DISEASES OF THE RESPIRATORY ORGANS.

TOPOGRAPHY OF THE CHEST: PHYSICAL DIAGNOSIS.

The regions into which the chest is divided for the purpose of physical exploration are given in Figs. 1 and 2, and the relations of the external lines and divisions to the contents of the cavity are shown in Fig. 13. The student should fix in his mind, especially, the position of the contained organs, with reference to the exterior anatomical landmarks.

The relations of the heart and great vessels have been discussed in the section devoted to diseases of the vascular system. It remains now to determine the relations of the lungs, and so much of the heart and great vessels as may be necessary to a proper understanding of the practice of physical diagnosis in pulmonary diseases.

In making a physical exploration of the chest, the position of the patient should be carefully arranged. In males the chest should be entirely bared, and in females covered with a close-fitting chemise or flannel undershirt. If the condition of the patient will admit of it, the best position for the examination is the erect posture, with the hands folded on the hips behind, when the front of the thorax is to be explored; with the arms folded on the chest, and the body slightly inclined forward, when the back is to be examined.

The examination should be conducted in an orderly manner. It includes *inspection*, *palpation*, *mensuration*, *percussion*, and *auscultation*. Some practical observations on these methods may fitly precede a study of the maladies in which they are applied.

Inspection.—By this term is meant a survey of the exterior of the thorax; of its size, shape, deviations from the normal, of its movements.

The thorax may be contracted either in consequence of original defect, or from disease in early life interfering with the play of the lungs. A very common condition is that known as *pigeon-breast*, the ribs having yielded at the sides, giving the sternum an apparent prominence. The chest of rickety subjects is also comparatively common, the pigeon-breast being one of its features, but there are, also, a deep groove along the line of junction of the cartilages with the ribs, nodosities on the ribs near the cartilages, and flattening of the chest posteriorly, the ribs being rather sharply bent at their angles. By inspection, the greater size of one side; the absence of the proper motion, and filling out of the intercostal spaces, or the opposite condition of retraction; bulging at special areas; retraction of the intercostal space at the point of apex-beat, etc., are alterations to be observed.

By inspection may be noted whether the respiratory movements are rhythmical, thoracic, or abdominal. In children and males the respiration is largely abdominal; in females, thoracic. The breathing may have the Cheyne-Stokes type; i. e., beginning with movements normal in number, the rate of breathing lessens, and the depth and force diminish progressively, until at length breathing seems to be suspended, the face becomes cyanosed, consciousness appears to be lost—then, with a start, respiration is resumed with increasing frequency until the maximum is reached, when again the number of respirations declines to zero.

In beginning an examination of the chest, an attentive inspection should be made of the whole thorax during the movements of inspiration and expiration.

Mensuration.—For ordinary purposes, a common tape-measure suffices to ascertain the size of the thorax, of its lateral halves, and of special parts deviating from the normal. The circumference of the chest is taken at the level of the nipples, and the difference between the completest expiration and the fullest inspiration is known as the *expansive mobility*. This difference should be about three inches, but practice by developing the chest muscles may greatly increase the mobility. No adult chest is normal the expansive mobility of which is less than two inches.

Palpation.—Important information is had from palpation, which consists in applying the palmar surface of the hands to the chest, and noting the changes, if any, in the condition of the parts. When the fingers are applied to the intercostal spaces, the degree of resistance becomes an element of diagnosis. Resistance is increased by anything causing induration of pleura or lungs. When the intercostal spaces are distended, as by hydrothorax, or the lung is solidified, the character of the resistance is changed from the peculiar elastic quality belonging to the parts in a normal state.

The vibration imparted to the chest-wall by the voice, by the friction of inflamed pleural surfaces, and by the movement of mucus in the larger tubes, is called *fremitus*. *Vocal fremitus* is produced by the voice, as when the patient says in a distinct tone "twenty-one," or "ninety-nine," or any similar words. That is *tussive fremitus* when caused by cough, and *friction fremitus* when the rubbing together of inflamed pleural membranes imparts a trembling or vibration to the chest-wall. To ascertain it, the hands are placed flat on the chest at various points, according to the situation of any morbid process in the thorax. The rhythm of the vibration is a point to be noted; as, for example, when a pleural friction fremitus is to be distinguished from a pericardial. Vocal fremitus is increased

by any cause increasing the density of the pulmonary substance, as in pneumonia, phthisis, etc.; it is lessened by any cause separating the lung from the chest-wall. It must be remembered that normally the vocal fremitus is greater on the right than the left side, especially over the primary bronchus.

Percussion.—Certain notes are produced by percussion of the walls of the chest. The mode of eliciting them is *mediate* or *immediate;* by the former, a body is interposed—a *plessimeter*—on which the blow is struck; by the latter, the percussion is made on the chest-wall. Plessimeters are made of bone, ivory, or hard rubber, and some of them have a scale to mark the dimensions of the part percussed. The most convenient plessimeter is the finger, being of material having the same physical qualities as the parts percussed, and adapting itself perfectly to the surface. If any air is interposed between the plessimeter and the surface beneath, the percussion note has a clacking, metallic quality.

The hammer usually employed is composed of the three fingers of the right hand, so arranged that their extremities are on the same plane. In very delicate percussion, a single finger may be used.

The hammers which I find most useful are of several sizes, and of differing weight. The most frequently used nowadays is of rubber, conical in shape, and attached near the middle to a metal handle tipped with ivory or bone or celluloid. The hammers having this shape vary in weight, and are adapted to light or strong percussion. The heaviest of these now made are not of sufficient weight for all purposes. A metal hammer, with the percussion end composed of a rubber tip, is at present a popular instrument, and, as this can be made of any size or of any suitable configuration, it will continue to be employed. Where heavy percussion is necessary, I have used with much satisfaction a triangular rubber hammer, the larger extremity being employed for developing the "knee-jerk" and for other purposes, while the smaller end can be used for percussion of any part. The weight of the larger extremity of the hammer gives a firmness to the stroke, although it may be directed with the utmost gentleness. In the other hammers, for the most part, the rubber tips with which they are provided are too extensile, and hence the density of the rubber is increased at the point of impact, and varies from its usual state.

Plessimeters of hard rubber, having a transverse bar for fitting intercostal and other spaces and another bar on which the percussion blow is made, are now in use. They answer an admirable purpose, if the form is such as to permit exact adaptation to the part where the percussion is done. To be entirely successful, each plessimeter should have a projecting point which can serve as a handle.

Formerly I was much opposed to any other hammer or plessimeter than the fingers, but enlarging experience has taught me that rather better results can be had with the instruments described above.

On percussion of the normal chest, a characteristic note is obtained, which becomes the standard of comparison for all sounds produced by this method. It may be entitled the *normal pulmonary percussion sound.* This normal resonance may be variously altered: it may be *increased* or *exaggerated,* or it may be *tympanitic* in quality.

The resonance may be reduced below the normal: the percussion note may be simply *dull,* or it may be entirely *flat.* When percussion is made over a hollow organ, as the trachea, or over a cavity, the note is said to be *tubular.* When the cavity contains air, also, the resonance has a metallic and hollow character, and is then known as *amphoric.* A higher-pitched sound, still more metallic in quality, is called the *metallic.* Another percussion-note, similar in quality to the last, is the *cracked-pot sound,* "*bruit de pot fêlé.*" To produce this sound effectively, percussion must be made during expiration, the patient keeping the mouth open. The sound may be very successfully imitated by forming a hollow cavity with the hands folded, and striking on the knee.

Auscultation is the art of hearing the various audible sounds produced within the cavity of the thorax, in both healthy and morbid states. The ear unassisted can be applied directly to the chest, or the hearing function can be supplemented by an instrument called the *stethoscope.* The utility of such an instrument, and the comparative value of the various kinds of stethoscopes, have been subjects of almost interminable controversy. The majority of physicians prefer the wooden cylinder, but the author, on the other hand, finds that the Cammann's double stethoscope gives the best results in his own hands. The double stethoscope has many advantages; binaural audition, like binocular vision, is more accurate, better defined, and comprehensible than uniaural; the double instrument, by excluding exterior noises, conveys the thoracic sounds to the ear with far greater distinctness, and thus prevents diversion of the attention from them. The manifold sounds of a great city interfere in the most perplexing way with the chest-sounds, and hence the utility of a binaural instrument. The author has found it very useful to employ the unassisted ear, the cylinder stethoscope, and the binaural in every case involving any difficulty or obscurity of the physical signs. The defects of the one mode of observing may be compensated for by the greater clearness or defining power of the other. When the ear is applied directly to the chest, a towel or napkin, only, interposed, the method is entitled *immediate auscultation;* when the stethoscope is used, it becomes *mediate auscultation.*

When the ear is applied to the chest by mediate or immediate auscultation, in health, certain sounds appropriate to certain special situations are heard. The soft, breezy sound produced by the entrance and exit of air from the pulmonary alveoli, is called the respiratory murmur—the *pulmonary or vesicular murmur.* The inspiratory

murmur is of longer duration, is louder (higher pitched) than the expiratory, which may be indeed, and often is, inaudible. The passage of air through the larynx and trachea causes a sound of considerable intensity, high pitched, and of large volume. This murmur or sound begins with the act of inspiration and persists throughout it; then an interval of silence coincident with the time between the respiratory movements occurs; and the sound is resumed with, and continues during, the act of expiration. The expiratory portion of the sound is rather higher in pitch, longer in duration, and coarser in quality, than is the inspiratory. This murmur, heard by applying the stethoscope over the trachea, is the *tracheal murmur*, really the *laryngeal*, for it is caused by the movement of air through the larynx.

The *bronchial murmur* is the sound caused by the movement of air through the primary bronchi, or is tracheal in origin but propagated through the bronchi. It is a coarse, blowing murmur, not so high pitched as the tracheal, and is shorter in duration. The interval between inspiration and expiration is comparatively short, nor is it so distinct as that between the tracheal inspiration and expiration.

Intensity.—The breath-sounds may be variously modified *in intensity*. They may be increased or lessened. When the vesicular murmur is simply increased, especially or entirely in inspiration, the change is entitled *puerile*, because of the resemblance to that intensity characteristic of early life. When lessened in intensity, there is simply a diminution in the volume of the respiratory sound communicated to the ear, without any necessary change in quality or duration.

Rhythm.—There are certain changes in *rhythm*. The most significant of these is the so-called Cheyne-Stokes breathing. This is characterized by a deep, prolonged inspiration followed by a succession of regularly diminishing respirations until zero is reached, then a cessation of respiration of less or greater duration, with a deepening cyanosis, and then the resumption of respiration increasing slowly in volume and depth until the maximum is again attained.

Prolonged expiration is a comparatively common alteration of rhythm. As has been stated, in the normal condition of the breathing organs, expiration is comparatively short, feeble, or wholly inaudible; but it may be greatly prolonged, inspiration continuing the same or actually shortening in duration.

The respiration may be jerky or jumping, affecting chiefly inspiration, but expiration may have the same character, especially when abnormally prolonged.

Quality.—The breath-sounds are variously altered in quality. They may be simply harsh, or less soft and breezy than normal. The increased roughness or harshness may be exaggerated into *blowing* respiration, which is similar to *bronchial* breathing, except that it is higher in pitch and clearer than the latter. Bronchial breathing corresponds in quality to the normal sound, and only assumes a pathological character when it becomes audible in unusual situations. *Tubular* breathing is an increased or exaggerated bronchial sound. It is high-pitched, rather metallic and concentrated, and appears to be sounded directly into the ear.

Cavernous, is a rather low-pitched and hollow sound, produced by the vibration of a cavity, and resembles *amphoric*, which is a still more hollow sound with a somewhat metallic quality.

Breath-Sounds—Râles.—Certain adventitious sounds caused by the movement of the air through tubes in a pathological state are entitled *râles* by the French; *rhonchi* by the English; but the former is now almost exclusively used in this country. A râle is a crackling, hissing, whistling, bubbling, or gurgling sound, heard only in inspiration or in expiration, or during both of these acts. Râles may be dry or moist. Dry râles are distinguished as whistling, or *sibilant*, and resounding, or *sonorous*. As the term implies, they are caused by lesions, affecting the diameter of the tubes, without any secretion.

The most important *râles* are those due to the presence of an increased secretion, and the most significant is that râle known as the *crepitant râle*. This is a fine crackling sound not inaptly compared to the crackling of salt thrown on to bright coals, or still more aptly to the sound caused by rubbing a lock of hair between the fingers in front of the ear, or to the crepitation produced by compression of rubber sponge. The true crepitant râle occurs only with inspiration, is feeble with the first rush of the air inward, and increases in distinctness and volume with a deep and forcible inspiration. Sounds closely resembling the true crepitant râle are that dry crackling which occurs in emphysema, the crepitation of œdema of the lungs, and that which marks the progress of resolution in cases of pneumonia and is called crepitation redux. But this last-mentioned form is larger, more of bubbling in character, and audible often with expiration as well as inspiration.

Subcrepitant, *mucous*, and *submucous râles* are caused by the passage of air through tubes containing fluid. They differ in size, and somewhat in quality. The subcrepitant has a rather crackling character, similar to but larger than the crepitant, and occurring with both inspiration and expiration. The mucous and submucous have more of a bubbling or gurgling character, and are consequently larger and produced in the larger bronchi, as the crepitant are formed in the minuter divisions of the bronchial tree.

Again, certain râles are formed in connection with cavities, dilated bronchi, and cavity-like communications with the pleura. These take name accordingly, and are known as *cavernous*, *amphoric*, *metallic tinkling*, etc.

Voice-Sounds.—The sounds of the voice in speaking, coughing, and whispering are variously modified by disease. *Vocal resonance* may be wanting, or it may be modified or exaggerated. It is wanting

when the lung has collapsed and lies against the spine, for example. The most important changes are those of exaggerated resonance. When the voice sounds clearly into the ear, as if coming from a bronchus, when it should, by transmission through the lung-tissue, be much softened, it is called *bronchophony*. The transmission of sounds in a more intense degree, the voice apparently sounding directly into the ear from the chest, is entitled *pectoriloquy*. This modification of voice tone becomes more distinctive by whispering, and is then called *whispering pectoriloquy*. Still another variation of the voice-tone is that entitled *ægophony*. It has a bleating character, a vibratory, nasal tone which is imparted to the sound by a thin stratum of liquid interposed, and is therefore characteristic of pleuritis.

Friction-Sounds.—These are, as a rule, *to-and-fro* sounds, synchronous with inspiration chiefly, and less with expiration, or in the præcordial region, with the cardiac movements. The sound varies in intensity from a mild rustling to a strong, harsh grating. The *creaking-leather sound* is apparently caused by the stretching of old, strong, and ligamentous adhesions, and hence is sometimes audible after the absorption of the liquid exudation of pleuritis.

Succussion.—This is an extremely significant sign, as it can only be produced by the splashing of fluid in a cavity containing air or gas, and hence its value in chest affections. Succussion is effected by smartly shaking the patient from the shoulder. The splashing may be felt by the hand, or heard by the ear on the chest.

The use and significance of the foregoing signs and symptoms will be made apparent in the course of study of the various thoracic diseases.

INFLAMMATION OF THE PLEURA—PLEURITIS.

Definition.—*Pleuritis*, or *pleurisy*, is an inflammation of the pleural membrane. Although not separable by any well-marked signs and symptoms, it is usual to consider two forms, *acute* and *chronic*. It may occur as an independent *primary* affection, or it may be *secondary* to some other disease.

Causes.—There can be little doubt that many cases arise from exposure to cold, especially when a current of cold air is directed against the body in a perspiring state. There is probably a constitutional condition of some kind which determines the seizure, but this state can not be defined. It is more common in early life, up to the middle period, but is uncommon in old age. The secondary disease is much more frequently encountered than the primary. It is very frequently associated with pneumonia, by extension of inflammation through contiguity of tissue; often, indeed, the pleuritis is the more important of

* "Transactions of the Pathological Society," vol. xxii, p. 108.

the two affections. It is also associated with catarrhal pneumonia, with bronchitis, pericarditis, embolic pneumonia, pyæmia, abscesses, and other affections of the thoracic organs. It may be excited by caries of a rib, deep-seated (sub-pleural) abscesses, cysts and abscesses of the liver, etc. A dyscrasia may be a cause, when it is said the pleuritis is an intercurrent malady; but it is now known that various morbific matters in the blood may excite serous inflammations, of which rheumatism, gout, Bright's disease, cancer, diabetes, and the eruptive fevers may be taken as examples.

Pathological Anatomy.—The initial lesion is hyperæmia of the subserous connective tissue, while red points due to congested vessels are rather thickly scattered over the pleura. Such is the force of the blood-pressure that minute points of extravasation occur on the pleura and in the subserous tissue. The membrane has an arborescent or striated appearance, and is of a reddish or reddish-brown color. The injected portion of the membrane is dull, opaque, and rough; the epithelium is swollen, cloudy, and granular, and is rapidly cast off, while the adherent cells undergo similar changes, and the subserous tissue becomes swollen, infiltrated, and crowded with migrated leucocytes. On the membrane there appears in detached masses, but rather thickly placed, an exudation which makes the surface rough and uneven. Large flakes of exudation may be thrown off, or the membrane may become thickly covered with a more or less heavy coating of fibrinous material. This may also contain a good deal of serous exudation in its meshes, when it presents a gelatinous, felt-like, or spongy appearance. If there be present much liquid, the flakes or masses of fibrin are seen floating in it, or they may be churned up with the serum and form a milky-looking fluid. The exudation which thus forms on the surface passes through various changes. It may undergo fatty metamorphosis, become emulsionized, and disappear by absorption, leaving the membrane unharmed. Adhesions may form by the gluing together of the opposed surfaces, the connecting band of exudation undergoing organization. The membranous exudation on the surface may also become organized; large thin-walled vessels develop from the leucocytes, according to Rindfleisch, and close connections are formed between the neomembrane and the pleura. Again, broad patches of membranous exudation on the opposing surfaces of the pleura uniting by their margins, a central cavity is thus formed in which there may be serum, sanguinolent serum, and flakes of exudation, etc., while close adhesions unite the pleural surfaces all around for a greater or less distance. These secondary cavities form at the base, on the lateral wall of the thorax, and between the pleura and pericardium, and, as they retain the effusion in a fixed position, give rise to errors of diagnosis. Those are examples of *dry pleurisy*, in which a very plastic exudation is thrown out on the two surfaces, over a small extent of the membrane, union

taking place, either directly or by a connecting band, there being no other exudation or effusion. It is probable that many of the examples of connecting bands, or adhesions between the pleural surfaces, which are found *post mortem*, no symptoms having occurred during life, were of this character. Usually, however, in pleuritis, a more or less abundant exudation is poured out. According to the nature of the effusion, the cases of pleurisy are divided into the *sero-fibrinous*, the *purulent*, and the *hæmorrhagic*.

In the *sero-fibrinous* form there is poured out from the distended vessels a quantity of fluid, straw-colored and having the qualitative composition of blood-serum. This contains floating in it masses of exudation or flakes, leucocytes, lymph, and red-blood corpuscles, which impart to it a more or less milky or sanguinolent character. The fibrinous part of the exudation consists of layers or folds of whitish, grayish, or reddish albuminous and fibrinous material deposited on the pleura. It may be soft, easily separated, or tough and elastic; and may be readily detached from the membrane, or may adhere with considerable tenacity. When removed, this exudation is found to be closely adherent to a layer beneath, made up of the proliferating connective-tissue corpuscles of the basement membrane, together with a plastic matrix. These layers become ultimately closely connected by the growth of the connective-tissue membrane, or the fibrinous exudation may undergo fatty degeneration and be absorbed. The new connective-tissue membrane, built up as above described, is very rich in vessels, and readily unites with the same formation on the opposing surface of the pleura. The corpuscular elements—leucocytes, lymph-corpuscles, cast-off epithelium, etc.—in the serous fluid may be so abundant as to give it a yellowish or purulent appearance. Hence it may be difficult to make a distinction between this and the truly *purulent form*, in which the serum contains such a quantity of pus-corpuscles that it is thick, yellowish, or greenish yellow. The term *empyema* is applied to a purulent collection in the thoracic cavity. Primary empyema is a very rare event, and, when it does exist, signifies the admission of air or some foreign matter to the cavity. The exudation is at first sero-fibrinous, and becomes purulent, usually not until after the first week. There takes place, under conditions not now understood, a remarkable production of pus-cells—probably by enormously rapid proliferation of the leucocytes which have wandered from the vessels. While the serous fluid has an alkaline reaction, the purulent exudation is acid in reaction. Often the color of the exudation is reddish from the presence of red-blood corpuscles in considerable numbers. But this is not the *hæmorrhagic exudation*, properly. This consists of blood derived from the newly formed, thin-walled vessels of the exudation undergoing organization. A vessel giving way, the blood is poured out (or there is a diapedesis of the red globules) between the layers of the exudation and bursts through into the cavity of the pleura, and, mixing with the serum, forms a bloody fluid. The hæmorrhagic form of pleuritis is usually tubercular in origin, or rather is due to the deposit of miliary tubercle exciting a recurring inflammation. An exudation may be hæmorrhagic when the pleuritis occurs in an individual having the hæmorrhagic diathesis, or who is the subject of purpura.

The evil results of effusions are not limited to the affected membrane. When the quantity is sufficient to displace the neighboring organs, various functional disturbances arise from the compression. At first the lung retracts before the effusion, and only suffers by pressure when the effusion attains a certain volume sufficient to counterbalance its elasticity. As the fluid increases from below upward, the lung at first floats; but gradually the expansibility declines, less and less air enters, and the organ is finally flattened against the spine about its roots. It then appears as a grayish, bluish, or reddish-gray, rather solid and flattened mass, about the size and shape of the adult hand without the fingers. It contains no air, is bloodless, and may be coated with a membranous exudation, or may be bound down by membranous bands. If adhesions exist, the lung will be compressed in part, or, if the organ is infiltrated by caseous or other deposits, the fluid will act on those parts that yet remain compressible. The fluid may be collected in secondary cavities, and compression be confined to those situations. The blood being forced out of the lung, when the organ is flattened against the spine, distends the right cavities, which may dilate, and fills the sound lung, which may become congested and œdematous. If the effusion occupies the right cavity, the heart is forced toward the left side, the diaphragm is pushed down, enlarging the capacity of the right thorax, and displacing the liver downward; if the left cavity, the heart is forced over to the right, the diaphragm is pushed down to a less extent than on the right side, enlarging the left thorax, and displacing the spleen downward. The intercostal muscles become infiltrated, weakened, and, yielding to the pressure, assume a convex instead of a concave shape, the thorax being globular and increased in circumferential and diametrical measurement. If absorption take place and the lung is not adherent, the air will again distend the alveoli, and the thorax assume its normal shape; if the lung can expand again only in part, under the force of the atmospheric pressure, there will take place a depression of the ribs and distortion of the spine to efface the portion of the cavity which the lung can not fill.

When there is present purulent or ichorous exudation in the thorax, the pleura will, if long exposed to its action, undergo necrosis, and a canal may be tunneled through the lung into a bronchus, and through this there may be more or less discharge, and a cure be ultimately effected. Caries of a rib may follow necrosis of a portion of the cos-