

besides those mentioned is the anterior pulmonary nerve, which passes in front of the root of the lung, and, joining filaments from the sympathetic, forms the anterior pulmonary plexus.

Phrenic Nerve.—The phrenic nerve arises from the third, fourth, and fifth cervical, passes diagonally downward and outward across the anterior surface of the scalenus anticus muscle, and then, continuing its course between the subclavian artery and subclavian vein, enters the thorax, lying on the right side just external to the superior vena cava and on the left side external and anterior to the subclavian artery. Passing in front of the root of the lung, it lies between the pleura and the pericardium, to both of which it gives off branches. It is longer on the left side than on the right, on account of the oblique position of the heart and because the left nerve forms a loop in passing around the left side of the pericardium. On the right side it breaks up into from three to seven branches about 1 cm. above the upper surface of the diaphragm. These branches, piercing the diaphragm, supply it, while the innermost branch passes down to communicate with the right semilunar ganglion of the solar plexus. On the left side the nerve does not perforate the diaphragm, but ramifies in its substance.

Intercostal Nerves.—The intercostal nerves, twelve in number, are derived from the anterior division of the dorsal nerves. The anterior division of the first dorsal nerve divides into two branches, the larger of which joins the eighth cervical to form the lower trunk of the brachial plexus. The smaller branch forms the first intercostal nerve. The anterior divisions of the second, third, fourth, and fifth dorsal nerves form the intercostal nerves for the respective intercostal spaces. They pass forward between the pleura and the external intercostal muscles, as far as the angle of the ribs, where they pass between the external and internal intercostal muscles as far as the middle of the shaft. Here they enter the substance of the internal intercostals and run through their substance as far as the costal cartilages, where they lie between the internal intercostal and the pleura. Breaking up into branches, they send cutaneous filaments to the front of the chest and the mammary gland, forming the anterior cutaneous nerves of the thorax. At the midaxillary line each one of the six upper intercostal nerves except the first gives off a lateral cutaneous branch which pierces the external intercostal and serratus magnus and divides into two branches, an anterior and a posterior. The anterior branch passes forward, supplying the anterior lateral surface of the chest and the skin over the external surface of the mammary gland. The posterior branches pass backward and supply the skin of the scapular region and over the latissimus dorsi. The lateral cutaneous branch of the second intercostal does not divide into two branches, but passes diagonally outward across the axilla, forming the intercostal humeral nerve, and, uniting with the nerve of Wrisberg, it supplies the skin of the inner and back portion of the arm above the elbow. This nerve is occasionally missing, or there may be two intercosto-humeral nerves, the second coming from the third intercostal.

The anterior divisions of the seventh, eighth, ninth, tenth, and eleventh dorsal nerves form the lower or abdominal intercostal nerves. They have the same relations in the intercostal spaces as the upper, but are distributed to the integument and muscles of the anterior abdominal wall, forming the anterior cutaneous nerve of the abdomen.

Sympathetic Nerves.—The thoracic gangliated cord is continuous above with the cervical gangliated cord, and enters the thorax on each side of the spinal column, lying along the heads of the ribs behind the great vessels covered over by the parietal pleura. The ganglia are twelve in number and are connected by nerve fibres forming cord-like prolongations derived from the substance of the ganglia. The external branches from each ganglion communicate with the dorsal spinal nerves. The internal branches from the upper five ganglia enter into the formation of the posterior pulmonary plexus. The internal branches from the lower seven ganglia unite to form the

three splanchnic nerves. They are called the greater, lesser, and least or renal splanchnic. The greater splanchnic is formed by the internal branches from the ganglia from the fifth to the tenth. These fibres unite to form a large nerve, which descends obliquely in front of the bodies of the lower dorsal vertebrae, pierces the crus of the diaphragm on each side, and terminates in the semilunar ganglion of the solar plexus, sending branches to the renal and suprarenal plexuses. The lesser splanchnic nerve is formed by the internal branches from the tenth and eleventh ganglia. It pierces the diaphragm and joins the solar plexus. The least or renal splanchnic arises from the twelfth ganglion, pierces the diaphragm, and joins the renal plexus.

The Oesophagus.—The oesophagus begins at the upper border of the cricoid cartilage, opposite the substance between the fifth and sixth cervical vertebrae, and enters the thorax in the median line lying between the vertebral column and the trachea. It passes downward and to the left in the posterior mediastinum, and, piercing the diaphragm to the left of the median line, expands into the stomach at the cardiac orifice. Its relations in the thorax are as follows: It lies behind the arch of the aorta, separated from it by the trachea. It passes downward and to the left, lying on the right of the aorta to a point just above the diaphragm, where it crosses to the left, passing in front of the artery and piercing the diaphragm. The pneumogastric nerves lie in close contact with it, the left lying in front and the right behind.

The Thoracic Duct.—The anatomical relations of the thoracic duct are described in the next article but one preceding this.

Trachea.—The trachea begins at the lower border of the cricoid cartilage and descends into the thorax, lying in front of the oesophagus, as far down as the upper border of the fifth dorsal vertebra, where it divides into the right and the left bronchus. The point of division is on a level with the junction between the first and second pieces of the sternum. The thoracic portion of the trachea therefore lies in the superior mediastinum. It has lying in front of it, besides the first piece of the sternum and the origins of the sterno-hyoid and sterno-thyroid muscles, which form the anterior thoracic wall at this point, the thymus gland, deep cervical fascia, and transverse aorta. On the left side lie the left common carotid artery, pneumogastric nerve, recurrent laryngeal nerve, and the pleura; on the right side, the innominate artery, right pneumogastric nerve, and pleura. The bronchi lie in the posterior mediastinum, entering into the formation of the roots of the lungs. The right bronchus is shorter and of larger size than the left, and passes more horizontally, the two bronchi diverging to form an angle of one hundred and thirty degrees. The left bronchus crosses in front of the oesophagus, the descending aorta and the thoracic duct, passes under the arch of the aorta, and enters the lung behind the pulmonary artery. The right bronchus passes horizontally to the right lung, passing above and then behind the pulmonary artery on that side. The relation of the structures that form the root of the lung has already been noted.

I desire to acknowledge my indebtedness, for much of the material to be found in the above account, to the standard writers on anatomy, principally Gray, Morris, Quain, Gerrish, Deaver, and McClellan.

Frederick R. Green.

THORAX, SURGERY OF THE.—INJURIES OF THE THORAX.—Injuries of the chest include contusions and wounds.

Contusions of the thorax are caused by the action of blunt violence, and may result in injury of either the thoracic wall or the thoracic contents, or both. The usual injuries of the thoracic wall are contusions of its soft parts and fractures of the ribs or sternum. The intrathoracic lesions include injuries of the pleura, lung, pericardium, and heart.

The variation in the nature and extent of the specific injuries makes possible a great variety of symptoms in

these subcutaneous traumatism. The symptoms of a local injury may be lost sight of in the general symptoms of shock, which always accompany the most severe forms of thoracic contusions. A condition known as "concussion of the thorax" may occur without demonstrable injury to the walls or contents of the thorax.

Slight ruptures of the parenchyma of the lung, or a mild effusion of blood into the pleural cavity may cause very insignificant clinical symptoms. The patient may expectorate a little bloody mucus. Severe ruptures of the lung and excessive hemorrhage into the pleural cavity will cause marked symptoms of dyspnea and sometimes extreme anæmia from loss of blood. Injury of a large bronchus may cause pneumothorax. On account of the injury of important organs the prognosis of severe contusions of the thorax is serious. Should, however, the patient withstand the primary shock and the immediate effects of injury of internal viscera, other secondary consequences, such as infection, are not of frequent occurrence.

The treatment of contusions of the thorax is largely expectant and symptomatic. Rest in bed, morphine, ice bags on the chest, and possibly a venous infusion of salt solution are all the measures necessary in most cases. In cases of extreme hæmothorax aspiration of the pleural cavity may be indicated. Arrest of hemorrhage from a large intrathoracic vessel by ligation is usually out of the question.

Wounds of the thorax may be either non-penetrating or penetrating. The former are of special importance only in case of injury of a large artery in the chest wall, such as the internal mammary, or one of the intercostals. Such an injury may result from a stab or gunshot wound. The symptoms would be those of anæmia with local escape of blood, or flatness on percussion over that part of the chest. In order to arrest the resulting hemorrhage it will often be necessary to resect a portion of one or more ribs and their cartilages. In place of ligation of the artery packing the wound with gauze may be substituted. Subsequent removal of the gauze must be done very carefully to avoid secondary hemorrhage. Penetrating wounds of the thorax may cause injury of the pleura, lung, pericardium, heart, or one of the large vessels inside the chest. Injury to the pleura alone or combined with injury of other organs is of very serious moment, both on account of the primary pneumothorax or hæmopneumothorax and of the possible secondary infection of the pleural cavity. Extreme degrees of pneumothorax may be fatal from pressure; but fortunately this is not often the case, the air in the pleural cavity being gradually absorbed. In case of infection of the pleural cavity the resulting exudation may cause pressure on the heart and lungs, resulting in dyspnea and cardiac weakness. There will also be the general manifestations of sepsis.

Wounds of the lungs may involve penetration of the entire thickness of one or both organs, or merely a superficial surface wound. Most of the wounds are caused by sharp-pointed knives or by fire-arms. The modern bullet frequently traverses the whole thickness of the lung. The primary symptoms of injury of a lung are those of shock from which the patient gradually recovers unless some large vessel has been wounded. In addition dyspnea is often very pronounced, due usually to a serious hæmo- or pneumothorax. Hemoptysis is a characteristic symptom, and varies in amount from a little bloody and frothy mucus to abundant hemorrhage.

Empysemata, starting in the vicinity of the external wound, is present in some cases. It is usually confined to the region of the wound, but may in rare cases extend over the greater part of the body. In case of a large wound prolapse of the lung may occur. Symptoms due to infection of the pleura (empyema, abscess of the lung) may arise subsequently, but under expectant treatment are not common. In case a foreign body, such as a bullet, splinter, or tip of a knife-blade, remains behind in the lung, the tendency to abscess formation is more marked. A bullet may heal up in the tissues without marked re-

action, and at some subsequent time give rise to severe disturbances. Gunshot injuries of the lung have become much less formidable since the introduction of small-calibre projectiles. These bullets make a cleaner cut and smaller channel. In many cases the bullet passes entirely through the lung, leaving behind but slight damage to the parenchyma of the lung and an aseptic wound canal.

The diagnosis of injury to the lung can usually be made from the history of the injury, the position of the wound (in the case of gunshot wounds the location of the entrance and exit), hæmoptysis, pneumothorax, extensive emphysema. The x-ray may demonstrate a bullet or other foreign body in the interior of the lung.

The treatment of injuries of the pleura and lung is largely expectant and symptomatic. The use of the probe for determining the depth of the wound should be discarded. The danger of infection is materially increased thereby. The wound and its vicinity should be thoroughly disinfected and a sterile dressing applied without suture of the wound. In case of active hemorrhage from a vessel in the thoracic wall resection of a rib, followed by ligation or packing, may be necessary. Bleeding from a large vessel in the lung is beyond the surgeon's control. Rest and the application of ice bags to the chest will be efficient to stop mild hemorrhages in the lung. Hypodermic injections of morphine are of value for the pain and restlessness. Aspiration in case of hæmothorax is seldom necessary, and should be performed only when the symptoms of pressure are very urgent. The same is true of the pneumothorax. Subcutaneous emphysema usually disappears of itself under an occlusive dressing. If it shows a tendency to spread, it may be treated by multiple incisions into the subcutaneous tissue. The secondary empyema, which is a rare complication, is treated by resection of a rib and drainage. In making an incision for the purpose of drainage, the original wound may if practicable be made use of; otherwise, the incision is made at the place usually chosen for empyema operations. (See farther on, in the section relating to empyema.)

Wounds of the pericardium without involvement of the heart are comparatively rare, and the diagnosis can usually not be made before operation or autopsy. The hemorrhage into the pericardium is not severe as a rule, and does not require special treatment. There may be sufficient to cause indistinctness of the heart sounds and increase in the area of cardiac dullness. Severe pressure symptoms with alarming heart weakness and dyspnea from excessive hæmopericardium usually mean a wound of the heart itself. Infection of the pericardium may later give rise to a large exudate within the pericardium, which will produce symptoms of pressure and sepsis and demand incision and drainage.

Wounds of the heart may be either superficial or penetrating; in the latter instance one or more cavities of the organ may be opened. Wounds of the apex are the most favorable. The symptoms of a wound of the heart may be sudden collapse and death from hemorrhage. The less severe wounds, however, may give characteristic symptoms and be susceptible of recovery either spontaneously or after operation. The external wound does not show anything typical. There may be little or no hemorrhage from it; or, in case of large wounds, large amounts of arterial or venous blood may escape. The position of the wound is important in making the diagnosis of injury of the heart. Hemorrhage into the pericardium gives rise to more or less marked symptoms of pressure upon the heart and lungs. The heart sounds are inaudible. The pulse becomes irregular and weak and there is severe dyspnea. The patient is restless and has a feeling of anxiety. In case the patient survives the primary shock and the effects of hemorrhage, the secondary symptoms of infection, particularly of the pericardium, may supervene. Suppurative pericarditis, though fortunately a rare complication, may prove a dangerous one, and its early recognition is imperative. The symptoms of pressure of the purulent exudate upon the heart and the signs of sepsis are usually sufficiently well marked

to make the diagnosis possible. Bullets may remain within the heart or pericardium for years without producing circulatory disturbances or infection. G. Fischer collected 452 cases of wounds of the heart with 380 deaths and 72 recoveries. Death was immediate in 104, and in 270 it occurred after intervals varying from one hour to nine months.

The treatment of wounds of the heart is usually symptomatic, but in some cases active interference becomes necessary. Complete rest in a recumbent position is combined with the administration of morphine, the application of an ice bag over the heart, and, when necessary, the judicious use of some heart stimulant, such as digitalis. In extreme collapse the infusion of salt solution may be called for. Severe pressure of the blood within the pericardium upon the heart may demand aspiration or incision. Different points in the chest wall have been chosen for making the incision to expose the pericardium. A favorite place is the fourth or fifth intercostal space close to the sternum, with resection of the fourth or fifth costal cartilage. The point of entrance of the instrument which inflicted the wound may be made use of in making the incision. Incision is preferable to puncture, as it is much more effective and involves less danger of injuring the heart. Furthermore, an incision of the pericardium makes possible suture of the heart, should this be necessary. The insertion of sutures into the heart is usually a difficult procedure, but has been successfully accomplished in a number of instances. Silk or catgut may be used. The introduction of one or two long sutures facilitates the insertion of the other stitches. The sutures should pass only through the muscle tissues and not enter the cavity. The most favorable wounds for suturing are the smaller ones of the anterior surface of the right or left ventricle. Wounds of an auricle or those which pass through both ventricular walls cannot as a rule be sutured. The indications for attempting suture of the heart are progressive bleeding into the pericardium, or externally, with increasing anemia or symptoms of pressure on the heart. Out of 34 cases of heart suture collected by Sherman, 5 died on the operating table of hemorrhage, 10 died very soon after operation, and 13 recovered.

For fractures of the ribs and sternum see under *Fractures*.

Inflammatory Diseases of the Chest Wall.—Cold abscesses are generally tuberculous in origin and arise usually from some carious process in a rib. The thoracic and dorsal muscles easily permit of gravitation and burrowing of the pus so that the original focus in the bone may be a considerable distance from the abscess itself. The symptoms are slight. The abscess causes a fluctuating swelling, varying in size, over which the skin is normal. The treatment may be either aspiration with injections of iodoform and glycerin, or incision and drainage.

Osteomyelitis of the Ribs and Sternum.—Acute osteomyelitis of these bones is rare. Typhoid fever is occasionally complicated by subacute osteomyelitis of the ribs. The treatment is in general the same as in other bones.

Tuberculous osteomyelitis is far more commonly localized in the ribs or sternum. The process leads to the formation of a tuberculous abscess, which either breaks through the skin in the vicinity, forming a fistula leading down to the focus in the bone, or burrows under the muscles, forming a cold abscess, which comes to the surface at some more distant point.

The treatment consists in dividing the fistulous tracts and resecting the rib. In case of long fistulous tracts the injection of iodoform emulsion may be substituted. Extensive resections of the sternum are sometimes necessary.

SURGICAL DISEASES OF THE PLEURA.

Empyema.—Inflammations of the pleura belong in the province of surgery only when the exudate is purulent in character. The purely serous exudates and transu-

dates are treated by internal medication and aspiration (paracentesis thoracis). Should, however, a serous exudate become suppurative, the more radical surgical measures of thoracotomy, with or without resection of a rib, have to be resorted to.

The *etiology* of empyema is varied. The infection may gain access to the pleura through an external wound, through the blood or the lymphatics, and finally by direct extension from a neighboring organ, most commonly the lungs. It may thus represent a purely local suppurative process or be a part of a general sepsis. An abscess within the abdomen may rupture through the diaphragm and cause an empyema, or a suppurative process in the neck or chest wall may extend directly or through the lymphatics to the pleural cavity. The bacteriological examination of the exudate has shown the presence, in different cases, of the pneumococcus, the streptococcus, the staphylococcus, and the bacillus of tuberculosis. Pneumococcus infections are the most common ones in children, while in adults the streptococcus is the most frequent cause, with the bacillus tuberculosis next. The character of the infection determines to a large extent its virulence. Tuberculous cases are by far the most unfavorable.

The *symptoms* of empyema are those of pressure produced by a fluid contained in a closed cavity, and the manifestations of absorption of septic materials. Pressure may cause displacement and interference with the functions of the lungs and heart. The septic absorption causes fever, emaciation, and ultimately death unless the pus finds a spontaneous or artificial escape. Spontaneous discharge of pus, which is unusual, may take place through a bronchus or the chest wall. Even when such an outcome occurs the escape of pus is not complete, and in order to heal a resulting fistula or expectoration of pus, an operation is usually necessary. The longer the operation is delayed the greater the danger of sepsis, and in case of recovery the longer the healing process will be. In chronic cases the pleural surfaces become enormously thickened, the lung, from continued pressure, becomes greatly contracted, and the enclosed abscess cavity tends to persist owing to the rigidity of its walls.

The *treatment* of empyema consists in prompt and thorough evacuation of the purulent exudate, followed by drainage of the cavity (thoracotomy). For this purpose resection of a portion of a rib is advisable in order to gain better access to the cavity and secure more complete drainage. In children incision through an intercostal space may be sufficient. The rib chosen for resection may be either the eighth, ninth, or tenth posteriorly, to the outer side of the long dorsal muscles, or the fifth or sixth in the axillary line. The advantage of the first location is that the abscess cavity is opened at its lowest portion and in the usual recumbent position the drainage is the best possible. On the other hand, the ascent of the diaphragm may tend to displace or compress the drainage tube. In the axillary line the ribs are more accessible, thus making the operation easier, but the drainage is inferior and hence the healing process will be slower. In either locality the portion of rib in question is exposed by an incision along the rib, three or four inches in length. The periosteum is divided in the line of the skin incision and separated from the outer and inner surfaces of the rib by means of a pericostal elevator. Care must be taken not to injure the intercostal artery which runs along the lower border of the rib. The latter having been exposed, a piece, two inches in length, is removed with bone-cutting forceps or a Gigli saw. The exposed pleura should now be punctured with an aspirating needle to make sure that pus is really present; and if pus is found, a pointed knife is thrust into the distended cavity. The finger may now be inserted for the purpose of exploring the cavity and removing solid pieces of lymph which might obstruct the drainage tube. The pus having been evacuated, irrigation with 1 to 10,000 bichloride solution or 1 to 4 peroxide of hydrogen followed in most cases by salt solution may be practised, although this is not

necessary except when the exudate is very foul. One or two thick-walled drainage tubes are now inserted and a safety-pin is passed through their outer end to prevent them from slipping into the cavity. Finally a voluminous gauze and cotton dressing is applied and held in place by a muslin bandage or binder. During the after-treatment the cavity may be washed out with some harmless solution and the drainage tubes gradually shortened. In order to accelerate expansion of the lung expiratory exercises, such as blowing air into a rubber ball, may be employed. Healing of the thoracic opening may be very slow, but ordinary cases heal even after the lapse of months. Cases which had existed a long time before operation and tuberculous cases may not heal, and will then require further operative treatment. The cause of failure of healing in those cases is the existence of a chronic abscess cavity with rigid walls which can neither be filled up by expansion of the lung nor contract by shrinkage of the surrounding parts. In case the cavity persists the patient suffers from the effects of septic absorption, particularly if the fistulous opening becomes stopped up. In case of tuberculosis the general symptoms are more marked and the local process may spread to the neighboring ribs and other adjoining parts. For this reason it is desirable to bring about a radical cure of the conditions which otherwise may continue indefinitely. Several operations have been devised for this purpose which have as their common object the contraction and obliteration of the abscess cavity. *Estlander's operation* (thoracoplasty) consists in the subperiosteal resection of a piece from all the ribs covering the cavity. The number resected will depend upon the size of the cavity, but it is better to resect too many than too few. Removal of a portion of the ribs in question makes the thoracic wall much more movable, and thus enables it to come in contact with the visceral pleura, and finally unite with it. *Schede's thoracoplasty* consists in removal not only of portions of the ribs, but also of the thickened parietal pleura as well. For this purpose a curved incision is made from the outer border of the pectoralis major muscle at the level of the fourth rib to the tenth rib in the posterior axillary line. From here the incision ascends in a curve and runs along the vertebral side of the scapula. The skin and muscles are dissected up, exposing the ribs, which are removed subperiosteally from the costal cartilage to the tubercle. The thickened parietal pleura is now removed with forceps and scissors, leaving behind a shallow gutter-shaped cavity which is scraped out and then covered with the flap of skin and muscle. The wound is sutured in front, but left open and packed behind. This operation is the most successful one for large cavities; smaller ones can usually be covered by the Estlander method. *Délorne* practised "decortization of the lung" for chronic empyema, and a number of cures by this method have been reported. His operation consists in reflecting a flap of skin, muscle, and bone, and then removing both pleural surfaces with the finger or scissors. The flap is then returned to its place. The hemorrhage from the surface of the lung is often excessive and requires postponement of the operation to a second sitting. Most cases of chronic empyema can be cured by one of these forms of operation. *Estlander's* is sufficient for the smaller cavities, while *Schede's* is designed for the extensive cavities and the tuberculous cases. *Délorne's* operation is still in the experimental stage.

SURGICAL DISEASES OF THE LUNG.

The most important diseases of the lung for the surgeon are abscess, gangrene, and bronchiectasis. Tuberculous cavities are only seldom adapted to operative treatment.

Abscess of the Lung.—The causes of pulmonary abscess are acute pneumonia, infectious embolism, foreign bodies in the lung, wounds, and perforations of a suppurative process in the neighborhood. The characteristic sputum of abscess of the lung is pure creamy-pus with-

out marked odor. Microscopic examinations show the presence of elastic fibres and haematoidin crystals. Fever is present and there are physical signs of a cavity in the lung which is alternately full and empty. Without operation the prognosis is unfavorable.

The treatment consists in opening the abscess as soon as the diagnosis is made. The prognosis of operation is best in case of abscess following pneumonia and much worse in one due to a foreign body or to embolism. The thorax is opened by an incision similar to that made for empyema, one or two ribs being resected for the purpose of gaining more room. In place of resecting ribs a flap consisting of skin, muscle, and bone, can be reflected and then replaced after completion of the operation. The costal pleura having been exposed it should be determined whether or not adhesions exist between this and the visceral pleura. Such adhesions are necessary to prevent a pneumothorax or escape of infectious contents into the cavity. To determine the presence or absence of adhesions a fine aspirating needle may be thrust into the pleura. If it moves back and forth freely there are no adhesions present. In case of adhesions the movements of the needle are slight or absent. If not already present they should be artificially produced by packing gauze upon the costal pleura, and leaving it in place for several days, or by suturing the two surfaces. The adhesions having been obtained the presence of pus is ascertained by means of an aspirating needle thrust into the cavity. If pus is present an opening into the lung is made with a pointed knife or the thermo-cautery. The latter method is followed by less hemorrhage and the opening is more likely to remain patent. A drainage tube is inserted into the abscess cavity and gradually shortened as the healing process progresses.

Gangrene of the Lung.—When circumscribed, gangrene of the lung may be the object of surgical treatment. Its etiology is much the same as that of abscess; it occurs particularly in alcoholic or diabetic patients, or those in poor general health. It is distinguishable from abscess chiefly through the character of the sputum. This is extremely foul-smelling and contains particles of broken-down lung tissue. The different forms of gangrene can be treated only by medicinal means, such as inhalation of carbolic acid or turpentine, and the internal administration of creosote, etc. The prognosis in these cases is usually hopeless, the patients succumbing to the septic absorption. Localized foci of gangrene should be attacked in the same way as abscess by thoracotomy and resection of one or more ribs. The good effects upon the general condition of free evacuation of the contents of the gangrenous cavity are almost instantaneous, and the removal of the foul odor and taste is an immense boon to the patient. *Tupper's* statistics show 74 cases of pneumotomy for gangrene with 60 per cent. recoveries. *Lenzharzt* has collected 148 cases that were operated upon, of which 94 were cured and 54 died—i.e., 63.5 per cent. of cures. *Villière's* statistics show that with internal treatment from 75 to 80 per cent. die. This seems an excellent showing for the operative treatment.

Bronchiectatic Cavities.—In recent years the drainage of cavities resulting from bronchiectasis has been performed in a number of instances with satisfactory results. This is true only of a single cavity, or of two or more which lie closely adjacent. The diagnosis is made chiefly from the history, the character of the sputum, and the physical examination of the chest. The odor is not so intense as in gangrene, and there is an absence of degenerated tissue elements. The technique of the operation is much the same as in abscess and gangrene. After exposing the pleura adhesions are produced by packing or by sutures and the pus is sought for with an aspirating needle. The thermo-cautery is the best instrument for cutting through the layer of healthy lung before entering the cavity. Drainage is provided for in the usual way. The beneficial effects of removal of the purulent focus are often surprising. Some bronchorrhœa is likely to persist, but it can be kept under control by proper hygienic measures and and by the use of expectorants.

DISEASES OF THE MEDIASTINUM.—The diseases of the mediastinum are acute and chronic mediastinitis, and mediastinal tumors.

Mediastinitis.—The etiology of inflammations in this region includes traumatism, extension from adjacent organs, and tuberculosis. The anterior mediastinum is by far the most frequently attacked. The symptoms of the acute and chronic forms are much the same except that in the former they are more intense. Pain is present in all cases and is located behind the sternum, from which it radiates to the shoulder blades. The sternum is often tender on pressure and may become red and edematous. Fever is present particularly at the beginning, and in the acute cases may be accompanied by chills and sweating. As soon as pus has formed pressure symptoms may make their appearance, including dyspnea and heart weakness. The abscess may finally work its way to the surface and point either in some intercostal space close to the sternum or at some more distant part. Rupture into the diaphragm, trachea, or pleural cavity may also occur. The treatment consists in evacuating the pus at the place where the abscess points, or in opening the anterior or posterior mediastinum. The anterior mediastinum is opened by resection of one or more ribs or costal cartilages, and the adjacent sternum. The posterior mediastinum has only seldom been attacked. On the cadaver it has been shown that removal of a transverse process of a vertebra and the underlying piece of rib gives a good opening for the discharge of pus.

Tumors of the mediastinum include the benign and malignant. Glandular enlargements form a goodly percentage of these new growths. Some of the tumors are primary, others are secondary. The benign tumors include fibroma, lipoma, and dermoid cysts. The malignant tumors, both carcinoma and sarcoma, may have their origin in the bronchial glands or in the bronchi themselves. In all varieties the symptoms are practically the same, and are chiefly those of pressure. The heart, lungs, large vessels, nerves, œsophagus, and trachea may be compressed and their function impaired. Furthermore, the chest wall may be pushed forward and ultimately the tumor may come to lie beneath or perforate the skin. Malignant tumors run a more rapid course than the benign, and may cause death before the tumor has appeared externally. Percussion is dull or flat over the tumor when it is situated close behind the sternum. Pressure upon the recurrent laryngeal nerve causes paralysis of the vocal cord on the same side. Pressure on the pneumogastric may result at first in slowing of the pulse, later in acceleration of the same.

The differential diagnosis from aortic aneurism can usually be made from its history and from the presence in the latter of arteriosclerosis, aortic insufficiency, friction sounds, etc.

As regards the prognosis the differentiation of the benign from the malignant tumors is of extreme importance. The malignant are the more common, and whether primary or secondary can usually be recognized by their more rapid growth, by the presence of glandular enlargements, by the greater severity of the pain, and by the rapid loss of flesh and strength.

The treatment may be begun by the internal administration of potassium iodide or arsenic, and in case of syphilitic lymphomata, malignant lymphomata, and some sarcomata a diminution in the size of the tumors will result. Other cases will call for active surgical treatment, and this should not be delayed too long either in the malignant or in the benign forms. The operation is the same as in suppurative mediastinitis, except that more room will be necessary for removing the growths than for opening the abscess. Excision of several ribs and part of the sternum or temporary osteoplastic resection of ribs by means of a flap of skin, muscle, and bone furnishes a good exposure of the anterior mediastinum. Through such an opening the tumor masses are enucleated, care being taken not to injure the pleura or the pericardium. If such an accident occurs, the opening is closed at once by suture or the wound packed, and the

operation put off to a second sitting. Excessive hemorrhage may be another reason for postponing the completion of the operation. The benign as well as the malignant tumors may require extensive dissection, although adhesions with adjacent structures are more intimate in the malignant forms.

Diseases of the Pericardium.—As in the pleura exudations occasionally take place within the pericardium. Of these the suppurative form will demand surgical interference. Collections of serum or of blood may be removed by aspiration, but, should this not be sufficient, incision may be resorted to. Purulent collections, just as in empyema, require for a cure incision and drainage. Puncture and aspiration are frequently resorted to in making the diagnosis of the presence and character of the exudate. A safe place for puncturing the pericardium is at a point between the fifth and sixth ribs, close to the sternum. The third or fourth intercostal space can also be chosen. Care must be taken not to injure the internal mammary artery which lies at a distance of from 1 to 2.5 cm. to the outer side of the sternum. Puncture is performed with an aspirating needle or a trocar. As the heart may be pushed forward by the exudate behind and thus lie close to the anterior thoracic wall, care must be exercised in not injuring that organ. The instrument is thrust in cautiously in an upward direction, and it is often possible to feel the heart come in contact with the point of the needle. Délorne collected eighty-two cases of puncture of the pericardium with twenty-eight cures.

Incision of the pericardium may be performed through a variety of incisions. Ollier's incision seems the simplest and answers the purpose. The incision runs from the middle of the sternum along the centre of the fifth costal cartilage. The latter is dissected free, resected with a knife or bone-cutting forceps, and the internal mammary artery tied. In case sufficient room is not obtained, a piece of the sternum is resected. Another incision (Délorne) begins 1 cm. from the left border of the sternum and runs from the fourth to the seventh costal cartilage. Two short lateral incisions are made outward from each end of the longitudinal one, and the flap is turned back. The cartilages of the fifth and sixth ribs are resected, care being taken not to wound the internal mammary artery. Drainage is provided for by means of a rubber drainage tube inserted into the cavity. Among thirty-five cases of suppurative pericarditis operated upon by incision and drainage, Kobert found that forty-three per cent. recovered.

Benjamin T. Tilton.

THOROUGHWORT.—(*Eupatorium* U. S. P.; Boneset.) The dried leaves and flowering tops of *Eupatorium perfoliatum* L. (fam. *Compositæ*). This is a widely spread species, growing in the greatest abundance about the borders of ponds and brooks, and in wet places generally, from Canada to Florida, and from the eastern to the western side of this country. It is a handsome, large, perennial herb, with a hairy, rather simple stem, growing from two to four or more feet high, large, dark green and completely connate pairs of rough hairy leaves, and flattened, complex, cymose clusters of small heads of minute creamy-white flowers.

DESCRIPTION OF DRUG.—Leaves opposite, the two united by their broad bases, the uppermost often distinct, those of the inflorescence mostly alternate and greatly reduced; 8-15 cm. (3-6 in.) long and 1.5-5 cm. (½-2 in.) broad, tapering regularly from near the base to an acute apex, crenate-serrate, above bright green or somewhat yellowish-green, rugose and finely bullate; underneath yellowish-gray-green, densely short hairy and resinous dotted, the prominent, rounded, crooked, fine veins conspicuously reticulated; flower-heads very numerous, in broad corymbs, the branches rough hairy; mature involucre campanulate, the imbricated scales lance-oblong, obtusish, green, hairy, the inner longer and with whitish tips and margins; flowers of the head about ten to sixteen, tubular, yellowish-white, the pappus in a single

row, white, bristly; odor weak, aromatic; taste bitter, astringent, aromatic.

The constituents of thoroughwort are chiefly the bitter glucoside eupatorin, which is soluble both in alcohol and in boiling water, a very small amount of volatile oil, a glucosidal tannin, which constitutes the coloring matter, and another tannin. There are also gum, resin, and ordinary plant constituents. The presence of an alkaloid has been reported, but this subject requires further investigation.

USE.—Boneset has been long used in the United States as a tonic and antiperiodic, and even as an emetic, but always more of a family medicine than one prescribed by physicians. Since the beginning of the last century it has fallen very much into disuse. In small doses thoroughwort is a mild bitter tonic, like the chamomiles and others in the same family, but with less aromatic character than most of them. It is also a good deal like horehound in the *Labiatae*. In larger doses, especially in hot infusion, it is diaphoretic, possibly diuretic, and is still occasionally used, followed by a sweat under blankets, to abort colds, and in the beginning of most acute diseases. In very large doses (an infusion of an ounce or so) it is a nauseating emetic. Doses as large as can be borne by the stomach, repeated for some days, have had a considerable reputation in the country, and have a little real value, in the treatment of intermittent fever and other malarial manifestations.

In domestic practice thoroughwort is usually given in the form of a decoction, especially when its diaphoretic, antirheumatic, or antiperiodic action is desired. Physicians also often prescribe it in that way, though more often at the present time in the form of the fluid extract. The dose of the latter, of which 1 c.c. is the equivalent of 1 gm. of the drug, is 10-15 minims as a tonic, 1-4 c.c. (fl. ʒ ¼-i.) as a diaphoretic and antiperiodic, and two or three times as much as an emetic.

ALLIED SPECIES.—The genus *Eupatorium* comprises many hundreds of species, a large number of which, in various countries, are employed similarly to the above. Numerous plants belonging to related genera have similar properties. (See *Compositæ*.) Henry H. Rusby.

THREE SPRINGS.—Huntingdon County, Pennsylvania.

POST-OFFICE.—Three Springs. Hotels and sanitarium.

ACCESS.—Take the Pennsylvania Railroad (main line) to Mount Union, Pa.; thence take East Broad Top Railroad to springs.

The village of Three Springs is located in a valley formed by Jack's Mountain, 2,220 feet high, and Care Hill, 2,210 feet in altitude. The place takes its name from the presence of three mineral springs, situated about one hundred feet apart, and forming the corners of an equilateral triangle. The springs are known as "No. 1," "No. 2," and "No. 3." They have been known and used for many years, but it was not until 1891 that they came under control of the present proprietor, who has brought them to an advanced state of development as a resort. Spring No. 1, the most important of the group, flows about one thousand gallons of water per hour, having a temperature of 55° F. It is used commercially under the name of the Hygeia Natural Mineral Water, and is shipped in five-gallon demijohns. The following analysis was made in 1895 by Prof. G. G. Pond, of the Pennsylvania State College:

Spring No. 1 (Three Springs). One United States gallon contains (solids): Calcium bicarbonate, gr. 34; calcium sulphate, gr. 53.63; magnesium sulphate, gr. 33.54; sodium sulphate, gr. 5.91; sodium chloride, gr. 0.35; lithium sulphate, gr. 0.02; potassium sulphate, a trace; silica, gr. 1.15. Total, 128.6 grains.

Gases: Carbonic acid, cub. in. 5.47; oxygen, cub. in. 1.72; nitrogen, cub. in. 3.85. The water is bright, sparkling, and palatable, and entirely free from organic impurities. It is an efficient laxative and mild diuretic and has been found beneficial in cases in which activity of the

emunctories is desirable. The water has been used with success in cases of obesity and in uræmia and general anasarca, as well as in local dropsies. In habitual constipation a systematic course of the water is often curative. It is also beneficial in other disorders requiring a sulphureted saline water. The sanitarium at Three Springs is kept open all the year. James K. Crook.

THROMBOSIS.—DEFINITION.—Thrombosis is a pathological state or process in which there is a deposit within the heart or vessels, during life, of solid material originating in transformation of the blood.

The solid mass or plug thus produced is called a *thrombus*.

It used to be taught that thrombosis was caused by the coagulation of the blood, but fuller researches, more especially those of Eberth and Schimmelbusch, have proved that many thrombi, at least at first, are due to the agglutination of blood platelets or of corpuscles without fibrin formation, so that it is more correct to adopt a wider definition, such as that given above.

VARIETIES OF THROMBI.—Any or all of the formed elements of the blood or their derivatives may enter into the composition of thrombi, viz., red corpuscles, leucocytes, blood platelets, and fibrin.

Red Thrombi.—These are produced in stagnating blood and are strictly comparable to clots formed outside the body, being composed of fibrillated fibrin, red and white cells, in much the same proportion as in ordinary clots.

White Thrombi.—Thrombi deposited from the circulating blood are generally of the white variety. The characteristic color, whence they derive their name, is due to the presence in excess of fibrin, leucocytes, and platelets.

It is not, however, uncommon to find *mixed thrombi* in which there is an admixture of red cells, giving them a somewhat reddish tint. When recent, white thrombi under the microscope are composed of granular material having the form of clumps or strands of irregular size and shape which are embedded in fibrin, leucocytes, and a certain number of red cells. The granular matter in question is composed of altered blood platelets. The fibrin has frequently a distinct fibrillated structure, and is particularly abundant at the periphery of the masses of platelets, sending anastomosing branches into their substance or forming a loose meshwork in which red cells are entangled.

Fibrin Thrombi.—These are not infrequently found in inflamed areas, usually in the smaller vessels. They may be seen particularly well in the vessels of the lung in croupous pneumonia. According to K. Zenker, who has described them in detail, whorls or brush-like tufts of coarse fibrin may be seen springing from the wall of the vessel. These appear to radiate from a definite centre composed of degenerating material, such as endothelial cells, leucocytes, blood platelets, or debris. The amount of deposit is not usually sufficient completely to block the vessel. In old white thrombi also the cellular elements degenerate and are replaced by fibrin.

Leucocytic Thrombi.—As has been already hinted, leucocytes enter into the formation of a large proportion of white and mixed thrombi; but thrombi composed almost entirely of white cells are also to be met with, particularly in areas that are acutely inflamed. In this case the condition is really a capillaritis, arteritis, or phlebitis, and the plug is due to the accumulation of leucocytes attracted to the spot by chemotaxis. Somewhat similar masses are seen within the vessels in cases of leukæmia, but these are perhaps not strictly to be regarded as thrombi.

Hyaline Thrombi.—For the recognition of this form we are indebted to von Recklinghausen. Hyaline thrombi are found chiefly in the capillaries, but also in the smaller veins and arteries. The lumen of the affected vessel is filled with a homogeneous, translucent, and refractile substance, without color, or at most having a faint yellowish tinge, which gives the microchemical reactions for fibrin. This variety is found more especially in toxic and infective conditions and after exposure to heat