yellow tint of gray hepatization. When such tissue is squeezed a little, a quantity of pus exudes, and the whole is easily broken up into a fatty and granular mass. Not all parts of the inflamed area are equally advanced in suppuration, some parts still preserving the reddish-brown, with here and there a patch of yellow; and others uniformly grayish-yellow, and some still advanced beyond this into a yellowish, almost diffluent mass. The stroma of the lungs yet remains intact, notwithstanding the enormous production of pus-cells. In rare cases a portion of the affected tissue proceeds beyond the stage of gray hepatization, or purulent transformation; the stroma of the lungs yields, becomes disintegrated, and a small purulent collection is formed. A large abscess may be formed by the coalescence of several smaller ones. The collection may be bounded only by disintegrating lung-tissue, or the pus may be inclosed by a limiting membrane, or, in other words, become encysted. The author has seen a case of encysted abscess occupying a part of the middle of the right lung, which had existed for several months without symptoms. They may discharge by a bronchus, or into the pleura, or the pus of the encysted abscess may gradually undergo absorption. The termination by gangrene is much more uncommon than that by abscess, and, when it does occur, signifies a most depraved state of the tissues. The passage of acute into chronic pneumonia is a comparatively frequent occurrence, when the disease is of diathetic origin, especially in strumous subjects, or when a tendency to pulmonary disease exists. When the change to the chronic form takes place, the process of retrograde metamorphosis of the exudation preparatory to its extrusion is arrested; the tissue appears compact, grayish, with here and there dark patches of pigment; the hyperæmia has ceased, and the infiltrated liquid is absorbed. In other cases the whole of the inflamed area does not pass over to the chronic stage; resolution takes place more or less perfectly; the exudation is disposed of in part, but still portions remain, more or less impairing the functions of the part. In other cases the products of inflammation are transformed into caseous matter. This change occurs when purulent transformation has taken place. The pus loses the fluid in which the corpuscles float, and these bodies become fatty, and more or less calcareous matter is mixed up with the fat, the ultimate product being a soft solid, looking like and having the consistence of cheese—whence the term *caseous matter*. It must be stated that this termination to croupous pneumonia is regarded by the best modern authorities as very uncommon, while it is usual to catarrhal pneumonia. All parts of the lung are not equally susceptible to the pneumonic inflammation. The statistics show that the right lung is affected alone in one half of the cases, and as regards the left nearly twice as often, or, to express the relation more definitely, using the statistics of Juergensen—the right lung was affected in 53·7 per cent., the left lung in 38·23 per cent., both lungs in 8·07 per cent. The inferior lobe of the right lung is the point of election, being the seat of inflammation in three fourths of the cases. There are certain consequences which follow on a pneumonia that ought not to be overlooked. When a considerable part of a lung suddenly ceases to functionate, there must be disturbances set up in its fellow. The obstruction to the pulmonary circulation induces over-distention of the right cavities and the veins, and ischæmia of the arteries. The blood displaced from the inflamed part, and which can not circulate through it, induces hyperæmia and œdema of the other lung.

Symptoms.—There are two modes of onset: in the less frequent there has been a day or two of bronchial catarrh and general *malaise*, when some chilliness is experienced, pain is felt in the side, and the disease proceeds in its usual way. In the other and more frequent mode, a decided rigor is the initial symptom—a rigor more severe than in any diseases except malarial fever and pyæmia. Elevation of temperature occurs at once, and by the evening of the first day has reached about 104° Fahr. In infants, instead of chill there may be a violent general convulsion or several of them. The duration of the cold stage is from a quarter of an hour to three or four hours, and during it the thermometer in the axilla notes some slight elevation of temperature, and in a few hours not only is the external temperature high, but the subjective sense of heat is great. The face is flushed, the eyes injected, there are intense headache, severe pains in the back, and muscular soreness in the members. The pulse is large in volume and strong in tension. There is usually a whitish-coated tongue, the appetite is wanting, and the stomach is nauseated, or there are attacks of vomiting on the first day. By the end of the first day, or the beginning of the second, there are rational symptoms which indicate the chest as the seat of the mischief. Pain in the side is experienced, and difficulty of breathing and cough now come on. The pain in the side varies in severity, and indeed is not always present. If the pleura is involved, the pain is more prompt and more acute; if the deepest part of the lung, there may be no pain until the inflammation approaches the surface. The pain is most severe when it is first felt, and then it usually declines. The position of the pain is, as a rule, in the right chest, a little below and external to the nipple, but it may be felt in the lumbar region, in the iliac region, and in the shoulder. When pneumonia has attacked the summit of the lung, or as it occurs in the aged, pain may be absent. Coughing, breathing, especially a deep expiration, increase the pain. Accompanying the pain, or coming soon after it, is dyspnœa; the respiratory acts are more frequent and shallow, reaching as high as thirty or forty per minute, the shallowness being due to the pain caused by full breathing, and by the narrowing of the respiratory field. The flushed, anxious, and somewhat dusky countenance, the working of muscles of respiration merely accessory, and

those of the alæ of the nose, make up an expression which has been called *facies pneumonica*. The cough, which appears on the first or second day, is very characteristic ; it is husky, suppressed, and painful. At first there is brought up a little frothy mucus, but on the third day there appear the sputa characteristic of this disease ; thick, viscid material like that which is poured out and coagulates in the alveoli and bronchioles of the lung. The sputum also contains blood-corpuscles intimately incorporated with the viscid albuminous matter, but in varying proportion of coloring, from a light brick-red to a brownish-black. So tenacious and adhesive is the sputum that it remains adherent to the bottom of the vessel if turned over, and if a considerable quantity is collected in a vessel it presents a jelly-like appearance of consistency. The blood is not always mixed with the sputa at first, but the peculiar characteristics of the expectoration are in other respects present, the blood appearing in four or five days. In some debilitated subjects—for example, the subjects of chronic alcoholism—the expectoration is thinner and more abundant, presenting an appearance like prune-juice, whence the name *prune-juice expectoration*—an ill-omen. Again, there may be no expectoration at all, which is sometimes the case in very adynamic states, and in pneumonia of the apex. There are also present in the sputa casts of the finer bronchi. The sputa should be agitated with water, and the grayish, undissolved particles should be fished out and then be put under the microscope. They are fibrous in structure, cylindrical, and branching. As has been stated, the maximum temperature is soon attained. On the evening of the first day it may reach 104° Fahr. (axillary), and for several days it continues at about 103°, 104°, or even 105°, there being a slight morning remission and evening exacerbation. The fever pursues this course with little variation in favorable cases, until the period of crisis, when just before the defervescence a rise may take place. This rise in temperature in anticipation of the crisis is usual but by no means invariable. The pulse during the stage of hyperæmia is about 100—full, hard, and strong ; but, as consolidation takes place, if extensive or extending widely, a change occurs in the pulse ; it becomes less full, and, when the ischæmia of the arterial side has reached the lowest point, the pulse is small, soft, and weak, and the superficial veins are abnormally full and prominent. The skin, during the time of greatest fever, is mordicant, or burning-hot, and is dry or

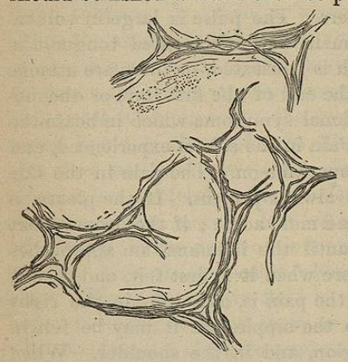

Fig. 29.—Fibrous Tissue in Sputa. (Beale.)

covered with a warm perspiration. If the skin is relaxed, dusky, cool, and covered with a cold sweat, the condition is unfavorable.

If the inflamed area is deeply situated and surrounded by healthy lung-tissue, the reactions produced on palpation and percussion are modified. On palpation the resistance is increased if the inflamed lung is exterior ; not affected, if within. The vocal fremitus is somewhat increased. The sonority is diminished when the lung is consolidated ; it is exaggerated when there is a layer of lung-tissue containing air overlying a consolidated area. Again, the sonority is exaggerated, or tympanitic, when in the beginning of the inflammation the lung still contains some air. The sound continues somewhat tympanitic in quality about the consolidated portion of the lung at the maximum. With the progress of the exudation, and when the peripheral portion of the lung is involved, there is greatly increased resistance, and the percussion-note over the inflamed area is flat, with still something of the tympanitic quality. The vesicular murmur becomes more and more feeble as the air less and less distends the alveoli. Within twenty-four to thirty-six hours there is heard, with or at the end of inspiration, a fine crackling sound over the region inflamed—the *crepitant râle*. This is wrongly said to be pathognomonic, since it occurs in acute tuberculosis, œdema of the lungs, etc. ; but it is highly significant in that it is audible in so few conditions, and occurs in pneumonia over a restricted area. This *râle* has been compared to the sound produced by rubbing a lock of hair between the fingers in front of the ear, to the burning of some grains of salt on live coals, but it is most perfectly imitated by the crackling made by India-rubber sponge when pressed and allowed to expand in front of the ear. As the sound is produced by the separation of the bronchioles and alveoli, adherent by the viscidity of the albuminous exudation, it is obvious that it can occur only during inspiration. When consolidation takes place, the crepitant *râle* ceases, but can be heard in the neighboring parts of the lung undergoing the same process. Again, it becomes audible when the stage of resolution is reached. It is then known as *crepitatio redux*, but it then differs somewhat in quality, and is coarser and louder. The crepitant *râle* in children and old subjects is much like the crepitation redux. This *râle* is audible for a brief period only, during the stages of engorgement and exudation ; presently the vesicular murmur ceases altogether ; the respiration becomes sibilant, then blowing, and on the third day bronchial breathing and bronchial voice come on. The conductivity of the lung being increased by consolidation, the sound produced by the vibration of a column of air in the larger bronchi is communicated directly to the ear—whence the term bronchial breathing. The voice-sounds are communicated with equal distinctness to the ear from the larger bronchi—whence bronchial voice. When the lung-tissue is consolidated, the disease is at its maxi-

mum ; there may be an extension of the area of inflammation in all directions, but the symptoms continue with uniform intensity for several days. We must now return to the rational symptoms and follow their development up to the period of crisis. The fever continues pretty uniformly at the point already mentioned, 102°, 103°, 104°, or 105°—there being a morning remission of less than a degree. The pain in the side lessens or ceases altogether. The decubitus is toward the right with the body flexed, so as to relax the muscles of the affected side, and thus take the pressure off ; but the dyspnœa is less, because, the pain having declined, the respiration is free, but there is still some difficulty in respiration. The cough is more or less troublesome, and the characteristic rusty expectoration, or the more abundant "prune-juice," is brought up with every effort. Sometimes the expectoration is hæmorrhagic, and several ounces may be discharged at a time. The smallness of the pulse and feebleness of the cardiac impulsion are due to ischæmia of the arterial side, as has been pointed out ; on the other hand, this state of the circulation may be largely due to depression of the forces. If the area involved in the inflammation is not very large, the pulse may continue full and strong up to the crisis ; if this area is large and extending, then the fullness of the venous system and the emptiness of the arterial will have the effect just stated over the circulatory system ; consequently, the condition of the circulatory system will afford valuable information in respect to the extent of lung-tissue involved in inflammation. A rapid and weak pulse—120, 130, 140—irregularities in the rhythm, and unequal filling of the artery, are very ugly symptoms, denoting cardiac failure. Delirium is a result of the diminished arterial supply and the venous stasis of the brain ; there may be merely hallucinations or illusions, or noisy and violent delirium. Mental disturbance is more especially present in the cases of pneumonia occurring in drunkards ; delirium tremens too often masks so completely the pulmonary symptoms that they are overlooked. In such cases, the pneumonia is the disease, and the delirium tremens the symptom or complication, instead of the reverse. The obstruction at the lungs and the consequent venous stasis affect other organs besides the brain. The liver is congested, and jaundice, more or less decided, is present in many cases, whence the name bilious pneumonia. Again, the pneumonia of malarious regions is so often modified by malarial infection that the biliary disturbance may be either caused or increased by this influence. Furthermore, an accompanying gastro-duodenal catarrh may, by an extension of the catarrhal process to the bile-ducts, set up a catarrhal jaundice. All of these influences coinciding, the biliary disturbance may enter largely into the symptomatology and therapeutics of the case. Very rarely a case of pneumonia may be complicated by acute yellow atrophy. The urinary secretion is altered in quantity and in composition ; the quantity is reduced ; the urea and uric acid are increased, and the chlorides are much diminished or disappear entirely. The chlorides are diverted to the inflamed part and from the urine, so that the return of the chlorides (chloride of sodium chiefly) to the urine signifies the cessation of the inflammation. So sensitive is this indication, that the return of the chlorides to the urine may precede for some hours the physical and rational signs which indicate the beginning of resolution. In consequence of the venous stasis, the hyperæmia of the kidneys may induce albuminuria, and the urine may contain also cast-off epithelium of the tubules, but the albuminuria is a transient state. It should be noted also that, during albuminuria, pneumonia arises as a complication, and not unfrequently a fatal one.

Pneumonia is one of the few diseases terminating by crisis. The critical phenomena consist in a sudden decline of temperature by crisis or lysis, and the occurrence of some special evacuation, as a large urinary discharge, a profuse diarrhœa, general sweating, an herpetic

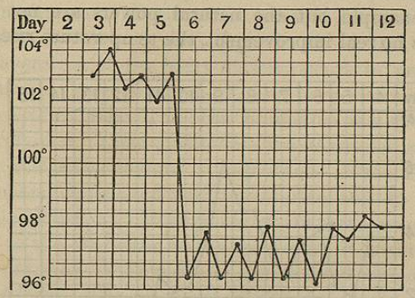

Fig. 30.—Temperature of Uncomplicated Pneumonia of Right Lung. Termination by Crisis.

eruption, or considerable expectoration. The return in a few hours to the normal temperature or below it is the most conspicuous of these phenomena. As has been narrated, just before the defervescence, the temperature may rise higher than it had been, and the aspect of the case appear more formidable ; then the decline begins, and within twelve hours the normal or somewhat below is reached, or, if by lysis, the descent to normal occupies two or three days. The change thus wrought in the aspect of the patient is most remarkable. The countenance clears up, the difficulty of breathing subsides, the pulse falls to seventy, to sixty, even to forty per minute, and an herpetic eruption appears on the lips ; appetite returns, the skin is covered with warm perspriation, the urine increases in amount, the chlorides reappear, and the patient experiences an internal sense of well-being. The physical are in accord with these rational signs : moist sounds now appear in the bronchical tubes, and the sputa become lighter in color, and

an abundant expectoration of grayish-yellow muco-pus takes the place of the rusty sputa; *crepitatio redux*, coarser than *crepitatio indux*, appears along the outer border of the consolidated area; bronchophony is succeeded by a softer blowing sound; the flatness is now dullness, with more of the tympanitic quality, and the vocal fremitus is less decided. Careful examination of the sputa during the stage of resolution will disclose the presence of the fibrinous casts of the finer tubes, already described, and small masses, remains of the coagulated exudation in the air-sacs. The alveoli are gradually opened up to the admission of air, and under favorable circumstances the restoration of the lung is complete in a few days. In some unhealthy subjects, the victims of a diathesis, and sometimes those whose vital forces have been reduced by depressing treatment, repair is incomplete, and the affected part lapses into the chronic state. When the course is not toward crisis and health, there may be abortive attempts at crisis; there may be some considerable subsidence of the temperature, an illusive appearance of a critical evacuation in the way of an exhausting diarrhœa, for example, but the natural powers are not equal to the effort; there is no real improvement, the temperature rises even higher

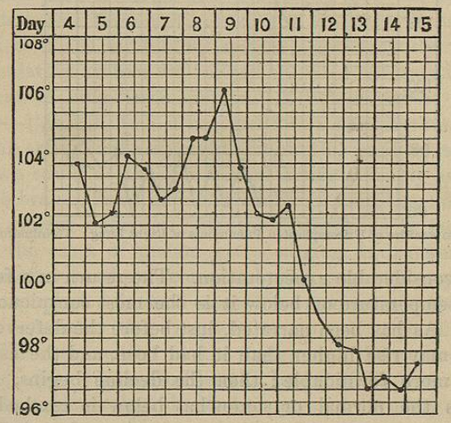

FIG. 81.—Temperature of Uncomplicated Pneumonia terminating by Lysis.

than before, and all of the symptoms develop new severity. The pulse declines in strength and volume and becomes very frequent, the dyspnœa increases, and an adynamic state, in which the tongue is dry, the face cyanosed, the breathing quick and shallow, and the debility great, supervenes. If delirium had existed before, it now assumes more of the low-muttering character; if it had not existed before, it is now apt to come on in the form of hallucinations; there are increasing somnolence and a tendency to coma as the venous stasis and carbonic-acid poisoning increase, and finally a condition of more or less profound coma ushers in death.

Complications.—Pleurisy is a frequent complication, the two diseases occurring together in from ten to twenty per cent. A more acute pain and the usual signs of effusion are the only evidences of the existence of pleuro-pneumonia. The effusion must amount to six ounces to be detected with certainty (Juergensen). If there be extensive consolidation, the effusion must be proportionally small. Pleuritis is ascertainable with certainty only if there be sufficient effusion to displace the heart. The existence of pleuritis does not modify the course and behavior of the pneumonia itself, but the situation is rendered more grave by the simultaneous development of the two diseases. Capillary bronchitis is a very dangerous complication of croupous pneumonia, and may so conceal the latter as to appear as a case of catarrhal pneumonia. Emphysema is an occasional complication; it should be stated, however, that pneumonia is an ordinary mode of termination of emphysema. Pericarditis is more frequently a complication of pleuritis, but it may also occur in the course of pneumonia. Granular degeneration of the heart-muscle occurs in pneumonia when the temperature is persistently high, and is a serious complication. The occurrence of jaundice has been alluded to as a symptom, and its mechanism explained. That pneumonia is a disease of great frequency and fatality in malarious regions is undoubted. Rheumatism and gout are also frequently associated with pneumonia, and to these may be added acute alcoholismus. Pneumonia of diathetic origin is severe or not according to the character of the diathesis; it is very fatal in the alcoholic, but not more so than the uncomplicated malady in the rheumatic or gouty form. The existence of a *typhoid pneumonia* is pretty generally admitted, but on questionable evidence. Pneumonia is an occasional complication of typhoid fever, but it is not a typhoid pneumonia. This term is applied to a form of pneumonia occurring in the weak and debilitated, and has therefore a specially adynamic character. There is not the fever process which we designate typhoid; there exists a pneumonia to which a specially adynamic character has been imparted by the depressed state of the vital forces. The term has been so far generalized that, in many places, every severe case of pneumonia is called typhoid pneumonia.

Course, Duration, and Termination.—Croupous pneumonia is a well-defined, self-limited disease, which passes through its several stages with considerable uniformity. The stage of congestion or engorgement occupies the first twenty-four to thirty-six hours; the stage of exudation or red hepatization—that period occupied by the pouring out and coagulation of the exudation—continues up to the crisis, which marks the beginning of the next stage. The crisis in pneumonia

occurs somewhere from the fifth to the eleventh day of the disease, so that the exudation stage lasts from two to eleven days. The stage of resolution begins with the phenomena of the crisis, and lasts two to four days till convalescence is established. In rare cases (abortive forms) critical phenomena may occur even earlier than the fifth day. In the largest number the crisis begins on the seventh day, and, according to Traube, always on the odd days, reckoning from the day of the initial chill, but if we except the seventh day the statement of Traube must be denied. The stage of purulent transformation is not distinctly separated from the stage of exudation or red hepatization, unless the occurrence of an abortive attempt at crisis fixes the period. It begins about the middle of the second week, and continues for several days to a week. The whole course of pneumonia is therefore comprehended within three weeks, but favorable cases may terminate in two weeks. The mortality from pneumonia has been and continues to be a subject of warm discussion on the part of those who advocate some special plan of treatment. Accuracy in diagnosis and skill in treatment are such uncertain elements in the statistics of mortality, under different plans of treatment, that but little reliance can be placed on the statistical method as applied to therapeutical questions. According to the most approved of the modern methods, the mortality ranges from five to twenty-five per cent. In determining a fatal result in croupous pneumonia, so much depends on the condition of the individual attacked, or the diathesis with which his system is tinctured, that no comparison of systems of treatment can be accurate that does not take note of them. Death is usually due to collapse—that is, cardiac failure, and obtunding of the nervous centers. This state is not necessarily caused by purulent transformation—it may be due to failure of heart, and lungs, and brain, before the end of the stage of red hepatization. Death may be caused by the mere extent of the lesions in the lungs, inducing asphyxia; these lesions consisting not only of localized pneumonia, but also of collateral hyperæmia and œdema. The effects of the pulmonary changes are enhanced by the stasis in the cerebral veins and ischæmia of the arteries, and by cardiac paresis. In subjects extremely delibitated, the tissues in a scorbutic state, the termination may be by gangrene, but this is extremely rare. The formation of an abscess is also rare, but is more common than gangrene. An example of encysted abscess which had been carried many months has been mentioned; usually the abscess formed during the stage of gray hepatization terminates in a short time by discharge either into the pleural cavity or into a bronchus. The presence of a quantity of the elastic tissue of the lungs in the sputa and the occurrence of repeated rigors and profuse sweats indicate the formation of the abscess. If it become encysted, just as is the case in abscess in the liver or in the brain, the acute symptoms subside, the fever

falls, the rigors and sweats cease, but yet some unfavorable symptoms continue—there are cough, fever, dry tongue, emaciation, and weakness, and the appropriate physical signs. In a variable period the abscess terminates in some of the modes already described. The termination may be in the chronic form. There are then no critical phenomena; the fever gradually diminishes, but does not cease; the difficulty of breathing lessens, but there is more or less embarrassment on making any effort; the cough also continues, and muco-pus and fibrous tissue are expectorated; the weakness and emaciation do not improve if the decline does not go on, and the physical signs of condensation of the pulmonary tissue remain. The subsequent behavior is influenced by the local condition and the direction taken by the products of inflammation. There may ensue a gradual liquefaction of the exudation, its softening and extrusion may be effected without much damage to the pulmonary parenchyma, and after some months a cure be effected. On the other hand, the exudation may undergo caseation, with the usual history of pulmonary consumption. The caseation of the inflammatory products of croupous pneumonia is held to be doubtful by many, and is not regarded as common. The clinical history is that of caseous pneumonia, and need not be discussed until that subject is reached. Finally, death may be caused by one of the complications, as pericarditis.

Diagnosis.—Ordinary well-defined cases are recognized without difficulty; it is the obscure or anomalous forms that occasion mistake. Pleurisy with effusion is very frequently confounded with pneumonia. They are differentiated by the following points: The onset of pneumonia is sudden, by a rigor, and followed by a high temperature—pleurisy begins more gradually, there is chilliness for a day or two, and the rise of temperature is gradual; in pneumonia, the pain is rather dull, or a feeling of soreness diffused over a considerable space—in pleurisy, a sharp stitch, which can be covered by a finger; in pneumonia, there is audible, on inspiration only, a crackling sound, the crepitant *râle*—in pleurisy, the friction-sound, synchronous with the respiratory movements; in pneumonia, the crepitant *râle* is succeeded by bronchophony, which continues—in pleurisy, when the effusion partly compresses the lung, a modified bronchophony, but, when the lung collapses, all voice and breath sounds cease; in pneumonia, the dullness has a tympanitic quality, and is fixed in position—in pleurisy, the dullness is flat, and changes with the gravitation of the fluid; in pneumonia, the organs retain their position—in pleurisy, the heart is pushed aside and the liver downward by the effusion; pneumonia is self-limited, and terminates by crisis—these phenomena are wanting in pleurisy, the duration of which is indefinite; subsequent to the crisis, the behavior of the two diseases is so different that further comparison is unnecessary. Next to pleuritis with effusion, pneumonia is confounded with catarrhal pneumonia. They differ in onset