given ; but as so much obstruction exists in the lung, and as there is also ischæmia of the arterial system, its use is doubtful.

GANGRENE OF THE LUNG.

Definition.—*Gangrene* is the same morbid process, whether occurring in the lung or elsewhere. Gangrene of the lung, therefore, means the death and decomposition of a greater or less portion of the lung-tissue.

Causes.—Sex exercises an important influence, since somewhat more than two thirds of the cases occur in men. Although it may happen at any age, it is more common from puberty to middle life. A lowered condition of the vital forces, such as is produced by abject poverty and its attendant miseries, seems necessary to the result. Interruptions to the blood-supply, as elsewhere, may induce gangrene. Thus it occurs in cases of pneumonia, hæmorrhagic infarctions, catarrhal pneumonia, etc. ; but a depressed bodily state is necessary, such as exists in drunkards who are ill fed and exposed to cold and wet. Gangrene may be due to the so-called blood-diseases—as typhus, diabetes, small-pox, measles, etc.—but a low state of the tissues or a depressing cachexia must coincide, the lung becoming the seat of the morbid process because invited by a local malady, such as pneumonia. The deposit in the lung of septic and decomposing materials, as septic or infective emboli, will set up a destructive inflammation terminating in gangrene. Putrefactive decomposition in the neighborhood of the lungs, the penetration of the organ by cancer-masses, or the lodgment of foreign bodies, may give rise to a gangrenous inflammation. Lastly, gangrene may be due to traumatism, or to penetrating wounds of the chest.

Pathological Anatomy.—Gangrene may attack any part of the lung, but the upper lobe is more often the seat of it than the inferior. It occurs in two forms, of circumscribed, of diffused—the former being well defined and strictly limited, the other not separated by any defined border, but spreading into the surrounding lung-tissue. The circumscribed form attacks by preference the outer portion of the lung, and may or may not include the pleura. There may be several of the gangrenous spots, which vary in size from a pea to an orange, or even larger, and they occur rather more frequently in the right lung. The borders are clearly marked, the surrounding tissue being hepatized or œdematous. According to the time at which the masses are examined, they are firm, dry, almost black or soft, diffluent, greenish, or brownish, decomposing and offensive masses traversed by large vessels not destroyed, and by bronchi, opened by ulceration, through which the liquid and softened *débris* are discharging. Gradually sloughing off after evacuation by the bronchi, there may be an attempt at repair, the spread of the decomposition being prevented by the formation of

a dense, tough, and rather hyperæmic connective-tissue membrane. A complete recovery can only occur when the gangrenous mass is small and communicates with a small bronchus. The membrane lining the cavity, formed as just described, pours out a quantity of ichorous pus, which serves to spread the morbid process. When the cavity is small enough to close and heal, granulations are thrown out, the walls approximate, and healing takes place, a cicatrix remaining. The ichorous pus poured out from the so-called pyogenic membrane sets up a destructive inflammation of the bronchial mucous membrane, which softens and is detached, and excites attacks in the dependent parts of the lungs of broncho-pneumonia, which pursue the same course. If situated at the periphery of the lung the softening may involve the pleura, and the decomposing materials be discharged into the pleural cavity, exciting a violent pleuritis and a pyopneumothorax, if a bronchus is at the same time opened. It is a remarkable fact that a limiting pleuritis may confine the inflammation to a small extent of the membrane, perforation of the thorax ultimately ensue, with a termination in recovery. In a few cases the pus has dissected downward along the sheath of the psoas muscle and opened externally at the groin. The diffused form may, as has been shown, arise from the circumscribed by an extension of the morbid process through the distribution of the ichorous pus from a gangrene cavity. But the diffused form usually has its origin in an inflammation proceeding from a gangrenous cavity, or from a case of purulent infiltration of pneumonia. The tissue affected with the gangrenous inflammation rapidly breaks up into shreds of decomposing materials, infiltrated with a brownish or blackish fetid fluid, and the morbid process spreads into the surrounding tissue, hepatized and œdematous, without any defined boundary. In a short time much of the upper lobe may be in a gangrenous state, and the whole of it, indeed, may be involved. In both forms the spread of the gangrene may be too rapid to permit the vessels to be closed, and hence there may be formidable or fatal hæmorrhage. Metastatic abscesses may form in various organs, from infective emboli proceeding from the veins of the gangrenous parts.

Symptoms.—Gangrene of the lung being usually a secondary disease, the symptoms proper to the gangrene are obscured by the associated malady ; and there are great variations at different periods. Before communication is established with a bronchus, when the diagnosis is rendered certain by the character of the expectorated matters, the only symptoms are, a sudden depression of the powers of life, changes in the character of the existing fever, and a very high range of temperature. The symptoms become characteristic only when the sputa contain the materials of the gangrenous decomposition. The sputum is a sanguinolent, sanious, or sero-mucus fluid, of brownish dark-green, or even blackish tint, having a horribly fetid odor, compounded

of decomposing animal matter and fæces, and so sickening that the patient himself as well as those about him is nauseated by it. That the odor is due to foul gases is evident from the fact that the breath on forced expiration is full of the odor, and the sputa allowed to stand cease after a time to have the smell. The odor may precede the expectoration, and may disappear for a time, to reappear again. The sputa on standing separate into three distinct layers: the uppermost, frothy, of a dark, greenish-yellow color, is composed of muco-pus chiefly; the middle layer is sero-albuminous and translucent; the lowest layer contains a sediment, greenish or brownish in color, with yellow or brownish flakes and masses of decomposing lung-tissue. Again, the sputa may be made up largely of black blood, in a decomposing state (Hertz). Chemically, the sputa have an alkaline reaction, and contain valerianic acid, the fat acids, leucin and tyrosin, triple phosphate, and other products of decomposition. During the process of development of the gangrene, the symptoms indicate the existence of a grave disorder. The elevation of temperature may be very considerable, but the thermal line is that of septicæmia: irregular chills, high fever, and profuse sweats. The complexion is fawn-color, livid, the expression anxious, the face sunken, the skin relaxed, the pulse quick and feeble, and the respirations are hurried and catching. There is usually severe pain in the side, and the decubitus is toward and on the affected side. There is an incessant and very painful suppressed cough. Copious pulmonary hæmorrhage may and usually does take place, started by the coughing. The fetid expectoration is apt to be swallowed, and excites by its presence nausea, vomiting, and diarrhœa, but the absorption of putrid matters and the congestion of the portal circulation will also cause watery and fetid stools. The operation of these causes rapidly exhausts the vital powers, and the patient lapses into a condition of profound adynamia. The physical signs are such as pertain to changes in the density of the pulmonary tissue. On percussion, the sonority of the chest is lessened in proportion to the extent of the solidification, but, as there is more or less pulmonary tissue still pervious to air about the gangrenous portions, the dullness has somewhat the tympanitic quality. On auscultation, coarse *râles*, mucous and submucous, are audible, and there are bronchial breath and bronchial voice. After the softening and extrusion of the gangrenous portions, the physical signs will correspond, and the symptoms of a cavity will be present.

Course, Duration, and Termination.—The course of the disease is so largely affected by the morbid condition on which it is ingrafted that no defined plan can be laid down. The circumscribed form is slower in development, and the symptoms are less formidable, than the diffused, and its duration is therefore longer. In those cases which tend to cure by the extrusion of the gangrenous mass through a bronchus, or by

establishing a fistulous communication externally, the duration is protracted, and not to be expressed with definiteness, because so much depends on the vital resources, and on the size of the gangrenous patch. The cases of partial recovery in which there is a cavity lined by a pyogenic membrane continue for months; but every now and then fresh inflammation arises, more tissue is destroyed, until death finally ensues. The usual termination is in death, after two or three or even six weeks of the circumscribed form, and in a week or two of the diffused form. Certain accidents may occur which will materially abbreviate either, as hæmorrhage, perforation of the pleura, etc. The causes of death are various—pleuritis, peritonitis, hæmorrhage, exhaustion, etc. Perforation of the pleura may cause death by the intermediation of pyopneumothorax, sudden distention of the cavity, severe dyspnœa, and collapse; or it may cause a fistulous communication, emphysema of the connective tissue, and exhaustion, the fistula discharging ichorous serum and the foul-smelling products of gangrenous decomposition. Perforation of the diaphragm and purulent peritonitis may be a cause of death. The prognosis is, of course, exceedingly grave.

Diagnosis.—It must be obvious that a diagnosis of gangrene of the lung is not possible when the mass affected does not communicate with a bronchus. Fetor of the breath is, of course, the first indication, but this is not pathognomonic by any means. As the pus in cavities and of dilated bronchi may by decomposition become fetid, and as bits of decomposing lung-tissue are cast off in the sputa, fetor of the sputa as a means of diagnosis must be accepted with limitations. The diagnosis, under these circumstances, must rest largely with the clinical history, the severity of the symptoms, and the duration. Those familiar with the character of the odor in gangrene will recognize its penetrating power and intensity, as compared with the much feebler odor in putrid bronchitis and in bronchiectasis. All of the symptoms in gangrene of the lung are much more active and severe than are those of bronchitis. In gangrene, further, there are present the physical signs of pulmonary disease, which are absent in bronchitis. The differentiation of fetid sputa from a cavity in phthisis, from gangrene, is more difficult, but the greater intensity of the odor in the latter and the appearance and composition of the sputa will serve to distinguish between them; but, as cavities are present, the history and behavior of the two maladies must be taken into consideration.

Treatment.—To maintain the powers of life by the free administration of spirits, small doses of opium and quinia, and such aliment as beef-juice, egg-nog, etc., is the leading indication, to which all specific treatment must be subordinated. Excellent results have been obtained from turpentine (gtt. v) every two hours; but still more from eucalyptol, which has been very much extolled recently. Eucalyptol is most easily taken in perls (℥ v), but it can be made tolerable in an emul-

sion. Benzoic acid, thymol, and carbolic acid, especially the last named, are very useful in correcting fetor, and also play the part of antiseptics, being eliminated largely by the lungs. Acetate of lead is the remedy most approved by Traube. Inhalations should be practiced with those remedies, such as iodine, which may diffuse by volatilization, and with oxygen, which relieves the dyspnœa and improves the blood. Iodine, or the tincture, may be vaporized by a gentle warmth, and the fumes gradually introduced into the air the patient is breathing. Ethyl iodide, oil of eucalyptus, and turpentine, are among the most useful remedies to be administered by inhalation.

CARCINOMA OF THE LUNG.

Pathogeny.—Cancer of the lung is usually secondary, and very often succeeds to cancer of the breast removed by amputation. It may be primary, but rarely so. While cancer of the lung as a secondary disease is more common in women, primary cancer of the lung is more common in men. It is a disease of advanced life, and is extremely rare before forty; nevertheless, a case has occurred at twenty-five. The form of cancer which attacks the lungs is usually the soft and rapidly growing variety known as encephaloid, and it occurs in two forms—in a distinct body or mass, and diffused through the tissue of the lung. In either case it presents the appearance of a yellowish-white, homogeneous, rather firm material, looking like brain-tissue which had been somewhat hardened—hence the name. When a mass is divided, a quantity of whitish, albuminous-looking fluid may be pressed out, and this fluid is called *cancer-juice*. Sometimes this cancer-juice may be found in cyst-like nodules, or in delicate canals, whitish in appearance, accompanying the lymph-canals. Cancer may occur in any part of the lung; when primary, in about two thirds of the cases in one lung, and when secondary in both, usually. The right lung is more frequently the seat of cancer, in so large a proportion as two to one. The distribution of cancer varies. In the primary form it occurs in nodules, from a pea to an orange in size, or there may be a great number of the smallest nodules, or a diffused infiltration involving a part or the whole of a lobe, even of two lobes. When it forms a distinct tumor of considerable size, the neighboring parts may be compressed: the lung may atrophy from pressure; the bronchi may be encroached on and closed, or the cancer elements may enter and fill them; blood-vessels may be impinged on, their lumen obliterated, or they may ulcerate and hæmorrhage result. The bronchi, trachea, and great vessels may be so far obstructed as to interfere with their functions respectively. The bronchial, tracheal, cervical, and axillary glands may be enlarged from simple adenitis, or from cancerous infiltration. The pleura is usually invaded; there may be an effusion into the cavity, or adhesions unite the two surfaces, and the cancer elements may make their way to the surface as nodules, or in thin plates. A large cancerous mass may displace organs, push the heart aside, and force the liver and spleen downward.

Symptoms.—When the cancer forms a tumor, the symptoms produced by it are dullness over the place occupied, increase of the vocal fremitus, and bronchial voice and breath sounds over the dull area. These sounds may have the cavernous character if the cancer-mass surrounds, without compressing, a large bronchus. Also, a large artery, impinged on by the tumor, will give forth a distinct systolic *bruit*, which may be mistaken for aneurismal *bruit*, unless it is recognized that there is but one center of pulsation (the heart) in the chest. If the growth be so situated as to press on a large vein, there will be present œdema of the head and face, or of one side; if it press on the recurrent laryngeal, spasm of the glottis, a peculiar cough (croupy), and difficult breathing, or, if the pressure be long continued, paralysis with its usual consequences, will result; if other nerve-trunks are impinged on, there will be deep-seated pains in the thorax, often of an excruciating kind, and there may be paroxysms simulating angina pectoris. The symptoms become more complex and difficult of interpretation, in cases of diffused or disseminated cancer. There are present the signs of consolidated lung-tissue on one or both sides. There are no adventitious sounds, but the respiration has a rather blowing character in some situations; in others, that of bronchial voice and bronchial breath. The diagnosis rests on these facts: all acute diseases are excluded, as this is comparatively slow in development and is free from fever; it can not be chronic pneumonia, as there is no localization of the deposits; from tuberculosis it is separated by the absence of fine crackling, and by the fever-movement; and, lastly, some indurated glands may be found in the neck or axilla, and possibly the traces of a former operation. There will be some difficulty of breathing if the deposits are extensive, and a dry, hard cough; but there may occur, finally, rusty-colored, semi-transparent, gelatinous expectoration. The difficulty of breathing depends on different conditions from those which obtain in the other form. In this case, the degree in which the air-space is encroached upon determines the amount of dyspnœa; in the other, compression of bronchi, or trachea, or displacement of the lung, affects the breathing. The character of the cough is very different, according as it is due to deposits in the lungs, to pressure on a bronchus, to irritation of the recurrent laryngeal, or pneumogastric nerves, etc. Besides the symptoms produced by and due to the presence of the cancer in the lungs, there is soon developed the cancerous cachexia, which is manifested by the following symptoms: progressive emaciation, weakness and sense of fatigue, a weak, small pulse, a peculiar earthy or fawn-color tint of the skin, pearly sclerotic, anorexia, œdema of the

ankles, etc. The rate of decline due to the cancer deposits is accelerated by the harassing cough, the dyspnœa, the dysphagia, and the pain. As the cancer extends, all of the rational symptoms increase in severity, and the physical signs more clearly indicate the diffusion of the cancer elements through the lungs, or the enlargement of the tumor.

Treatment.—This must be directed by the symptomatic indications. Anodynes to relieve pain and support for the increasing weakness are the measures necessary.

HYDATIDS OF THE LUNGS—ECHINOCOCCI.

Definition.—Hydatids found in the lungs are the intermediate or larval condition of the *tænia echinococcus*—the tape-worm of the dog—and are therefore designated *echinococci.* The cysticercus cellulosus, the larval state of the *tænia solium*, is very rarely, if ever, found in the lungs. Echinococci migrate from the intestines and take up their abode in the lungs. Each cyst contains the embryo—the scolex with its four suckers, and row of hooklets, inverted and contained within its cyst.

Dermoid cysts are rarely found in the thorax, but they should not be confounded with echinococci.

Pathological Anatomy.—Hydatid cysts usually exist in the parenchyma of the lungs, but sometimes develop in the cavity of the pleura, or they may be present in both at the same time. They are found in the inferior lobe, and chiefly on the right side. Often, the intra-thoracic cyst is a solitary hydatid, which fills the cavity, distending and enlarging the chest on that side, pushing out and widening the intercostal spaces, compressing the lung against the root and the spinal column, and forcing the heart downward or to one side, and depressing the liver or spleen. If the cyst is large, the pleural surfaces may be united and the cavity obliterated. Adhesions are often formed to a bronchus, which may be perforated and a cure effected by discharging the parasite by expectoration. The cavity which remains contracts and cicatrizes. In other cases the parasite is not discharged, but sets up an inflammatory induration about it, which excites fever, cough, and expectoration, that ultimately exhaust the patient unless carried off by some intercurrent affection. Rarely do hydatids come into relation with the vessels of the thorax, but a vessel may be invaded, with results determined by its size. Habershon * reports a case of a youth of seventeen in whom repeated hæmorrhages occurred, from an opening into a branch of the pulmonary vein, produced by "ulceration at the seat of the hydatid cyst." In this case tubercular disease followed the troubles due to the hydatids. Sometimes the cysts attain

* "Guy's Hospital Reports," third series, vol. xviii, 1872–'73, p. 373.

sufficient volume to cause death by suffocation. In other cases death is produced by atrophy of the inferior lobes of the lungs. In a larger number of cases, pneumonia and gangrene of the lung, induced by the presence and pressure of the hydatids, are the cause of death. The length of time hydatids continue in the lungs is measured by years. The ordinary duration is two to four years.

Symptoms.—The cysts must attain a sufficient size to interfere with function before symptoms are produced. More frequently than in other situations, hydatids of the lungs give rise to pains which may be felt in the back, in the side, or in the epigastrium. The pain is severe, persistent, and is somewhat paroxysmal, and its situation may indicate the seat of the mischief. The decubitus is on the back or on the affected side. The most marked as well as the most constant symptom is dyspnœa, which is always present in a moderate degree unless the cyst is very voluminous, and there occur also violent paroxysms, in which the breathing is suffocative. The cough is dry, or accompanied with a little expectoration, unless the cyst communicate with a bronchus, when the cough is incessant and the expectoration enormous, consisting of a serous liquid or earthy and calcareous masses, filled with the *débris* of hydatids. Sometimes the expectoration is fetid, from gangrene, or bloody. Small hydatids of the volume of a pigeon's-egg may be expected, but usually fragments and hooklets. The expectoration takes place at intervals sometimes of weeks or months; then a great mass may come up, almost suffocating the patient.

The physical signs will depend largely on the volume attained by the cysts, their number and situation. There may be seen, on inspection, an enlargement of the affected side, dilatation of the intercostal spaces, and displacement of the heart or of the liver, or of both. Fluctuation or the purring tremor will be felt only if the cysts are protruding through the chest-walls, and if a number of daughter-vesicles are contained within the parent-cyst. On percussion, there will be dullness according to the space occupied, and increase of resistance, commencing below the clavicle, over the inferior lobe. The vocal fremitus is diminished. The vesicular murmur is absent, replaced by bronchial voice and bronchial breath. Egophony may be audible. The signs of a cavity will be present when the cysts are expectorated.

Course, Duration, and Termination.—The origin and early development of echinococci of the lung necessarily escape detection. It is only when they are large enough to interfere with neighboring parts that symptoms are produced. The whole course is usually completed within four years, sometimes earlier, if the opportunity for free discharge exists by an opening into a bronchus. In forty cases of which Davaine * has given an account, there were fifteen recoveries and twenty-five

* "Traité des Entozoaires," *op. cit.*, whose account I have closely followed in this subject.

deaths, the termination by expectoration of the hydatids occurring in twelve cases. Of the twenty-five fatal cases, twelve or thirteen occupied the inferior lobe, and five or six the upper lobe. In another collection of cases quoted by Davaine, of sixty-two terminating in recovery forty-five recovered by the expectoration of the cysts, and seven by puncture of the chest, expectoration also occurring. The proportion of cures to cases in the last-mentioned collection was sixty-two to eighty-two. The termination by death is therefore more common than recovery. Death is due to a variety of causes—to exhaustion from profuse purulent expectoration, hectic and marasmus, to tuberculosis, to hæmorrhage, to gangrene, to pleuritis, etc.

Diagnosis.—There are no well-marked distinctions between hydatid cysts and pleuritic effusion, as regards the physical signs, but they differ widely in history. Pleuritis begins by a violent pain in the side, chill and fever, the effusion following in a short time. Echinococci very slowly develop, and the symptoms of effusion are not produced until after many months. Puncture and examination of the fluid for the characteristic hooklets may be required, to determine the question at issue. When expectoration of echinococci or of fragments takes place, there can be no doubt left.

Treatment.—When the existence of hydatid cysts is ascertained, there should, if possible, be made a free opening to permit their evacuation. Puncture and withdrawal of fluid will arrest their growth, but, as decomposition, suppuration, even gangrene may result, the extrusion of the cysts should be procured, if possible. Free opening into the cyst cavity, and drainage with antiseptic precautions, has proved very effective in the hands of Dr. Fenger, of Chicago. Such a cavity, when free exit is secured, can be washed out with solutions of germicides of suitable strength.

CATARRH OF THE BRONCHIAL TUBES—ACUTE BRONCHITIS—CAPILLARY BRONCHITIS.

Definition.—The term *bronchitis* is limited to a catarrhal inflammation involving the bronchial tubes, of a caliber above the terminal tubes. Catarrhal inflammation of these terminal tubes, or bronchioles, is designated *capillary bronchitis*, and if associated with atelectasis and catarrhal inflammation of the alveoli, is then known as *catarrhal pneumonia* or *broncho-pneumonia*. If the trachea is at the same time affected with the bronchial tubes, the disease is named *tracheo-bronchitis*. If the inflammation is general over the whole tube, it is called *diffuse bronchitis;* if limited to a part, *circumscribed bronchitis*. According to the rate of progress, it is *acute* or *chronic*, but the difference is slight.

Causes.—Bronchitis is very dependent on climatic conditions. A humid, changeable, and cold climate favors it, while dryness, uniformity, and warmth of climate have the opposite effect. More than any

other single factor does humidity influence and promote the occurrence of bronchitis. Those seasons of the year characterized by the most rapid alternations of temperature, by cold and damp winds, and by excess of humidity, are especially liable to produce bronchitis. All depressing hygienic influences, unsuitable clothing, exposure to damp, cold air—especially when the body is warm and perspiring—are influential factors. In a lowered state of the general health from any cause, the bronchial mucous membrane is more susceptible to evil influences. Bronchitis occurs in greater ratio in men, because they are more exposed to the conditions producing it. Age has an unquestionable influence. The extremes of life are more susceptible, but in infancy bronchitis is more frequent than in old age, but from different causes. The inhalation of irritating gases and vapors and the dust of various occupations will excite inflammation and catarrh. Among the causes must be placed minute organisms, the pollen of plants, which excite local irritation of the respiratory tract, and epidemics of catarrhal diseases. Valvular affections of the heart, which maintain congestion of the lungs and bronchi, necessarily induce a catarrhal state of the bronchial mucous membrane.

Pathological Anatomy.—The initial factor in inflammation of the bronchial mucous membrane is hyperæmia, or increased blood-supply, the whole surface marked by a fine arborescent or punctiform redness, or spots or limited areas only are thus affected. The depth of color depends on the period and intensity of the disease—recent and severe inflammation causing deep redness, and passive inflammation a dark-red, even purplish injection. It is hardly ever the case that the entire bronchial tract is invaded by the redness, but portions of the trachea, a considerable part of the primary and some portions of the second and third divisions of the bronchi. In old cases the redness disappears and is replaced by a grayish, ashy hue, with relatively numerous enlarged and tortuous vessels showing through. Nutritive changes in the epithelium, overgrowth of the glands, and proliferation of the connective-tissue cells of the submucosa, increase the thickness of the mucous membrane. The cartilaginous rings also undergo important changes, and the peribronchial connective tissue is the seat of an active hyperplasia. The new connective-tissue elements displace the cartilage. The secretion of the mucous membrane is changed in character; at first the sudden hyperæmia suspends the production of mucus and the membrane is dry; the next step consists in an increased production of mucus, soon followed by purulent elements, which rapidly preponderate, giving the expectoration a yellowish color. The amount of secretion varies in different cases: when it is deficient, the case is known as *dry catarrh;* when pus is copiously discharged, it receives the name of *bronchorrhœa*. The extension of bronchitis to the alveoli of the lungs and the collapse of lobules constitute catarrhal pneumonia. Emphysema may also result, especially the vicarious emphysema,