in children.

In *old age* pneumonia may be latent, coming on without chill; the cough and expectoration are slight, the physical signs ill-defined and changeable, and the constitutional symptoms out of all proportion to the extent of the local lesion.

When pneumonia is prevailing extensively, particularly in jails and garrisons, cases are found which have some of the initial symptoms of the disease—perhaps a slight chill, moderate fever, and a few indefinite local signs. This is the so-called *larval pneumonia*. *Apex pneumonia* is said to be more often associated with adynamic features and with marked cerebral symptoms. The expectoration and cough may be slight. I cannot say that in my experience the cerebral symptoms in adults have been more marked in this form, nor do I think it necessarily graver than if situated at the base.

The creeping or *migratory pneumonia* successively involves one lobe after the other and is a peculiar and well-recognized variety.

*Double pneumonia* presents no peculiarities other than the greater danger connected with it. The term *massive pneumonia* is applied to the rare condition in which not alone the air-cells but the bronchi of the entire