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PREFACE.

THE design of this small work is to make students familiar with the principles of Physical Diagnosis, as practised for the investigation and diagnosis of diseased states of organs. Description of diseases and matters of semeiology are supposed to be learned from other sources.

JOHN C. THOROWGOOD.

WELBECK STREET, W., 1880.

AIDS TO PHYSICAL DIAGNOSIS.

SECTION I.

EXAMINATION OF THE PHARYNX AND LARYNX. LARYNGOSCOPY. RHINOSCOPY.

THE cavity of the pharynx opens into the œsophagus at a point bounded posteriorly by the fifth cervical vertebra, and anteriorly by the posterior portion of the cricoid cartilage. The cavity extends upwards, as the naso-pharynx, to the basilar process of the occipital bone, but this portion is not seen in ordinary inspection of the throat.

For purposes of examination the patient must be placed opposite a good light; and, when he has opened his mouth, the tongue should be gently drawn forwards and downwards, rather than merely depressed, by a spatula, so that thus it may be out of the line of vision. The parts to be first examined are the pillars and arches of the soft palate. Normally often redder than the surrounding mucous membrane, these structures should appear free from any trace of catarrh, and the arches on each side of the uvula should be well-formed and symmetrical. The uvula should not be swollen or unduly pendulous; and the tonsils, if healthy, scarcely visible. When the patient inspires deeply through the throat, the posterior surface of the pharynx comes well into view, and should not be rough or granular-looking, nor should it exhibit any sign of venous congestion,

increased secretion, or ulceration. The small nodules that are seen are caused by the presence of small follicular glands, and the whole mucous membrane is covered with pavement epithelium.

A translucent appearance about the edge of the uvula and palatine arches indicates œdema of the parts; and much catarrhal mucus indicates cold caught or an unhealthy state of the digestive organs. Under either of these conditions the voice will be thick, husky, and nasal.

LARYNGOSCOPY.—The larynx is examined by means of the laryngoscope. In the best forms of the laryngoscope, a mirror fixed to a spectacle-frame by means of a ball-and-socket joint, is placed before the eye of the observer, opposite to whom sits the patient with his head thrown slightly back and his mouth open. A lamp is placed on a level with the patient's left eye; from which the light, falling on the reflecting mirror, is projected into the throat, and so illumines the small laryngeal mirror which is held by the physician just over the larynx, and in which, therefore, the laryngeal image is readily seen by him as he looks through the small aperture in the centre of his reflecting mirror.

As soon as a ray of light is clearly thrown from the reflector on to the uvula of the patient, the observer must take the warmed laryngeal mirror in his hand as he would a pen, and pass it over the dorsum of the tongue, which organ must be drawn well forward by the free hand grasping its tip with a soft napkin.

He should then pass the mirror backwards till it reaches the uvula, care being taken not to touch the surface of the tongue, as retching would then be the result.

The laryngeal mirror being thus in position, with its metallic surface gently pressing the uvula upwards and backwards, the patient must be directed to say 'eh' or 'ah,' and the image of the larynx will then be seen reflected in the mirror. A little movement of the mirror to right or left, up or down, will bring all the parts of the larynx under inspection. First will be seen the back of the tongue and its papillæ; then, at the top of the

mirror, comes into view the epiglottis and the glosso-epiglottidean ligaments. From each side of the epiglottis extend the ary-epiglottidean folds, containing the small prominences known as the cartilages of Wrisberg and of Santorini. These last cartilages surmount the arytenoid cartilages, and are seen at the bottom of the mirror. Between the aryteno-epiglottidean folds and the true vocal cords is seen the red mucous surface of the ventricular bands or false vocal cords, containing in their free edge the thyro-arytenoid ligaments. Between these ventricular bands appears as a dark line on either side the ventricle of the larynx; by turning the mirror so as to get a lateral reflection, the space of the ventricle is better discerned. Below these parts are seen the true vocal cords shining like mother-of-pearl, and moving to and fro in the acts of phonation and respiration. Beneath the cords can sometimes be seen the rings of the trachea, and, rarely, the opening of the right bronchus.

The true vocal cords constitute the limit of the greater part of the rima glottidis. Posteriorly they are continuous with the vocal process of each arytenoid cartilage, so that the anterior part of the chink of the glottis is ligamentous, and the posterior part or base of the lozenge-shaped chink is cartilaginous. The vocal cords are covered with pavement epithelium, the rest of the laryngeal epithelium being ciliated.

It should always be remembered that the parts of the larynx seen to the right and left in the mirror correspond with the patient's right and left; thus there need be no confusion in describing the appearance of the parts as seen by the observer.

The opening of the glottis is bounded laterally by the arytenoid cartilages and vocal cords; its apex is the thyroid angle or anterior commissure of the vocal cords. This aperture dilates in inspiration and contracts in expiration and phonation. To see it dilate, the patient must be directed to inspire deeply, and then the posterior and anterior wall of the larynx are well opened to view. The arytenoid cartilages, surmounted by the cartilages of Santorini, will be observed widely to separate, and thus to display the rings of the trachea.

Sometimes the ventricular bands or false vocal cords approach

so near the median line as to hide the true vocal cords from view. In such a case a deep inspiration will cause a full separation of the ventricular bands, and then the white true cords are seen below the ventricles of the larynx.

The colour of the epiglottis is like that of the inner surface of the eyelids; in shape and size this cartilage varies much, and for a right understanding of its different sizes and forms I must refer the reader to the excellent plates and descriptions given in Mr. Lennox Browne's recent work on the 'Throat and its Diseases.'

An inflamed and catarrhal condition of the larynx is known by the epiglottis, on its posterior surface especially, being tumid and very red. The arytenoid cartilages also may be of a deep red colour, and swelled to the size of peas or small beans. The superior or false vocal cords may be affected by catarrhal inflammation, and, losing their natural pale red hue, they become deeper in colour, and by swelling encroach on the ventricles of the larynx, so as to obscure the true cords. When these last-named structures are inflamed, they lose their white colour and become injected with an irregular red mottling. If the inflammation be severe, the margin of the true cords is rounded from œdema, and respiration obviously much impeded. In these catarrhal conditions of the larynx, strings of viscid mucus are often seen extending across the laryngeal aperture.

In narrowing of the laryngeal aperture inspiration is observed to be slow and prolonged, and may be accompanied by a crowing sound, or stridor, as is observed in the case of children when the rima glottidis is constricted by croupous inflammation.

Should it be observed that the patient cannot form a properly sounding cough or sneeze, attention should be directed to the way in which the vocal cords come together, for the probability is that one of them (usually the left) will be observed motionless when an attempt at phonation is made. This indicates paralysis of the adductor muscles of the vocal cord, and may be due to a tumour within the thorax pressing on the motor nerves of the larynx. After a while the arytenoid cartilage and vocal cord on the paralysed side become shrunk and wasted by atrophy.

When the mucous membrane of the larynx is seen to be thickened and covered with irregular prominences, it is probably the early stage of laryngeal phthisis, and before long ulcers will form on the cords and on the posterior surface and cushion of the epiglottis. These ulcers are irregular, with 'nibbled' look at the edges, covered often with purulent secretion, and once formed, scarcely ever get well.

The syphilitic ulcer of the larynx usually attacks the cords and the surface of the epiglottis; it is slow in development, and very often circular, with sharply defined edges. The ulcers can be healed under a proper course of anti-syphilitic treatment; but, if neglected, they spread and cause destruction of the epiglottis and of the other laryngeal structures in a most serious way; hence the great importance of early recognition and treatment. Morbid growths in the larynx often interfere very seriously with the act of speaking; they are nearly always found attached to the vocal cords. Cancer, when it attacks the larynx, spreads usually to this organ from some contiguous part.

Œdema of the larynx or glottis may be a result of inflammation, or it may be part of a general state of dropsy or anasarca. The parts are tumid, and respiration much obstructed. Examination by the laryngoscope under these conditions is often impracticable, and the diagnosis is made by observing the aphonia, the harsh, barking cough, and the difficult, hissing inspiration. The finger passed deeply into the throat will detect the swelling about the epiglottis and the rima glottidis.

RHINOSCOPY.—The naso-pharynx and nasal passages may be inspected by means of a laryngeal mirror fixed on a slightly curved shank, and turned upwards just in the opposite direction to that employed in laryngoscopy. Rhinoscopy is a more difficult process than laryngoscopy. Where a pendulous tumour or nasal polypus occupies the posterior nares and extends down behind the soft palate, its relations are best made out by means of the finger passed deeply behind the soft palate. Further knowledge may be acquired by dilating the anterior nares by Browne's, or Elsberg's trivalve nasal speculum, and seeing how much of the tumour can be thus brought into view.

SECTION II.

TOPOGRAPHY OF THE CHEST.

THE ANTERIOR part of the chest comprises:

1. SUPRA-CLAVICULAR region, a triangular space containing the apex of the lung on each side, with portions of the sub-clavian and carotid arteries and sub-clavian and jugular veins. The first rib forms the floor of this region.

2. CLAVICULAR region, comprising the parts lying beneath the clavicle, which consist of lung; and, on the right side, at the sternal articulation, the innominate artery.

3. INFRA-CLAVICULAR region, extending down to lower border of third rib and containing the upper lobe of the lung, and on the right side, close to the sternum, the superior cava and a portion of the aortic arch. On the left side the inferior border of this region corresponds to the base of the heart. The right bronchus passes off just behind, the left a little below the second costal cartilage.

4. MAMMARY region, extends down to the sixth rib. On the right side there is lung substance, and between third and fifth ribs, close to the sternum, lie the right auricle and part of right ventricle of the heart.

On the left side the anterior edge of the lung passes outwards and downwards from the level of the fourth cartilage, leaving a free space for the heart. The left auricle and ventricle lie within this region.

5. INFRA-MAMMARY region contains on right side the liver and small portion of lower border of lung. On left side are contained the stomach and anterior edge of the spleen, and small part of left lobe of the liver.

6. SUPRA-STERNAL region is a small part bounded below by the notch of the sternum, and laterally by the sterno-mastoid muscles.

It contains the trachea; and in some cases the arch of the aorta reaches its lower border.

7. UPPER STERNAL region is that part lying above the level of the third rib. It contains the left innominate vein, and the ascending and transverse portions of the aortic arch; the pulmonary artery; the aortic valves close to the lower border of the third left cartilage, the pulmonary valves a little higher up, and the trachea with its bifurcation on the level of the second ribs. At this point the edges of the two lungs come close together.

8. LOWER STERNAL region contains the right, and part of the left ventricle of the heart, and interiorly a portion of liver and stomach. The mitral valves lie at the upper part of this region, close to the left edge of the sternum; the tricuspid valve is nearer the middle line and more superficial.

9. AXILLARY region, on each side contains the upper lobes of the lung, with the main bronchi lying deeply.

10. INFRA-AXILLARY region contains the lower edge of the lung sloping downwards and backwards. On the right side is found the liver, and on the left are situate the spleen and stomach.

POSTERIOR PART OF THE CHEST.

11. The UPPER or SUPRA-SCAPULAR regions contain the posterior part of the apex of the lung on each side.

12. The INFRA-SCAPULAR regions contain the lungs as far as the eleventh ribs; and then, on right side, comes the liver; and on the left a portion of the intestine and spleen. Close to the spine on each side lies a small upper portion of kidney.

13. The INTER-SCAPULAR region, or space between the inner edge of the scapula and the spines of the dorsal vertebræ, contains lung-substance, the main bronchi, and the bronchial glands. It also encloses, on the left side, the œsophagus, and, from the third or fourth vertebra downwards, the descending aorta. The bifurcation of the trachea takes place in the middle line.

SECTION II.

PHYSICAL DIAGNOSIS OF DISEASES OF THE RESPIRATORY ORGANS.

INSPECTION OF THE THORAX.—SHAPE AND MOVEMENTS.—In examining the thorax by inspection, the chest must be uncovered and the patient made to sit, lie, or stand in a good light. Note should then be taken of the movements of elevation and expansion as the breath is drawn, and these movements viewed anteriorly, laterally, posteriorly, and from above downwards, the observer standing above and looking down at the movements of the chest of the patient sitting below.

Note should be taken of any enlargement of the cutaneous veins, for this may indicate obstruction to the circulation beneath, and attention should be paid to any irregularity or thickening about the ribs or their cartilages. Lateral flattening of the ribs, and consequent diminution in the lateral diameter of the thorax with protrusion of the sternum, is observed in children affected with rickets. There is also seen a groove on either side of the sternum, extending from the first to the ninth ribs along the line of junction of the ribs with their cartilages. This change is produced by the recession of the thoracic wall during inspiration. The groove extends further down on the left than on the right side, in consequence of the support given by the liver to the thoracic wall on the right side. The chest of a rickety child is often covered with hairy down, and its forehead is square in form. Obstruction to entry of air into the lungs by partial occlusion of the windpipe or of the bronchi by spasmodic asthma in the child, often leads to a retraction and falling in of the lower part of the thorax. Very great retraction and collapse of the lower ribs, and forcing forward of the sternum, like the keel of a boat, produce the 'Pectus Cariniforme.'

A well-formed thorax is symmetrical on its two sides, its anterior walls arch forward slightly to line of nipples, and thence slope downwards to the lower ribs. The nipple line corresponds about to the level of the fourth interspace.

Under certain conditions the conformation of the thoracic parietes may be changed as a result of imperfect development independent of any diseased action. In this way is produced the long narrow chest with wide intercostal spaces, and sinking of the manubrium sterni so that it forms an angle at the point where it joins the body of the bone. This form of chest is usually associated with more or less delicacy of lung.

Pathological changes in the shape of the thorax may be thus arranged :

1. General bilateral bulging and enlargement, with increase in all the diameters of the thorax. This condition constitutes the 'barrel-shaped chest,' and is observed in advanced large lunged emphysema, resulting usually from long standing bronchitis.

It will be observed that in these emphysematous chests very little difference in circumference takes place in the movements of inspiration and expiration, the lungs being distended in a permanently inspiratory position.

2. Unilateral dilatation of the chest may be due to an excessive pleuritic effusion on that side. This great distension of one side of the chest indicates a large amount of fluid which has pressed the lung well back against the spine. Before such distension of the chest wall is observed, it will be noticed that the intercostal spaces are flattened, so that the external surface of the chest feels even and smooth to the applied hand.

A large distension of one side of the chest will also cause displacements of organs by pressure. Thus the heart is carried over to the right by fluid in the left chest, and liver or spleen may be pressed downwards by a collection in the thoracic cavity above these organs.

Accumulation of air in the pleural sac (pneumo-thorax) may cause enlargement of the side. This effect is brought about by a sudden laceration of the lung by an injury, or the ulceration of a superficial tubercular deposit or cavity. The lung shrinks

and collapses, while the thoracic wall becomes more and more distended with pent-up air. The rapid development of this state of chest, and the tympanitic sound of the chest when struck, serve to distinguish it from a distension by fluid. When a pneumo-thorax has formed, however, fluid soon collects in the pleural cavity (hydro-pneumo-thorax), and then a splashing sound is heard on shaking the patient.

3. Tumours within the chest may cause undue bulging of some part of the chest wall. A bulging of the lower part of the right chest may be caused by enlargement of the liver.

Contraction of one side of the chest may be due to the absorption of an old pleuritic effusion. The lung having been long subjected to pressure from a collection of fluid, is so destroyed that it will not expand when this pressure is removed; hence the falling in and contraction of the chest wall. In these cases the ribs are drawn so close as to overlap one another, the nipple is nearer to the sternum, and the shoulder-blade to the vertebral column on the affected side. The shoulder is drawn down, and the spine curved with its convexity towards the sound side of the chest. The diaphragm and liver, on the right side, may be drawn up; and, on the left side, the heart may be drawn away from its normal position, even into the left axilla.

These signs of a contracted chest after absorption or evacuation of fluid are often seen very well marked in the cases of growing children.

Circumscribed local depressions on the surface are due to shrinking of the subjacent lung, and may be caused by the contraction of a phthisical cavity, or condensation of lung tissue over a dilated bronchus. These local depressions should be looked for in the upper and anterior part of the chest wall.

In interstitial chronic pneumonia, cirrhosis of lung, or fibroid phthisis, the affected side, usually the right, is contracted, but the spine and shoulders are not altered, as they are in contraction of chest after pleurisy.

Tuberculosis and primary cancerous infiltration may also act as causes of retraction of the chest wall.

MENSURATION OF THE CHEST is best effected by means of

two tapes joined at the commencement of their scales and fixing them at this line of junction over the spine. The movement of each side of the chest in deep inspiration is thus readily ascertained. It should be remembered that in right-handed persons the right chest has always an inspiratory excess of half-an-inch over the left. About thirty-three inches may be taken as the normal girth of a healthy chest. To trace a gradual retraction of the chest wall, as in an absorbing pleurisy, a narrow strip of lead should be moulded to the contour of the chest, then carefully laid on a piece of paper and traced by a pen or pencil. Comparison at intervals of such tracings will show at what rate chest contraction is progressing.

The antero-posterior measurements of the chest are obtained by applying a pair of common steel callipers, and observing the divergence of the blades.

MOVEMENTS OF RESPIRATION.—During inspiration a movement of expansion and elevation takes place in the thorax. In the first of these movements the sternum and anterior segment of the ribs pass forwards, the lateral outwards, and the posterior backwards. The intercostal spaces in ordinary calm breathing remain visibly hollow, the ribs diverging in forced inspiration and converging in expiration.

In the elevation movement of the chest the anterior and lateral walls are drawn upwards.

During expiration the walls of the chest are restored to their previous condition by the movements of retraction and depression. The lungs, unless fixed by morbid local adhesions, follow every movement of the chest wall.

Supposing the time occupied by a respiratory act to be represented by 10, the value of the visible duration of inspiration would be represented by 5, that of expiration by 4, and the intervening pause by 1.

The abdominal movements of respiration differ much in the two sexes. The ordinary calm breathing of a man is effected mainly by the descent of the arch of the diaphragm, so that in counting the respirations of a male, the hand should be applied over the epigastrium.

In the female, abdominal expansion is almost nil, and always posterior in time to the upper costal movement, hence, in counting the respiration of a female, the hand must be placed over the upper third of the chest.

The expansive movement of the chest can be roughly estimated by applying the palms of the hands under each clavicle while the patient inspires deeply. By practice the correspondence in expansion of the two sides can be very fairly judged by this method. To gain a more accurate knowledge, two pieces of measuring tape should be joined at the commencement of their scales, and the measurement made by placing this point of junction over the spine in the manner already described. In children, thoracic expansion is greater, and abdominal breathing less than in the adult.

Chest movement may be much changed by disease. In peritonitis, and diaphragmatic pleurisy, but little abdominal movement will be seen; and in intercostal neuralgia, pleurodynia, and the outset of pleurisy, movement will be notably diminished on the affected side. More or less tenderness on pressure will be found at the part where this limitation of thoracic movement is most marked.

Sometimes the respiratory movements exceed those of health. If the upper air passages are obstructed by laryngeal swelling or stoppage, then the chest will actually retract during inspiration, while the abdomen enlarges from the descent of the diaphragm. In highly developed vesicular emphysema of the lungs, the lower intercostal spaces will be seen to fall in during inspiration. The cause of this is the rarefaction of the air within the lungs, and the consequent preponderance of the external over the internal atmospheric pressure. The retracted state of the lower intercostal spaces, and the forcing forward of the sternum, seen in cases of 'pigeon breast,' are conditions due to obstructed inspiration, dating usually from infancy, at a time when the thoracic walls are young and yielding, and so easily forced out of shape by unusual and irregular respiratory strain.

In some consumptive persons, with the upper part of the lungs disabled by disease, it will be seen that the lower lobes of the

lungs act vigorously, the diaphragm contracting powerfully. In those who are emphysematous from old standing bronchitis but little movement of the thorax will be seen save in an up and down direction, with much straining of the sterno-mastoids and other muscles of the neck.

FREQUENCY OF RESPIRATION.—A healthy adult man breathes from 14 to 18 times in a minute. A new born child breathes about 40 times per minute. Increased action of the heart by exertion quickly increases the rate of the respirations.

Various morbid causes may lead to an increase in the respirations, and they may rise as high as 60, 70, or 90 per minute In an acute attack of spasmodic asthma, due to constrictive narrowing of the smaller bronchi, the respirations may quickly reach 80 in the minute. In some abdominal diseases, as ovarian tumour, dropsy, etc., rapid and difficult breathing is speedily induced by the recumbent position.

In fevers, respiration is usually much quickened. This appears to be a result of the high temperature, for the pulse does not always rise in correspondence with the respiration.

In pleurisy and pneumonia the respirations are notably quickened.

In laryngeal obstruction inspiration may be much prolonged, so that the respirations become abnormally slow. The same condition is observed in croup. In some diseases of the lungs, followed by affection of the brain, a great slowness of the respirations has been noted. Respiration may fall as low as 8 in the minute.

The ratio of the respiration to the pulse is important; more so, indeed, than any absolute frequency of pulse or respiration taken alone. In the adult the natural ratio is as 1 : 4, or 1 : 4·5 Dr. Walshe has recorded as extreme pulse-respiration ratios 9 : 1 in chorea; 1 : 1·25 in acute pneumonia. In hysteria the range has varied from 5 : 1 to 1·8 : 1.

In paralysis of the vagus nerve from pressure of a tumour, or other cause, respiration has been noticed to fall as low as 12 per minute.

There is a special form of dyspnœa known as *Cheyne-Stokes*

respiration, met with in some forms of disease of the heart and brain, which consist in a regularly occurring pause, lasting ¼—1 minute, during which respiration is completely suspended. This suspension is preceded by short shallow inspiration, becoming at length very difficult, then the respiration becomes again shallow, and eventually comes to a standstill, as just indicated. The whole cycle of the above phenomena is worked in about 1½ minutes. This form of dyspnœa is of very serious import, and usually betokens a fatal result.

In persons prone to attacks of dyspnœa it will be observed that the accessory muscles of inspiration, such as the sterno-mastoid, scalenus and omo-hyoid, stand out prominently. In subjects of old emphysema and asthma, this condition of the muscles is well shown. Sometimes, where expiration is very difficult and impeded, the contractions of the accessory expiratory muscles of the abdomen can be plainly seen. Normally expiration is effected by the elasticity of the lungs alone, but when this natural elasticity is diminished by emphysema or bronchial catarrh, then expiratory aid from accessory (abdominal) muscles is required.

When a patient can lie flat on his back, his dyspnœa is by no means severe, but as it increases, he has to raise himself, till at last he sits up erect, and is then said to be in a state of *orthopnœa*, a form of breath-difficulty usually seen in the instances of asthmatic persons, and of those who have dropsy connected with disease of the heart. Waldenburg and others have proved that in healthy persons the power put forth in expiration exceeds that of inspiration.

TACTILE EXAMINATION, OR PALPATION, OF THE THORAX.—After the expansion of the two sides of the chest has been estimated by the applied palm or surface of the hand during deep inspiration, examination should be made by touch and pressure over the ribs and intercostal spaces, to see if there be any tenderness on pressure.

Pain due to periostitis of a rib will be increased by pressure; so too will pain due to pleurisy, if pressure be made over an intercostal space, and this pain on pressure is usually confined to

the seat of the pleurisy, and does not extend backwards along the course of a nerve, as it does when due to intercostal neuralgia.

VOCAL FREMITUS is a vibration of the walls of the thorax, perceptible to the hand during speaking in a loud ringing voice. This vocal fremitus is always most evident on the right side of the chest, the right bronchus being more capacious than the left, and it is generally more perceptible in the upper than in the lower part of the thorax. Vocal fremitus is entirely abolished when one side of the chest is full of fluid, but if the lung be inflamed, as in pneumonia, with its parenchyma consolidated and firm, then the vibration on making the patient speak is notably increased. Thickening of the pleura may cause a very distinct vibratile thrill, felt by the hand applied during respiratory movements.

Bronchial fremitus indicates the presence of diffused bronchial catarrh, and is a noteworthy symptom in the bronchitis of children, as, owing to imperfect expectoration, mucus collects largely in the bronchi. In vesicular emphysema, vocal fremitus is scarcely perceptible unless bronchitis co-exists. Fluctuation in the thorax is occasionally felt when much fluid is present in the pleural cavity, by placing the palm of one hand at the back and tapping on the front with the fingers of the other hand. Fluctuation of fluid in pulmonic cavities of large size has been now and then detected.

SECTION IV.

DIAGNOSIS BY PERCUSSION OF THE THORAX.

PERCUSSION is a most important aid to the physical diagnosis of disease in the thorax or abdomen. What is called *immediate* percussion consists in striking the thorax directly with the tips of the fingers. It is a method now abandoned, as it does not enable us to distinguish with sufficient precision between the

finer shades of difference in the pitch or quality of percussion sounds.

MEDIATE PERCUSSION is exercised by interposing the finger as a pleximeter between the thoracic wall and the percussing finger. The index finger of the left hand is applied closely and evenly to the chest, and then this is tapped with two or three fingers of the right hand kept firmly together. The movement of the right percussing hand must spring from the wrist only, the forearm must be motionless. The blows must be gentle at first, for thus we avoid hurting any tender part, and by this method we obtain accurate knowledge of the density or dulness of superficial parts. When deep seated structures are the object of investigation, the blow must be more forcible. The blow must be given and the fingers withdrawn quickly, so that surface vibration be not impeded. The only exception to this rule is when we wish to elicit a 'cracked-pot' note over a lung cavity.

Percussion is sometimes performed by striking with Wintrich's hammer on an ivory disc pleximeter. Very marked differences of resonance, as between lung and liver sounds, are clearly demonstrated by this instrument, but the finer differences in tone are far better judged by the method of digital percussion.

POSITION OF THE PATIENT should, if possible, be that of standing or sitting; more accurate results being then obtained than where the patient is recumbent in bed. While the front of the chest is percussed, the arms should hang loosely by the sides. The hands may be clasped across the top of the head during percussion of the lateral and axillary regions, and during examination of the back the head must be bent forward and the arms tightly crossed in front.

Percussion should commence at the supraclavicular region, and proceed symmetrically downwards on each side, till, on the left side, at the fourth rib, the heart is encountered, and the note on striking becomes therefore dull as we pass from the air-containing resonant lung to the solid heart. On the right side in health we find resonance to cease at the sixth rib, where we come over the dull-sounding liver.

PROPERTIES OF THE PERCUSSION SOUND IN VARIOUS REGIONS IN HEALTH AND DISEASE.—The resonance of the percussion note over healthy lung is due to the vibration of the air contained in the pulmonary vesicles, in part also to the vibration of the thoracic parietes. The greater the body of healthy lung beneath the spot struck, the lower will be the pitch, the longer the duration, and the softer the quality of the percussion note. About the fourth interspace, on the right side, a perceptible elevation of pitch on percussion will be remarked; at the same time the applied finger will recognise an increased sense of resistance to firm percussion. The cause of these changes is that the liver lies here behind the shelving border of the lung. On deep inspiration a portion of lung fills out and extends in front of the liver, a fact that a skilful percusser will be able to demonstrate by using very gentle percussion after a very complete inspiration.

At the level of the fourth rib on the left side, the lungs diverge and percussion becomes dull from falling over the heart, and this dulness can be followed outwards as far as, or, with a firmly given blow, a little beyond, the left nipple.

The supra-sternal region gives a tubular note on percussion, but sometimes this is modified if there be much cellular substance beneath at the top of the mediastinum. Below the third rib sound is toneless as we approach the regions of the heart and liver.

POSTERIOR REGIONS.—The supra-spinous fossæ, on firm percussion, give a good pulmonary note. Both infra-scapular regions also should be resonant as far as the eleventh interspace, but on right side strong percussion will bring out the hard high-pitched liver note as high often as the eighth rib. As a rule percussion of extreme right base never gives so clear a note as left extreme base.

PERCUSSION IN DISEASE.—When the pulmonary cells are obstructed so that they contain no air, we get what is called a dull percussion sound. With this dulness is associated diminished mass of tone, increase of pitch, and greater sense of resistance; these conditions indicating that the air in the lung is

diminished and the lung more or less consolidated, or they may show that fluid is present in the pleural cavity and the lung compressed and airless. We expect, therefore, to detect this dull, toneless note on percussion in cases where (1) the lung is consolidated from exudation into its cells, as in the second stage of pneumonia, or in case of tubercle, cancer, or abscess infiltrating the lung tissue; (2) collection of fluid in the pleural cavity, or a solid or cystic growth or tumour, would be another cause of this dulness; and (3) condensation of lung tissue from dilatation and thickening of a bronchial tube. At times the percussion note is said to be *hard* or *wooden*, with raised pitch and increased sense of resistance. This form of note is met with where air is diminished and hard consolidation of lung is present. When found at the apex of a lung, it is a great indication of early tuberculisation. It is also met with at times over a superficial cavity in the lung with a thin indurated adherent wall, or where dilated bronchial tubes are surrounded by hardened tissue, as in the state known as pulmonary cirrhosis.

A third type of morbid percussion resonance is recognised where the lung sounds extra resonant; the mass of tone being increased, the pitch lowered, duration increased, and sense of resistance lessened.

These signs show excess of air in the lung and belong to the diseased states known as emphysema of lung, pneumo-thorax, and pulmonary hypertrophy.

The resonance in pneumo-thorax and hydro-pneumo-thorax may be tympanitic or drum-like. A temporary tympanitic note has been observed by Graves and also by Walsh rarely to occur over pulmonic consolidation, and also over the apex of the lung when its lower part is compressed by fluid effusion in pleurisy. Amphoric sound (from *amphora*, a jar) is more the sort of sound that is heard under the first of the above conditions, according to Walshe, this sound being an exaggeration of tubular sound, and comparable to that which is elicited on filliping the distended cheek. Tympanitic or amphoric sounds on percussion are found where the lung has ruptured, and so caused distension of the pleural cavity with air, as in *pneumo-thorax*.

When fluid is present in the cavity of the chest, the dull percussion note can be made to vary by changing the position of the patient, and so shifting the fluid from one part to another. If the fluid be pent up by adhesions, this test fails, and then the best method to solve doubt is to puncture the dull or bulged part of the thorax with a fine trochar or hypodermic injection syringe.

A *hollow* quality in the percussion note over the chest comprises the *tubular* and *amphoric* sounds just mentioned, and also a third variety known as the *cracked-pot* sound ('bruit de pot félé' of Laennec). This note can be imitated by striking the back of the hands, loosely folded across each other, against the knee—the contained air being forced out between the fingers at each blow. Usually this cracked-pot note is associated with an amphoric sound, and it is well shown when percussion is made over a large-sized cavity in the lung, which opens freely into the bronchus and has yielding walls. The patient must open his mouth, otherwise the true cracked-pot note will not be detected, though the amphoric sound may be quite plain; and, further, the percussing fingers should remain an instant in contact with the pleximeter finger; then, as air is forced out of the lung cavity through the bronchus and mouth, the peculiar 'click' of the cracked-pot will be unmistakable.

In the case of a consumptive adult the presence of this cracked-pot note on percussion is good evidence that a cavity exists in the lung; but in young children the sound may be heard often in cases of bronchitis or of pneumonia at the lung apex. The pliancy of the chest wall in those who are young is the cause of this. In all cases where the chest wall is thickly covered with muscle or fat the percussion note is more or less muffled in sound.

SECTION V.

AUSCULTATION OF THE CHEST.

AUSCULTATION, like percussion, of the chest may be mediate or immediate, according as we listen with or without the intervention of the stethoscope between the ear and the chest. THE STETHOSCOPE is best made of some long fibred wood, such as cedar or deal; it should be of one piece, and the ear-plate concave, so as to fit closely to the ear. The sternal end should be small when we wish accurately to limit and define a cardiac murmur. Flexible stethoscopes are useful when the patient is weak and cannot be readily moved. Many observers now use the binaural stethoscope of Dr. Cammann, by which both ears can be employed at once, and in consequence all pulmonary and cardiac sounds heard with great intensity, so that any one accustomed to this binaural instrument can do but little with the ordinary wooden stethoscope. The slightest movement of the tube or ear-piece of this binaural stethoscope will produce loud accessory sounds which may be very perplexing.

In auscultating the lungs we seek to obtain knowledge of:

1. Simple respiratory murmurs.

2. Rales, or rattles, produced during respiration by the presence of fluid in the bronchi or lung substance.

3. Friction sounds caused by the rubbing of roughened surfaces on each other.

4. Dry, sonorous, and sibilant sounds, due to narrowing of the larger and smaller bronchial tubes.

The pulmonary murmur of health is described as a soft, breezy sound, produced by the entry of air into the cells, or alveoli, of the lung, hence it is often called the vesicular murmur. This being the cause of the murmur, it is easy to understand how it comes to be abolished when the air-cells are impervious from being filled with exudation.

In health the vesicular murmur, audible only during inspiration, is heard over the whole thorax, most loudly at those parts which are thinly covered. It is, therefore, loud in the infra-clavicular region, feeble at the supra and infra-spinous regions; it is weak where the subjacent layer of lung is thin, as at its border. Greater convexity of ribs on one side than on the other will cause the vesicular murmur to be weak on the convex side.

The pulmonary *inspiratory* sound is soft and continuous; the *expiratory* sound is slightly harsher and hollower, as well as weaker and shorter than its predecessor, and in one out of four healthy persons may be quite inaudible on the left side of the chest. The two sounds follow one on the other closely in health, but as we proceed to listen at points distant from the pulmonary parenchyma, so will the sounds be separated one from the other by a distinct interval. This will be well observed on listening to the tracheal sound over the upper part of the windpipe. The respiratory sounds are always louder in women and children than in men.

Bronchial Respiration is best heard between the scapulæ, at the upper end of the sternum, and over the bifurcation of the trachea; it has not the 'breezy' sound of vesicular breathing, but is of higher pitch, and is not closely followed by expiration. Tracheal breathing is higher in pitch and more hollow than the bronchial sound, and is heard best over the trachea. The respiratory murmur is usually of higher pitch under the right than under the left clavicle, and expiration is always most audible on the right side.

SECTION VI.

AUSCULTATION IN DISEASE.

In diseased conditions of the lungs the respiratory murmur may be altered.

A. In *duration* and *intensity*, becoming: (1) Exaggerated or Puerile. (2) Weak or Senile. (3) Suppressed.

B. Its rhythm may be: (1) Jerking. (2) Deferred. (3) Expiration prolonged.

C. Its character may be: (1) Harsh. (2) Bronchial or blowing. (3) Cavernous. (4) Amphoric.

EXAGGERATED RESPIRATION is known by increase of the intensity and duration of the inspiratory and expiratory sounds. When general over one lung, it probably will be found to indicate that the other one is disabled from acting by inflammation, or some other cause; hence the exaggerated breathing in the sound lung is called *supplementary;* it is also called *puerile,* from its resemblance to the loud strong respiration of young children. Exaggerated respiration is to be regarded, therefore, as indirect evidence of disease in some part, more or less remote, of the pulmonary substance.

WEAK RESPIRATION, called also senile respiration, as being characteristic of old age, is marked by diminished intensity and duration of the sound. In asthma, pulmonary emphysema and obstructive disease of the larynx and air-passages by thickening or swelling, we get superficial weak respiration. When one side of the chest is full of fluid, we may hear a deep-seated weak breath sound, or all sound may be suppressed, while on the other, healthy, side we hear exaggerated respiration.

JERKING RESPIRATION.—Here the rhythm of the sound is changed, and it is best noted in the inspiration. This jerky breathing is noted in some spasmodic affections of the air-tubes, in hysteria, the early stages of pleurisy, and pulmonary phthisis. Usually most notable under right clavicle.

DEFERRED INSPIRATION is often well marked in emphysema of the lung. The inspiratory movement of the chest commences before any sound is produced. In some cases of consolidation of the lung, an opposite condition to the rarefied state known as emphysema, the inspiratory sound ceases before the expansive movement of the chest is complete. This constitutes *unfinished inspiration,* and is rare.

The normal ratio of inspiration to expiration is as 3 : 1, but it may be changed to 1 : 4, and such perversion would mark very great and unusual prolongation of expiration, and would only

occur in a case of extreme emphysema, where the natural elasticity of the lung was much impaired.

BRONCHIAL RESPIRATION, of pathological origin, may be high or low in pitch, and it indicates more or less consolidation of the lung around the bronchial tubes. It is heard very harsh, and high in pitch, when the upper part of the windpipe is compressed by tumours, or narrowed by exudation, as in croup and diphtheria. When the air-cells of the lung are filled with exudation, as in the hepatisation stage of pneumonia, we hear bronchial breathing over the part thus solidified. Under these conditions also we hear *bronchophony*, or bronchial voice, when the patient speaks, his words being conveyed with a brazen clearness into the ear of the listener in consequence of the solid lung becoming a good conductor of sound.

Bronchial respiration, less intense than that heard during the hepatisation stage of pneumonia, can be detected over portions of lung rendered more or less solid by congestion, by caseous degeneration (phthisis), by chronic interstitial pneumonia with dilatation of the air-tubes, and in the vertebral groove in cases of pleuritic effusion where the pulmonary tissue is rendered airless by compression. Such compression of lung may result from fluid in the pleura, or from an aneurism or other form of tumour.

CAVERNOUS AND AMPHORIC RESPIRATION. PECTORILOQUY. ÆGOPHONY.

THE hollow sound of cavernous breathing is heard over a cavity in the lung, and is therefore commonly met with in cases of advanced consumption at the anterior or posterior part of the lung apex. Expiration under these conditions is usually of higher pitch than inspiration, and the sounds often have a whiffing metallic note. In very large lung excavations with dense walls, as well as in cases where the pleura itself is full of air that has escaped from a rupture in the lung tissue (*pneumothorax*), we get *amphoric* breathing, hollow, high-pitched, and metallic, like the noise produced by blowing into a jug. The amphoric note is heard both with inspiration and expiration, and

the best place to hear it is about the middle of the thorax. While listening to the amphoric respiration, the observer may hear *metallic tinkling*, a sound produced by drops of purulent matter falling from the top to the bottom of the large cavity.

Fluid and air together in the pleural cavity (*hydro-pneumothorax*) produce the succussion or splashing sound on moving the patient from side to side. It should be noted that cavernous breath-sound may be heard over dilated and bulged bronchial tubes (*bronchiectasis*) when these are surrounded by dense pulmonary tissue. At times cavernous breath sound is heard one day and not the next. This is due to the cavity being full of secretion; after the patient has got rid of this by coughing the cavernous sound will be very distinct.

RHONCHI, RALES, OR RATTLES.

The above-named accidental sounds, indicative of disturbances in the respiratory process, are produced in the air tubes, the air cells, or in cavities formed by disease in the lung tissue. Being formed within the lungs, these sounds may be called *endo*-pulmonary, as distinguished from the *exo*-pulmonary sounds produced by pleural friction. Endo-pulmonary sounds may be dry, moist, or indeterminate in character.

1. Dry or Vibrating Rhonchi may be sibilant and high-pitched, or sonorous and low-pitched.

The sibilant rhonchus, or rale, is a whistling or hissing sound, varying in intensity and duration, co-existent with inspiration and expiration, though now and then limited to one or other act only. The cause of this sound is a narrowing of the smaller bronchial tubes by contractile spasm, as in asthma, or far more often by swelling of their lining membrane with deposition of viscid mucus. Coughing, by altering the position of this collected mucus, will often clear away the rhonchal sound for a time. Persistence of the sibilant rale in one spot indicates narrowing of the bronchial tube there by continuous spasm or by pressure from some growth or tumour. Generally this sibilant rale is found associated with bronchitis in its early and dry stage and pulmonary emphysema. When secretion commences into the

air-tubes, then bubbling sounds will be heard, fine at the bases of the lungs, and coarser higher up in the chest.

Sonorous Rhonchus, like the sibilant, is of a vibratile character, and is a deep snoring or cooing sound, rather more marked in expiration than in inspiration, produced in the larger air tubes and associated with bronchitis, emphysema, and spasmodic asthma.

Mucous Rhonchus or Rale is a moist sound produced by the bursting of bubbles of unequal size, and it can be modified by coughing and expectoration. The bubbling is audible with inspiration and expiration as the air passes through fluid (mucus, blood, or pus) in the smaller air tubes. The best place to listen is over the central and middle parts of the lung. The disease with which this moist rale is associated is bronchitis after secretion has become established.

Sub-Mucous, or Sub-Crepitant Rale is a weaker and finer bubbling sound, chiefly heard with inspiration, and produced by the bubbling of air through viscid fluid in the minute bronchioles. The diseases with which it is associated may be capillary bronchitis of both lung bases, tubercular bronchitis at the apex of one lung, and the resolution stage of pneumonia.

With respect to mucous rales, it should be borne in mind that a few scanty rales may be heard in the chest of many perfectly healthy individuals on causing them to take a few sudden deep inspirations.

The Crepitant Rale of Pneumonia, known as the moist crepitating rale of Laennec, requires a word of special notice. This sound resembles that produced by rubbing the hair of the head between the fingers close to the ear, and it is produced in the chest in the extremities of the smallest bronchioles and in the air cells by air forcing its way through glutinous secretion. It is best heard at the close of full inspiration; the fine crepitations are uniform, not unequal, and are not removed by coughing.

This condition occurs in the early stage of pneumonia before the lung cells are blocked with exudation, and so made impervious to air.

In pulmonary œdema, or swelling of the lung substance, a condition met with often in dropsy, serous fluid is poured out into the air cells and bronchi, producing an irregular, unequal crepitation as the breath is drawn.

Crepitation may be heard at times over collapsed portions of lung and over lung compressed by collection of fluid in the lower part of the pleural cavity.

Redux Crepitation consists of a slowly-evolved bubbling audible in expiration as well as in inspiration. It is due to air bubbling through fluid contained in the smaller bronchi, and is indicative of the resolution of pneumonia.

Friction Sounds of grazing, rubbing, creaking, grating variety, are due to the rubbing together of two surfaces roughened by the deposit of lymph of varying consistence. When produced between the layers of the pleuræ, this sound appears with inspiration, and often too with expiration, as a series of abrupt jerks, very superficial, and attended with some degree of thrill or fremitus felt by the applied hand. In old chronic thickenings of the pleura this fremitus may be very marked and the attendant to and fro sound very loud. Creaky stretching sounds are heard when the two pleuræ are adherent by the intervention of plastic lymph.

As fluid effusion takes place in the course of pleurisy, the friction sound ceases, owing to the two pleural membranes being separated from one another, while at the same time a peculiar bleating twang (ægophony = goat voice) is heard by the stethoscope when the patient speaks. This, however, ceases as much fluid collects, and then the side becomes dull and respiratory sound is no longer heard.

Friction sounds are usually intensified by the pressure of the stethoscope, as in this way the opposed surfaces of the pleuræ are brought into closer contact, and the friction increased accordingly. Rales in the lung and air-tubes are unchanged by increasing the pressure of the stethoscope.

Auscultation of the Cough.

Obstruction of the bronchi by plugs of mucus can be removed

by causing the patient to cough, and then, the passage being cleared, the respiratory murmur, previously suppressed, becomes audible.

Mucous rales are intensified after the act of coughing. When the lung is solidified cough resonance is increased, and when large superficial cavities are present, auscultation over these, when the patient coughs, discloses a loud metallic ring.

The most sensitive part of the pulmonary mucous membrane is that which protects the larynx and trachea as far as its bifurcation; the mucous membrane of the bronchi is less sensitive. This will account for the fact that people usually refer their cough to the throat, and when blood is expectorated, as it is first perceived when it comes in contact with the lining of the trachea, patients usually believe it must proceed from the throat.

A few short, slight coughs every morning, with a scanty mucous expectoration, is very significant of early phthisis.

Continuous cough with varying expectoration is common in all diseases of the respiratory organs. Spasmodic or convulsive cough is best exemplified in whooping-cough.

SECTION VII.

OF SPUTA.

THE quantity of the sputum varies in acute as well as in chronic diseases of the respiratory organs. Sometimes in the course of severe acute disease, as senile pneumonia, there is no sputum, and in chronic disease also it may be wanting. Children commonly swallow their expectoration. When in bronchitis, pneumonia, or whooping-cough the sputum becomes more copious, more easy of discharge, and yellowish, it comes chiefly from the larger bronchi, and indicates that the smaller tubes are getting clear and the disease passing off. Heavy firm sputa sink in water while keeping their rounded form; such expectoration may

come from a cavity in the lung. Generally the air and mucus present float at the top of the water, while purulent matters subside to the bottom.

Very fluid sputa may come from an œdematous lung. When one lung is crippled by pressure from pleural effusion, the other may become œdematous, and one sign of this serious complication is the discharge of copious albuminous liquid expectoration, sometimes mixed with blood.

A clear glairy sputum, 'sputum crudum' of the ancients, is commonly observed in the early stages of laryngeal catarrh. As the disease progresses towards its abatement, the expectoration becomes thicker, yellower, and more rich in cells; this is the 'mucus purulent' expectoration corresponding to the 'sputum coctum' of old observers. When the smaller bronchi are affected with acute catarrh, the sputum, coming from the smaller tubes unmixed with air, retains the shape of the tube, and clings to the frothy lighter secretion from the larger bronchi, which is mixed with air and floats in water, the heavier portion hanging down beneath it.

In chronic bronchitis a muco-purulent homogeneous sputum is commonly coughed up every morning on rising. If the morning expectoration be fetid in smell, and less viscid than ordinary catarrhal sputum, depositing a grayish green sediment when left to stand, then there is reason to suspect dilatation or sacculation of some of the bronchial tubes, a condition known as *bronchiectasis*. The cough, under these conditions, comes on in violent paroxysms with copious bad smelling expectoration, and then follows an interval of rest and freedom from cough.

In pulmonary phthisis the expectoration is at first watery, or clear and mucilaginous, and at times, when allowed to stand, a thick pale grayish sediment forms which is very significant. After a while purulent yellow striæ appear in the expectoration, which grows less and less aërated; then, as the disease progresses, the sputum becomes distinctly purulent, and full of small ragged pellets (boiled rice sputum), or large nummular masses remaining apart in water are seen. These lumps, which sink to the bottom of the vessel containing the expectoration,

point to the presence of lung cavities, in which these thick lumps are formed. The more compact gray masses, if boiled in liquor sodæ and the liquor allowed to stand in a conical glass, will exhibit in the scanty sediment, viewed under the microscope, specimens of the elastic fibres of the air cells of the lung. The discovery of such elastic fibres is pretty certain proof that the lung is being destroyed by phthisis. Copious and sudden expectoration of pus betokens the sudden rupture of a large cavity into a bronchus, or the evacuation of an empyema by the same channel.

HÆMOPTYSIS.—PULMONARY APOPLEXY.—Red or sanguineous sputa consists of blood more or less blended with the expectoration.

Copious expectoration of pure florid blood shows that a vessel has ruptured in the lung. The blood rising into the trachea produces a sensation thereabouts which causes the patient often to believe that the blood must come from the throat rather than from the lungs. Hæmoptysis, or blood-spitting, may be the first sign of commencing phthisis, when as yet we can detect no physical signs of the disease, or it may occur at intervals during the course of the complaint. The quantity may vary from a teaspoonful to a tumblerful. Copious hæmorrhage in the course of phthisis may be due to the rupture of a large blood-vessel in the wall of a cavity in the lung, and when it thus arises, it is most serious, and at times is immediately fatal. Blood effused into the lungs is usually coughed up after the hæmorrhage, and this circumstance, together with the florid, frothy, fluid character of the blood thus thrown up, marks *hæmoptysis* from the lungs as distinguished from *hæmatemesis*, or vomiting of blood from the stomach.

Bleeding from the lungs may be due to disease of the heart, especially to constriction of the mitral orifice; this condition tending to induce congestion of the lung, and at times actual hæmorrhage through the throat; or the effused blood may form *infarctions*, stuffing up the air-cells, and producing a dull patch of what is termed *pulmonary apoplexy*. These hæmorrhagic infarctions, in cases of heart-disease, scarcely ever give rise to true caseous pneumonia.

The sputa may be tinged to varying degree with admixture of blood, the depth of coloration being in proportion to the quantity of blood present. When the sputum is *streaked* with blood, the probability is that the blood comes from the upper part of the air-passages, and not from the lung substance.

A scanty tough sputum floating in water and beset with specks of blood is very indicative of pneumonia just commencing in the stage of engorgement. As hepatization of the engorged lung comes on, the sputum becomes rusty-coloured from interblended blood, and so glutinous that the vessel containing it may be inverted without loss of its contents. As resolution of the pneumonia takes place, the sputum becomes yellowish, or of greenish hue from altered hæmoglobin, and fragments of small fibrinous casts of the smaller air-tubes may be intermixed. A fluid sputum of dark reddish brown or *prune-juice* hue indicates a low state of vitality, and is of unfavourable import. A greenish grey intensely fetid sputum, with shreds of necrosed tissue intermixed, is a sign of pulmonary gangrene. Needle-shaped crystals of the fatty acids are often met with in fetid and gangrenous expectoration. Ciliated epithelium, when found in the sputum, usually comes from the nasal passages. Columnar epithelium, the lining of the air passages, is not readily detached, and therefore not commonly found on microscopic examination of the sputum.

SECTION VIII.

PHYSICAL DIAGNOSIS OF DISEASES OF THE ORGANS OF CIRCULATION.

Before proceeding to the physical examination of the heart itself, note should be taken of any visible pulsation of arteries or veins about the body, and then the fingers should be placed on the radial artery at the wrist.

The Pulse, in a healthy adult, beats at the rate of 60—80

times per minute, the average being 72; in fever its frequency varies from 80—150. A pulse of 140 indicates high fever, and is of grave prognosis. Above this rate the pulse becomes very small and thready, and is then usually in acute organic or zymotic diseases the precursor of death.

It may here be noted that in exophthalmic goitre (Basedow's or Graves's disease), we may have a pulse of 150 though no fever is present. The cause of this unusual rapidity of the pulse is due to irritation of the sympathetic nerve. In young children from one to ten days old, the pulse averages, according to M. Billard, 101—2 per minute. Becquerel found that in children of six years the pulse usually ranged at 76 during sleep, and 92 whilst awake. The pulse in a child varies much under exciting influences, and it is best to count the pulse of a young child during sleep, when the circulation is free from nervous disturbing influences.

The rate of the pulse at the wrist is of some value in guiding us to the diagnosis of certain diseases of heart and blood-vessels. In acute affections of the heart, such as pericarditis and endocarditis, the pulse is always quickened. In chronic valvular diseases of the heart it will be noted that the pulse may be quickened in mitral valve lesions, while it is normal, or subnormal, in aortic valve disease. A very slow pulse sometimes accompanies atheromatous change in the coats of the aorta, and in cases of fatty degeneration of the muscle of the heart, the pulse has been known to fall as low as 30 in the minute. Obscure nervous affections have been reported, associated with a pulse of 18 per minute, the heart itself being in every respect sound and healthy.

A feeble *thrill* felt in the radial artery, with a pulse visible to the eye, and of sudden, short, jerking character, though regular in rhythm, is pretty certainly diagnostic of aortic insufficiency, with regurgitation of blood through the valves during the diastole.

A firm resisting pulse, with a hard rigid feel when rolled under the finger, is indicative of hypertrophy of the heart, and more or less atheromatous and calcareous degeneration in the coats of the blood-vessels.

Visible impulse in the arteries generally is a sign of hypertrophy of the left ventricle. Hypertrophy of the right ventricle is not attended with this forcible and visible arterial impulse.

A pulsation of the jugular veins in the neck is sometimes observed independently of any impulse given to the vein by proximity to the carotid artery. This venous pulse is caused by the regurgitation of a wave of blood, during the systole of the heart, into the superior cava and jugulars. It most commonly depends on regurgitation of blood through insufficient tricuspid valves. This pulse, when thus caused, is most marked in the right jugular vein, and it may be seen reaching as high as the angle of the jaw.

Before quitting the subject of arterial pulsation, a few words more may be said respecting the radial artery at the wrist, or *the pulse.*

RHYTHM OF THE PULSE. — The regular, or rhythmical action of the heart in health is subject to disturbance from various causes under which the pulse becomes more or less irregular or arhythmical. Nervous disturbance or disorder of stomach and liver may be a cause of irregular action of heart and intermittent pulse. Disease of the valves of the heart, especially of the mitral valve, may produce irregular action, and in old standing valvular disease, when the muscle of the heart begins to fail, intermitting pulse may be the warning of this change. Sometimes the action of the two pulses at the wrists does not correspond, and then we may suspect an aortic aneurysm, the circulation being delayed on the side on which the aneurysm lies.

An aneurysm may cause a delay between the cardiac systole and the arterial beat at the wrist. Stenosis, or narrowing of the aortic orifice, may produce the same results from the longer duration of the systole.

An intermitting pulse may be due to want of power in the ventricle to drive the blood to the radial artery, so that, after several regular strokes, one or two fail to be perceptible at the wrist. This condition is not incompatible with health, and is due to feeble contraction of the ventricle.

INCREASE OF VOLUME IN THE PULSE depends on increased capacity of the blood-vessel, and on the power of the cardiac contraction. A small quantity of blood circulating in the arteries causes diminished pulse volume, and thus is produced the *tremulous* and *thready* pulse of extreme debility.

Extreme tension of the artery by blood causes a *hard* pulse, not easily compressed, the reverse condition of the weak relaxed blood vessel and *soft* pulse. Hypertrophy of the left ventricle causes a hard pulse.

The pulse is *active, bounding, and rapidly receding* in cases of insufficiency of the aortic valves.

The DICROTIC OR DOUBLE pulse is marked by a secondary beat (bisferiens), and it is caused by a recoil wave of blood from the closed aortic valves. When the tension of the artery is lessened, as in high fever, this after-stroke is often very marked. A pulse that is obscurely *dicrotic* is named *sub-dicrotic;* it is noticed in moderate degrees of fever and at times in dyspepsia.

SPHYGMOGRAPHY.

In the SPHYGMOGRAPH a lever rises and falls with each beat of the radial artery, over which it is placed on the wrist, and by this rise and fall traces on a smoked paper, fixed on a moving dial, the cardiac beat. The tracing shows that in health the line of ascent of all arteries is upright and unbroken, and this line is traced by the contraction of the ventricle and dilatation of the arteries. Then comes the line of descent, which is broken and irregular, since the return blood wave from the contracting arteries recoils on the closed aortic valves, and a secondary dicrotic wave is generated by this shock.

When we find the pulse trace without any well-marked notch *before* the great secondary wave, and the line of descent forming an almost oblique line, it indicates *high arterial tension*, with full arteries and a hard incompressible pulse. On the other hand, when the line of descent falls suddenly, the arteries are insufficiently filled, and the pulse is soft and compressible.

Force of pulse gives a high upstroke from throwing the lever

of the sphygmograph well up. In old persons, where the volume of the blood-vessels is large, the trace shows great fulness.

The line of descent in the sphygmogram of a healthy pulse usually shows both the dicrotic and tricrotic recoil waves.

TRICOTISM is due to a recoil wave from the capillaries, or to secondary contraction of the elastic vessel wall.

With respect to the value of the sphygmograph as a means of diagnosis in cardiac disease, I must refer the reader to the works of Balthazar Foster, Burdon Sanderson, and F. A. Mahomed. As yet it has not done much to add to our knowledge of the diagnosis of cardiac diseases.

SECTION IX.

PHYSICAL DIAGNOSIS OF CARDIAC DISEASES BY INSPECTION AND PERCUSSION.

THE heart lies obliquely in the thorax behind the middle and lower bone of the sternum and the cartilages of the third, fourth, and fifth right ribs near the sternum, and the cartilages of the third, fourth, fifth, and sixth ribs on the left of the sternum. The heart rests upon the cordiform tendon of the diaphragm; its base is on a line with the interval between the cartilages of the second and third ribs, and the impulse of its apex can be seen and felt between the fifth and sixth ribs, slightly to the left of the junction of the fifth rib with its cartilage and on a line with the junction of the xiphoid cartilage and the sternum.

he true apex lies behind the sixth rib, covered in front by a tongue-like process from the left lung.

Deep inspiration tends to lower the heart's apex, and, by distending the lung, weakens the force of the impulse. Expiration has the reverse effect. A full stomach raises the apex. Enlarged liver may push the apex upwards and to the left. All enlargements of the heart depress the apex-beat, and may carry

it as low as the eighth rib. Effusion of fluid into the sac of the pericardium always raises the apex-beat. In children the apex of the heart may lie naturally as high as the fourth intercostal space. Effusion of fluid or escape of air into the left pleura will carry the apex-beat over to the right side of the chest.

The region of the heart's *superficial dulness*, known as the *præcordial* region, corresponds to a vertical line through the centre of the sternum. About the middle of the bone, nearly level with the cartilage of the fourth rib, the edge of the left lung separates from this middle line and passes obliquely to the left side, thus exposing a small portion of the pericardium in the form of a sort of triangle, the apex above, the base below. The parts of the heart thus uncovered by lung, and in contact with the thoracic wall, are a part of the left ventricle near its apex, and also a part of the right ventricle. A dull space is thus formed, which can be mapped out by careful and light percussion, and it will be found that its base is level with the cartilage of the sixth rib; its right boundary a vertical line through the centre of the sternum, and its left boundary is an oblique line through the cartilages of the fifth and sixth ribs on the left side. The lower boundary corresponds with the lower border of the right ventricle. The heart, as a whole, extends vertically from the second space to the sixth cartilage, and transversely from a little within the left nipple to a finger's breadth or more to the right of the sternum. These are the limits of the *deep cardiac region*. The deep-seated cardiac dulness extends vertically from the third to the edge of the sixth cartilage, and transversely from the left nipple to a little beyond the right edge of the sternum, opposite the fourth cartilage. Difficulty is experienced in defining by percussion the boundary between the heart and the liver. The pitch of liver percussion sound is always higher than that of the heart, and sometimes a narrow line giving a tubular note can be defined between the two organs.

Alterations in the area of the heart's percussion dulness may be produced in various ways.

1. By Effusion of Fluid into the Sac of the Pericardium.—This event may occur as part of a general dropsy, but is

specially prone to happen as a consequence of acute pericarditis in the course of rheumatic fever.

Inspection may show arching of the precordial region, bulging of the interspaces, and elevation of the left edge of the sternum. The beat of the heart will have an undulatory movement, and the apex may be raised as high as the fourth interspace.

Percussion discloses increase of the precordial dulness, which can be made out in a triangular form, base below, apex above. This triangle of dulness may, when effusion is large, extend from right para-sternal to left axillary line, while the apex of the dulness reaches to the second left interspace. Under these conditions the beat of the heart's apex will not be perceptible unless the patient lie flat on the back; then the apex may be again found as the fluid falls back by gravitation, provided the heart be not held fixed by adhesions. The more mobile watery fluid that is poured out in dropsy of the pericardium (hydro-pericardium or hydrops pericardii) shifts about more freely than the more glutinous exudation of acute pericardial effusion. A bulging of the abdomen is sometimes noticed in cases of great pericardial effusion.

2. Cardiac Dulness is increased in Extent and Intensity in Hypertrophy and Dilatation of the Heart.

There may be a general hypertrophy of the whole heart in all its compartments, and in this case it is always, according to the experience of Walshe, of the dilated or eccentric kind. In such a case of general hypertrophy the cardiac dulness will be increased laterally and downwards, and the impulse diffused generally.

In cases of hypertrophy of the left ventricle, the thickness of the muscular wall may increase from the normal amount of half an inch to as much as two inches. The area of dulness is increased towards the left, and the apex beat may be found as low as the seventh rib, or when there is much dilatation as well as hypertrophy of the ventricle, even to the eighth rib. The impulse of the heart may also be felt in the back.

Percussion dulness in dilated hypertrophy may reach from the second to the eighth rib, and transversely one or two inches across to right of sternum.

The left ventricle is the compartment of the heart most commonly affected with hypertrophy; next in frequency comes the left auricle, and then the right ventricle; last comes the right auricle—a cavity which, however, in a case of Dr. Bright's, was found so much dilated as actually to displace the liver. It contained eight ounces of blood clot.

In hypertrophy with dilatation of the right ventricle, it is chiefly the transverse area of cardiac dulness that is increased. The impulse of the heart is not so strong and heaving as in dilatation of the left ventricle, and passes further to the right than is normal. It may extend to the right mamillary line. There may be some bulging of the lower part of the sternum. Where the enlargement of the ventricles of the heart is due to simple dilatation without notable hypertrophy and thickening of the muscular wall, there is not seen any prominence of the cardiac region. The apex beat is diffused and not distinctly seen, the force of the impulse is unequal and the rhythm irregular. With these signs there is good reason to suspect fatty infiltration, or even fatty degeneration, of the muscular tissue of the heart's wall, and this opinion is confirmed if there be symptoms referable to the brain in the form of vertiginous and apoplectiform seizures.

In Hypertrophous Dilatation of the heart's cavities, the walls are thickened and the power of action increased.

In Simple Dilatation the thickness of the cardiac wall is very slightly augmented, but the capacity of the cavity is increased.

In Passive Dilatation the walls become very thin and attenuated, and here the intensity of superficial cardiac dulness is less than in the hypertrophous form of dilatation.

Dilatation carried to any extent involves both ventricles, but sometimes it is limited to the right ventricle.

The apex-beat in general cardiac dilatation is not readily pointed out; it may fall nearer the sternum than the natural

point in consequence of the rounded-off form which the heart assumes when dilated. The area of percussion dulness is notably increased in the transverse more than in the vertical diameter. Whenever the heart is being examined by percussion, the patient should lie flat on his back and on no account move his limbs or shift his position during the examination.

SECTION X.

AUSCULTATION OF THE HEART IN HEALTH AND DISEASE.

In health the contraction of the heart gives rise to two sounds with a short pause between them. The first of these is the *systolic* sound, and is synchronous with the *systole* or *contraction* of the ventricles. The second, *diastolic*, sound marks the beginning of the *diastole* of the heart; then follows the cardiac pause, which lasts till the next systole. The first, systolic, sound is more clearly accentuated at the apex of the heart and over the lower border of the sternum than is the second, diastolic, sound, which has its point of greatest intensity at the second intercostal space, close to the sternum.

The first sound of the heart is of a mixed character, one of its causes being *tension of the auriculo ventricular valves*, due to the shock of the mass of blood thrown against them during the cardiac systole. The sound produced by the action of the heart against the chest wall is too slight in the normal state of things to be audible to the listener, but when the heart is a little enlarged, or temporarily excited, then a sort of rub is heard with the systole, which probably soon subsides under the influence of rest. The prolonged booming character of the first cardiac sound has been held since the days of Laennec to be due to the act of muscular contraction.*

* It will be interesting to refer to Dr. Walshe's observations on this point, at p. 55 of the fourth edition of 'Diseases of the Heart.'

The *second* sound of the heart is produced by the recoil of the blood upon the surface of the sigmoid valves, together with the sudden tension of these valves.

To appreciate the varying character of the heart sounds at different points of the chest is very difficult, but very necessary, as the basis of observation on the organ in disease. At the left apex of the heart the first sound is dull, prolonged, and strongly accentuated. The second sound is but half as long as the first, clear, abrupt, short, and of high pitch. Moving across to the right, the stethoscope will come over the right ventricle, and here the first sound is clearer, shorter, and less accentuated than it is over the left apex-beat. The right ventricle has thinner muscular walls than the left, hence its systolic sound is shorter. At the base of the heart, or level of left and right second interspaces, the first sound is dull and without accent. The second sound is accentuated both to right and left, but chiefly at right side.

In listening for morbid sounds connected with valvular disease of the heart, it is found in practice not always best to place the stethoscope exactly over the anatomical site of the valves we are investigating. Thus sounds emanating from the *mitral valve* are not sought directly over the valve, the attached border of which lies on the level of the union of the third cartilage with the sternum, but lower down at the apex of the heart, where no lung intervenes.

Sounds connected with the *tricuspid valve* are heard best at the lower part of the sternum.

PULMONARY VALVE sounds are most clearly conducted over the anatomical site of the opening of the vessel at the sternal insertion of the third left costal cartilage.

AORTIC VALVE sounds are loudest, not just over the vessel, in the second *left* intercostal space, but in the second *right* space in the direction of the ascending aorta.

ENFEEBLEMENT OF THE SOUNDS OF THE HEART may proceed from a great covering of fat over the chest. Pathologically, weakness of the first sound is noticed in the debility of convalescence and in the course of some acute diseases; also in fatty

degeneration of the muscle of the heart and in cardiac anæmia or bloodlessness, often a precursor of fatty degeneration, the sounds are weak. In true fatty degeneration, the first cardiac sound is weak, short, and relatively high pitched; then comes a long first silence and a feeble, but relatively distinct and accentuated, second sound (Walshe). If, as often happens, the fatty change be in excess in the left ventricle, the first sound may be of notably fuller tone on passing to the right. Attacks of syncopal or of apoplectiform nature often attend these cases of fatty heart. The presence of the *arcus senilis* in the eye, due, as Canton has shown, to fatty atrophy of the cornea, is of some value as corroborative evidence of fatty heart if the patient be not far advanced in years.

Softening of the muscle of the heart and acute fatty necrosis of its fibres is apt to take place in typhoid and typhus fevers, and especially in those cases where the patient has been much weakened by any hæmorrhage.

Diagnosis of Cardiac Inflammations by Auscultation.

Pericarditis, or inflammation of the tissue of the pericardium, is known in an acute and chronic form. The disease passes through five stages: 1. Dryness and vascularity; 2. Plastic exudation; 3. Liquid effusion; 4. Absorption; 5. Adhesion of the two layers of pericardium.

It is exceedingly rare to find inflammation of the pericardium appear as a solitary disease, but it may be developed in the course of a variety of diseases, and especially during rheumatic fever, and next to that during the later stages of Bright's disease of the kidney. I have seen it appear as an idiopathic affection in a very poorly nourished child, friction sound being remarkably well developed.

The essential auscultatory sign of pericarditis is a friction or rubbing sound; with this there is more or less increase in percussion dulness, some tenderness and twisting upwards of the cardiac apex.

Pericardial Friction.—Usually best heard just above left nipple or behind the sternum, increased by pressure of the

stethoscope, and continuing when the patient stops breathing. The clicking, grazing, or rubbing sound may accompany both the systole and diastole of the heart or either singly, and the sound appears as if produced just under the surface. Friction of the grazing kind may vanish entirely in as short a time as six hours (Walshe), and that without the occurrence of any liquid effusion. The cause of the friction sound is the roughening of the surface of the pericardium by plastic lymph exuded upon it. When this is quite recent, a *grazing* friction is heard; when more chronic, the sound becomes *rubbing*, *grating*, or *creaking* in character. Generally, when we cease to hear the friction sound, it is because fluid is poured out, and so the two layers of pericardium are separated the one from the other. As fluid increases, the heart sounds become muffled and weak, and the percussion dulness assumes the form already described. It is remarkable that the friction sound is not necessarily abolished as fluid effusion comes on, for in a case recorded by Walshe, sixty fluid ounces of liquid effusion were found in the pericardium of a man over whose heart friction murmur was distinct a few hours before his death.

There are a few points in the diagnosis of pericardial friction sounds worthy of attention. A friction sound produced by inflammation of the left pleura may be of cardiac rhythm, and so confuse the observer. Pleural friction sound is increased by deep breathing, and ceases when the act of breathing is suspended. An *exocardial* friction murmur is distinguished from an *endocardial* murmur, due to valvular disease, by the changeableness of its seat and intensity from hour to hour, its superficial and limited character, and its non-transmission in the course of endocardial murmurs further serve to mark the exocardial sound of inflamed pericardium.

ENDOCARDIAL CARDIAC MURMURS.—1. INORGANIC. 2. ORGANIC.—These may be of *systolic* or *diastolic* rhythm, and when of the first the murmur may be inorganic and significant then of a spanæmic and weak state of the blood, or of coagulation of blood in heart's cavities. A murmur of diastolic rhythm is never inorganic. A systolic inorganic murmur is soft and

gently flowing, basic in seat, and usually best heard over the pulmonary orifice at the second left or 'pulmonary' cartilage. This inorganic murmur can also be heard over the orifice of the aorta, but it is not conducted up the vessel, nor can it be heard outwards toward the axilla or down at the cardiac apex. It is rare to hear an inorganic murmur at the mitral orifice, unequal tension of the valve segments, it is said, may cause such a transient murmur. Murmur due to coagulation of blood is most common on the right side of the heart. This coagulation of blood, or *intra-cardiac thrombosis*, is prone to occur as a very serious complication in rheumatic fever, croup, and pneumonia. Extension of percussion dulness to right and irregular action of heart with murmur marks the event. It must be remembered that inorganic systolic base murmur is not uncommon in many acute diseases when the blood becomes poor and thin.

VENOUS MURMURS are best heard in the external and internal jugular and subclavian veins. These 'humming-top' murmurs are invariably continuous in rhythm, and are at once silenced by pressure on the vein with the stethoscope. A thin anæmic condition of the circulation is the most probable cause of the existence of these humming venous murmurs.

2. ORGANIC CARDIAC MURMURS.

In inflammatory endocarditis, so often met with in the course of acute rheumatism, murmurs may be thus arranged in their order of frequency: aortic obstructive, mitral regurgitant, aortic regurgitant, aortic obstructive and mitral regurgitant, and aortic obstructive and regurgitant together. Pulmonary murmurs are infinitely rare. Surface-roughness, fissuring, and lymph-deposits are the main causes of the *obstructive* class of murmurs; while those of *regurgitant* character may be traced to intertwined lymph impeding the play of the tendinous cords and papillary muscles. An endocardial murmur early developed under observation during an acute attack is pretty good evidence of endocarditis, and if it be observed to persist all through the acute attack, it will probably remain as a permanent condition; at any rate, if some months after the attack it be not audible, owing to weak action of the heart, a little extra effort on the

part of the patient, by exciting the heart, will soon show whether it be really gone or not. Recent endocardial murmurs of soft tone I believe I have seen to go quite away after continuing two or three weeks. The disappearance of the murmur in these instances I have set down to the absorption of a recent lymph exudation on one of the cusps of the mitral valve.

Of the Murmur of Aortic Obstruction, Constriction, or Stenosis.

This murmur is produced by the onward current of blood meeting with obstruction at the seat of the aortic valves. The pulse is not materially affected unless the aortic constriction be great, then though regular in force and rhythm, it becomes small, hard, and prolonged, and this shows that there is some hypertrophy of the left ventricle, forcing the blood powerfully into the arteries through the aortic obstruction. Constriction of the aortic orifice does not *per se* cause any swelling of the ankles, or dropsy. The murmur indicative of aortic constriction and obstruction may be so prolonged as to cover not only the first, but also the second sound at the base of the heart, but this is not common; what we usually hear is a murmur, whose point of greatest intensity is at midsternum, opposite the third interspace, gradually losing force as we pass to the apex, where it may be quite inaudible, so that we hear the natural sounds of the heart at this point. The murmur is audible at the second right cartilage, faintly so at second left, and it can be heard on the left vertebral groove, and up towards the vessels of the neck, being carried in the direction of the blood-current. Usually this murmur is high in pitch, loud, prolonged, and harsh. Occasionally the second sound is reduplicate at the base.

Mitral Regurgitant Murmur.

A systolic onward murmur of maximum force at or just outside the apex beat, faintly, or not at all, audible at ensiform cartilage and at base of heart, but clearly heard in left auxillary line, and round to inferior angle of scapula, is due to regurgitation of blood through the mitral orifice at the moment of the ventricular systole into the left auricle of the heart. This murmur is seldom of high pitch; it may entirely cover the first sound of the heart

at the apex, but this sound may be quite natural at the base of the heart, and just to right of ensiform cartilage.

The second sound of the heart, usually in health most accentuated over the aortic valves, is, in mitral regurgitant disease, most accentuated, or intensified, over the pulmonary valves. The reason is that the left auricle and pulmonary veins being over distended with blood, the right heart has to act with greater force, and hence increased pressure falls on the pulmonary valves. Sometimes the second sound is notably distinct and sharp at the apex (Walshe, p. 364, 4to edition).

A transient mitral systolic murmur is met with at times in the course of chorea, and seems then to be produced by irregular or convulsive action in the musculi papillares.

The pulse in mitral regurgitation is variable. In slight cases it may be fairly natural, in other cases it is irregular in force and rhythm.

Dilated hypertrophy of the left ventricle is the common sequence of mitral regurgitation. The systemic system of vessels is not soon affected, and we do not therefore see any dropsy unless the dilatation of the heart has become general. The stress of mischief falls on the pulmonary circulation, so that we get cough with watery expectoration, dyspnœa, pulmonary œdema and apoplexy among the results of prolonged mitral regurgitant disease. The liver also becomes eventually liable to congestion, as also the kidneys, and if the heart become much dilated, we may find albumen in the urine.

Mitral Constriction or Stenosis is evidenced by a thrill or tremor, perceptible by the fingers applied over the cardiac apex, and by a murmur of diastolic rhythm loudest just above the heart's apex, and not audible posteriorly, and the lower angle of the left scapula. This murmur, at first feeble and soft, may towards the end of the diastole be rough and grating in character. Sometimes, in cases of narrowing of the left auriculo-ventricular passage, no murmur is audible over the apex of the heart at the beginning of the diastole, this being only developed at the end of the diastole, immediately before the systole; it is then recognised as a *præsystolic murmur*. Very commonly mitral stenosis

is complicated with mitral insufficiency; then the præsystolic murmur passes into the systolic murmur indicative of mitral regurgitation. Pulmonary congestion and hæmoptysis are among the frequent results of mitral stenosis, the second pulmonary valve sound becoming intensified, and the right ventricle of the heart dilated and hypertrophied.

TRICUSPID-VALVE MURMURS are very rare. A systolic murmur, most distinct over the lower part of the sternum, systolic pulsation of the jugular veins, and sometimes enfeeblement of the second pulmonary valve sound from lowering of blood-pressure, are the signs which indicate regurgitation of blood through the tricuspid valve.

A diastolic murmur over the lower part of the sternum, and præsystolic pulse in the jugular veins, would indicate the exceedingly rare condition of tricuspid stenosis.

AORTIC VALVE INSUFFICIENCY is known by the presence of a diastolic murmur, loud and of maximum intensity over the greater part of the sternum. Usually the first sound also is murmurish, owing to roughness of the aortic valves. By applying the finger over the subclavian or carotid artery during auscultation, the diastolic rhythm of this murmur is appreciated.

Owing to the reflux of blood in the diastole back into the left ventricle, this cavity tends to enlarge and elongate, so that the visible apex-beat is carried downwards and to left. The murmur, however, is usually louder at the ensiform cartilage than at the apex of the heart.

The pulse is jerking, rapidly receding from the finger, and usually very visible, especially when the arm is raised. This visibility of the radial pulses is not, however, peculiar to cases of aortic regurgitation, for it is sometimes found in association with the gouty diathesis.

A diastolic murmur most marked in the second left intercostal space might show constriction of the orifice of the pulmonary artery, especially if associated with hypertrophy of the right ventricle.

Aortic Aneurysm.

[illegible] give the often a systolic murmur and tactile thrill. With these signs we have [illegible] lancinating, neuralgic pains, and distressful signs as results of pressure. Aneurysms of the aorta tend to hypertrophy of the left ventricle when, as is usually the case, the aortic valves are at the same time insufficient. Should these valves remain competent to close the aortic orifice, there need be no ventricular hypertrophy.

Aneurysm of the aortic arch is known from an enlarged heart by the fact of there being in the case of the aneurysm two distinct centres of pulsation—one the heart, the other the aneurysmal tumour.

Of tumours likely to be confounded with aortic aneurysm, it may be remarked that *infiltrated cancer of the lung* produces no local prominence, deepens the intercostal spaces, and does not produce pressure-signs.

A *syphilitic* tumour, or *pulmonary syphiloma*, would be influenced more or less by mercurial remedies.

MEDIASTINAL TUMOURS often closely resemble aortic aneurysms. Common features are dulness and non-resilience, usually extending across the middle line. The conditions in favour of aneurysm would be: situation in the course of the arch of the aorta; vibratile thrill; marked accentuation of the second sound over the prominence; gradually increasing nearness of pulsation to the surface; double impulse; dysphagia, and gnawing boring pain over spine or sternum.

Aneurysms of the descending aorta give murmur loudest over the sac, and, by pressure on the bronchus, weak breath-sound in the corresponding lung. Shooting pains like rheumatism were prominent features in one case that came under my own observation, and the particulars of which are recorded in the *Medical Times and Gazette* of 1876. These aneurysms often rupture into the œsophagus, or into the right or left pleura; then collapse and death rapidly occur.

SECTION XI.

PHYSICAL DIAGNOSIS OF DISEASES OF THE ABDOMEN.

REGIONS OF THE ABDOMEN.—For convenience of description the abdomen is divided anteriorly into the *epigastric*, *umbilical*, and *hypogastric* regions, taken in order from above downwards. The lateral regions on either side are divided into right and left *hypochondriac* (*i.e.*, lying under the rib cartilages), right and left *iliac*, and right and left *inguinal*, or groin regions. The posterior regions embrace the *inferior dorsal* on the right and left, and the right and left *lumbar* regions.

The contents of the above-named regions may be thus described:

In the EPIGASTRIC REGION lies the *stomach*, its lower border or larger curvature crossing the epigastrium in a curved line situated nearly midway between the point of the ensiform cartilage and the umbilicus. A small portion of the anterior surface of the stomach, and the larger part of its great curvature, are in direct contact with the abdominal parietes anteriorly; the rest of the organ is covered over, partly by the left lobe of the liver, and partly by the left lung.

In examining the stomach the patient must lie on his back, and the upper limit of the stomach defined by percussion along the line where the resonant pulmonary note gives place to the tympanitic stomach-note. The boundary of the stomach to the right may be determined by following the dull liver-note till this ends in the lower margin of the cardiac dulness. The definition by percussion of the lower border of the stomach is not easy, because there lies just below it the transverse colon, which commonly gives, on percussion, a tympanitic note like that of the stomach. Enlargement of the tympanitic space occupied by the stomach indicates dilatation of the organ—a condition com-

monly found in gastric catarrh and in stricture of the pyloric outlet. When much dilated, the stomach has been known to extend far over the middle line to the right, and beyond the left axillary line.

Cancer of the stomach, which most frequently affects the pyloric end, manifests itself externally as a circumscribed elevation or tumour in the epigastrium, hard and firm to the feel, and more or less tender. Cancer of the left lobe of the liver will produce a similar elevation of the epigastrium.

A pulsating tumour in the epigastrium to the left of the spinal column would be suggestive of aneurism of some part of the abdominal aorta, but it must be remembered that in persons of hysterical or of gouty temperament violent pulsation of the abdominal aorta is at times met with of a purely nervous character. The aneurismal tumour has an expansive movement under the fingers, and is usually the seat of a systolic murmur.

RIGHT HYPOCHONDRIAC REGION.—In this part lies the *liver*, occupying the concavity of the diaphragm with its upper convex surface, while that portion of it which is in contact with the thoracic and abdominal wall extends on the front of the chest from the sixth rib superiorly to the margin of the arch of the ribs inferiorly, and reaching in the median line to midway between the base of the ensiform cartilage and the umbilicus. To the left of the median line it is scarcely possible to define the upper limit of liver dulness, as it merges into that of the heart.

In the right axillary line, or line falling from the centre of the axilla, the upper margin of hepatic dulness corresponds to the seventh intercostal space. In the right dorsal line, falling from the lower angle of the right scapula when the arm is dependent, hepatic dulness corresponds to the ninth intercostal space. This posterior dulness extends downwards to the twelfth rib, where it merges in the dulness of the right kidney.

After deep inspiration the lower margin of the liver may be depressed from half to one inch below the margin of the ribs when the patient stands erect. The under surface of the liver

is opposed to the stomach, and large intestine, and the right kidney and supra-renal capsule.

ENLARGEMENT OF THE LIVER.

The liver is proportionally larger in infancy and childhood than in adult life. In the adult the average weight of the liver is one-fortieth of that of the entire body, whereas, previous to puberty, it may be as much as one-thirtieth, or even one-twentieth (Murchison).

In cases of RICKETS the liver is often depressed and elongated from lateral compression. Tight-lacing is another well-known cause of depression and apparent enlargement of the liver. Fluid collected in the right pleura, and, more rarely, in the pericardium, may also depress the organ. When the liver is depressed by a pleural effusion, its lower margin is not changed by very deep inspiration.

It may be here remarked that before pronouncing any opinion as to the nature of an abdominal tumour, it is well that the bowels be well cleared out, for hardened collections of fæces in the various parts of the colon have been mistaken for all manner of abdominal tumours. Hardened scybalæ in the transverse colon have been mistaken for the nodulated edge of a cancerous liver.

DIAGNOSIS OF VARIOUS FORMS OF HEPATIC ENLARGEMENT.

Congestion of liver from excess of blood therein will produce a general and uniform enlargement of the organ, so that it may project an inch or more below the ribs in the right mammary line. The enlargement may be due to venous mechanical congestion from valvular cardiac obstruction, and in such case sooner or later it will give way to the opposite condition of contraction. The pressure exercised by the distended hepatic veins causes atrophy of the central portion of the lobules, and so causes a granular condition of liver—different, be it remembered however, from the contraction of cirrhosis, where the atrophy commences at the circumference of the lobules.

In active hepatic congestion, where the engorgement com-

mences in the arterioles, the enlargement is less marked than in the mechanical form of the disease.

In hepatic congestion there is a feeling of painful distension in the region of the liver, the surface of the enlarged organ is smooth, and usually in a day or two the conjunctivæ become yellow, and more or less of a jaundiced hue tinges the skin, while the tongue is furred, and the stomach irritable.

When the enlargement of the liver is due to an obstruction, however caused, of the biliary duct, jaundice is a marked symptom; the stools are white and free from bile, while the urine is dark and bilious looking.

Abscess of the Liver, whether due to pyæmia or to dysentery and long residence in a hot climate, will cause a very painful swelling of the liver. Often the organ enlarges upwards, and the abscess may burst through the diaphragm and pus be coughed up from the lungs mixed with more or less blood. Shiverings, great pain on pressure, and on movement from side to side, and the general history of the case, point to abscess as the cause of the hepatic enlargement.

Waxy or Lardaceous Enlargement.—In this affection the liver undergoes greater enlargement than from any other disease except cancer. A lardaceous liver has been known to weigh 180, instead of the normal 50 or 60 ounces. On palpation, the enlarged liver is felt extending below the ribs as a dense, firm, resisting mass. The outer surface is smooth, and the lower margin rounded and free from indentation. The smoothness of the edge distinguishes this form of liver disease from cancerous or syphilitic affection of the organ.

In waxy enlargement of the liver there is rarely any jaundice, or ascites, and other organs, as the spleen and kidneys, are usually affected with the same waxy change that affects the liver. Protracted suppuration in some part or other of the body is the common cause of lardaceous disease of organs.

Fatty Liver.—Like the preceding, this is an example of a painless enlargement of the liver. The extent of overgrowth in the size of the liver may extend nearly to the umbilicus. The ribs are not bulged, and the surface of the liver is smooth and

its margin even and rounded. Jaundice and ascites very seldom are found in connection with the fatty liver. The skin looks very bloodless and has a semi-transparent waxy appearance. Fatty liver is common in cases of advanced pulmonary phthisis.

HYDATID TUMOURS constitute another cause of painless enlargement of the liver, attended with very little constitutional disturbance. The tumour may attain to a great size, is smooth, painless, and free from irregularity. If there be several cysts, then the organ may have a lobulated feel and appearance. If the case be very obscure, a cyst may be punctured and an alkaline fluid abounding in chloride of sodium can be withdrawn, in which the microscope will reveal echinococci, or shreds of hydatid membrane, thus making clear the nature of the case.

CANCER OF THE LIVER may be secondary to cancerous disease of the pylorus. The enlargement of the liver is great—a cancerous liver has been known to weigh 250 ounces—and if the cancerous growths press on the common bile-duct, persistent jaundice will be the result, as I have observed in more than one instance. The enlargement is progressive, and in the softer forms of cancer may be so rapid that a weekly increase of growth may be noted. To the feel the enlargement is usually irregular, but sometimes the cancer is gathered into one large central mass, and the disease may be confined to the left lobe only. The tumours are always more or less tender on pressure, and sometimes the general outline of the liver is tolerably regular. This occurs when the cancer is of the infiltrating, rather than of the nodular variety. Jaundice and, sometimes, abdominal dropsy (ascites), are symptoms in hepatic cancer.

CONTRACTIONS OF THE LIVER are observed in cirrhotic contraction of the organ and in acute yellow atrophy of the liver. Marked diminution of the area of the normal hepatic dulness with ascites distinguish the first of these states, and acute jaundice and fever are concomitants of the second, much rarer, form of atrophy.

FLUID IN THE PERITONEUM.

Ascites, or abdominal dropsy, is a condition very important of recognition and requiring distinction from pregnancy, ovarian dropsy, and some other forms of abdominal enlargement. The signs of ascites are these:

1. Enlargement and uniform swelling of the abdomen.

2. Percussion note dull in the flanks, whither the fluid gravitates as the patient lies on his back. In the centre, where the intestines float up, percussion will yield a tympanitic note.

3. Fluctuation of the fluid is felt by the laying the left hand flat on the side of the abdomen, and then tapping on the other side with the fingers of the right hand. With care even a few ounces of fluid in the cavity of the abdomen may be detected by this procedure.

OVARIAN CYSTS are known, when in an early stage, by their appearing from one side of the abdomen, and the outline can often be defined by the fingers. As the cyst grows it ascends in front of the intestines, so that the prominent part of the abdomen is dull to percussion while the flanks are resonant, just the reverse of the conditions met with in ascites.

In ovarian tumours the distance between the umbilicus and the crest of the ilium may differ on the two sides, being greater on the side from which the tumour has sprung. This never occurs in ascites.

The umbilicus does not protrude in the case of an ovarian tumour. Sometimes a coil of intestine crosses over an ovarian tumour or any other form of abdominal tumour, then a belt of tympanitic resonance will be found following the course of the intestine.

When ascites and ovarian dropsy co-exist, changing the position of the patient and observing the gravitation of the fluid will aid to clear up the diagnosis. Hydatid cysts usually grow from the liver, but the possibility of such a cyst originating in the pelvis and growing upwards must be kept in view. Puncture of the cyst and examination of the evacuated fluid would be necessary to settle the diagnosis.

EXAMINATION OF THE SPLEEN.

To feel, or palpate, the spleen, the fingers must be thrust well under the margin of the ribs on the left side, while the patient draws a long breath. If the organ be slightly enlarged, it can then be felt as a smooth mass with a notch on its anterior and inner border. When very large, the spleen grows in a direction downwards and inwards towards the median line. It is only when very large that the spleen extends upwards against the diaphragm. Tumours in the substance of the spleen are very rare; the enlargement generally maintaining the shape of the spleen, with its notches or indentations, which are very readily felt. The surface of the enlarged spleen is smooth and free from irregularity.

The acute diseases in which swelling of the spleen should be looked for are typhoid and typhus fevers, small pox, relapsing and intermittent fever, and pyæmia. In old standing cases of ague, the enlarged spleen is called the *ague cake*.

In general lardaceous or waxy disease of the organs of the body, and in syphilis, the spleen is often enlarged.

In *leukæmia*, the disease in which there is excess of white blood corpuscles in the circulating fluid, enlarged spleen is constantly met with. The spleen can at times be moved about freely, in consequence of a lax state of its ligaments.

EXAMINATION OF THE KIDNEYS.

The anatomical relations of the kidneys prevent our being able, by percussion, accurately to define the extent of either of these organs.

Posteriorly the space included between the lower edge of the eleventh dorsal and the upper edge of the third lumbar vertebræ corresponds to the region of the kidney, and here it is covered by the mass of the sacro-spinalis and quadratus lumborum muscles.

PALPATION OF THE KIDNEYS.—When the kidney is much enlarged by distension with fluid, as in *hydronephrosis*, or with pus, as in *pyelitis*, it can be felt by the hand through the anterior abdominal wall as a soft fluctuating spherical tumour.

If the pus or other fluid suddenly find exit into the urine, the tumour of the kidney rapidly subsides.

The kidney appears sometimes, more often in women than in men, to become dislocated from its normal position, and free to move, so that when grasped by the hand it slips from the fingers as a smooth, painless, bean-shaped body. To feel the kidney thus, the flank must be well grasped in the hand, the fingers being below and the thumb above.

Examination of the Urine.

Quantity, colour, reaction, specific gravity, and abnormal constituents are the points to be remembered in examining urine.

Quantity.—The average amount of urine passed in twenty-four hours by healthy male adults was found by Dr. Parkes to be 52½ fluid ounces.

When the skin perspires freely less water passes by the kidneys, and in febrile diseases, as well as in inflammatory affections of the kidney (nephritis), the amount of urine is commonly diminished.

In the later stages of heart diseases, when the venous system becomes overfilled and the arteries comparatively empty, the urinary secretion will be found diminished.

In Diabetes mellitus and insipidus the urinary secretion may be increased to four or five times the amount passed in health. In hysteric attacks often large volumes of pale urine are discharged.

Colour.—Normal urine varies in colour from pale yellow to amber or yellowish red. The most common abnormal colouring matters that may occur are biliary matter and blood.

Biliary matter is detected in urine by pouring some of it over a white plate, and then allowing a drop of nitric acid containing also nitrous acid to mix with it; as the two fluids mix a zone of colour is found, with rings of green, blue and violet.

Blood will give to urine a decided red colour, if present in any amount, and mixed with the urine. If in small quantity it gives a smoky look to the urine, and in the sediment may be

seen blood corpuscles. A very good test for blood in urine is the addition of some tincture of guaiacum and ozonic ether, when a fine blue colour is quickly produced.

REACTION.—Healthy urine is acid and turns blue litmus paper red. After long standing urine becomes ammoniacal and alkaline, and this alkaline change may take place within the bladder in some chronic inflammatory affections of that organ.

SPECIFIC GRAVITY of healthy urine varies from 1015 to 1020, as measured by the scale on the urinometer, distilled water being taken as 1000. In disease, as for example saccharine diabetes (diabetes mellitus), the specific gravity may rise to 1040, and in some cases of Bright's disease of the kidney it may fall as low as 1005, owing to non-elimination of urinary excreta from the blood.

ABNORMAL CONSTITUENTS.—Albumen may pass from the blood with the urine in cases of disease of the kidney. When this is the case, the urine will form a white turbidity on the addition of nitric acid, or on boiling. In either case the albumen is coagulated, and this coagulum is soluble in alkali, so that if the urine be alkaline it must be acidified before it is boiled.

Casts or cylinders of fibrin and fatty, granular, or epithelial matters must be sought for in the sediment of albuminous urine. Their presence indicates disease of the kidney structure.

The presence of sugar in urine causes it to ferment when mixed with yeast. A good test for the presence of sugar is that known as Moore's test, where the urine is boiled with liquor potassæ. If sugar be present the contents of the test-tube, after boiling, become of a dark mahogany colour.

In using Trommer's test for sugar, a little solution of sulphate of copper is added to the urine after mixing with liquor potassæ, and then, as the mixture is warmed, a red deposit of suboxide of copper falls at the bottom of the tube.

When pus is present in urine, as in pyelitis, the urine forms a thick ropy mixture on adding liquor potassæ to the purulent sediment. Deposits of phosphates, lithates, lithic acid, oxalate of lime, cystine, etc., are discovered by the microscope, and their characters must be learned by becoming familiar with

them as depicted in the illustrations found in works on urinary pathology, and comparing these with specimens viewed under the microscope.

EXAMINATION OF THE INTESTINES.

In examining the course of the intestinal canal, the hand may encounter masses of hard *fæcal accumulations*, the recognition of which is very important.

These sort of tumours are usually felt on the right or left side of the abdomen in the course of the colon, as irregular, movable, somewhat tender masses. The diagnosis is made certain by noting the effect of purgatives and enemata in removing the accumulation. When there is a stricture of any part of the intestine, the peristaltic movements of the bowel can be seen and felt in the portion of the canal above the stricture. Large collections of fluid in the stomach and intestinal canal give rise to dulness on percussion, and gurgling, splashing movements on palpation by the applied hand. Gas in the intestine or stomach yields a more or less tympanitic note on percussion.

The diagnosis of stricture of the rectum, and of fissure, piles, or cancerous disease of that part, is made out by examination with the oiled finger passed well up into the gut, and also by the use of the rectum bougie and the anal speculum.

EXAMINATION OF THE UTERUS. PREGNANCY.

Only when the uterus is enlarged can it be felt through the abdominal wall. At times firm sub-peritoneal fibroid tumours grow from the womb, and extend into the abdominal cavity, where they are felt as hard masses.

By passing the uterine sound into the cavity of the womb, it will be discovered that the abdominal tumour moves as the uterus moves, and this is a proof of their intimate connection. It may be observed that the passage of the metallic sound into the uterine cavity at times gives rise to discharge, much pain, and sometimes even peritonitis; hence, before using the instrument, the practitioner should study the method of its employ-

ment in some special work, and after its employment the patient should be caused to rest during the remainder of the day on a sofa or bed.

By means of tactile examination of the uterus per vaginam, we ascertain if there be any hardness, irregularity, or thickening about the os and cervix uteri. We further observe any undue heat, tenderness, weight, and want of mobility about the uterus. By means of the sound passed through the cervical canal into the uterine cavity, we discover the length of the cavity, and whether the cervical canal be duly patulous and free from constriction.

The adult healthy uterus measures from the margin of the lip to the fundus nearly three inches, and its breadth between the two Fallopian tubes is about two inches or rather more. The length of the transverse chink, or os uteri, is from three-eighths to half an inch. The os, it may be observed, varies in form in different individuals; usually it is a transverse slit, but with some it is circular, and in others triangular, like a leech-bite—especially is it thus found in women who have borne many children. It is generally about the size of a goose-quill, or rather smaller.

The *cervical canal* is from half to three-quarters of an inch long; it first widens, then contracts again, where it enters the cavity of the uterus. The mucous membrane lining the canal of the cervix is disposed in rugæ, branching out from a centre, and this has been called the *arbor vitæ*. In passing the sound, especially if it be a small one, care must be taken not to get the bulbous point hitched and arrested among these rugæ of the *arbor vitæ*.

The weight of a virgin uterus is from seven to eight drachms, but after child-bearing it amounts to an ounce and a half.

The lower portion of the uterus can be investigated by the finger per vaginam, and examination with the vaginal speculum, which show any erosion or ulceration of the os or change of colour, and through the speculum local applications to diseased parts can be made.

THE OVARIES.—These are the essential organs of generation in the female, and are oval bodies, each about an inch and a

quarter long, hanging loosely in the pelvis, and attached to either side of the uterus by the posterior duplicature of the broad ligament known as the ligament of the ovary.

To investigate diseased conditions of the ovary in an early stage, the intestines and bladder being emptied, the patient must lie on her back with knees drawn up so as to relax the abdominal muscles, and then pressure should be made backwards towards the brim of the pelvis from a point a little above the curve of Poupart's ligament. Swelling and tenderness of the ovary will thus be detected. Professor Simpson used to get the diseased ovary between two fingers introduced well up the vagina, while the other hand was pressed down into the brim of the pelvis on the same side.

Ovarian dropsy and its distinction from ascites has been already considered, and for the diagnosis of pelvic cellulitis and pelvic hæmatocele and the more special forms of uterine tumour and uterine displacement, we must refer the reader to some of the special works on gynæcology and uterine pathology.

In pregnancy the uterus rises as a rounded tumour above the symphysis pubis about the fourth month. The abdominal enlargement increases uniformly, and when the gravid uterus reaches the umbilicus, it pushes it forward, so that in the sixth and seventh months it is about level with the surrounding skin, and afterwards it projects beyond it in most women.

To the feel, the uterine tumour is well defined, firm, and elastic, preserving its form in all positions of the body.

To hear the fœtal heart pulsating and the whirring sound of the *uterine souffle* or *bruit placentaire*, the patient must lie on her back, and all disturbing noises, such as watches or clocks, be removed to a distance. The abdomen should be uncovered, and then the stethoscope placed on a line from the umbilicus towards the crest of the ilium, first on one side, then on the other; and it is usually on the left side that we succeed best in discovering the rapid, short, regular, muffled tickings that mark the fœtal heart-beat. The number of sounds varies from 120 to 160 in the minute, and the earliest period of pregnancy at which

they may be heard is the end of the fourth month. The fœtal heart in the female is more rapid than in the male.

The *bruit placentaire*, or *placental murmur*, is heard in the second half of pregnancy; it is synchronous with the arterial pulse, and is developed in the dilated uterine arteries at the part where they terminate in the uterine veins.

THE END.

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