The essentials of physical diagnosis of the chest and abdomen ...

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ESSENTIALS OF PHYSICAL DIAGNOSIS OF THE CHEST AND ABDOMEN.

THE ESSENTIALS OF PHYSICAL DIAGNOSIS OF THE CHEST AND ABDOMEN

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PREFACE.

LAST summer, when I had occasion to take my Ward Tutorial Class under my own care, I had a difficulty in referring the Junior Students to a simple concise work on Physical Diagnosis, that would take the place, to some extent, of the Clinical Lecture, and leave me more time for Practical Demonstration. I was induced for this reason to write the present text-book, in the hope that those beginning the study of Medicine might find it of some service.

The paragraphs in smaller type may be read at a later stage, as they deal chiefly with what is matter of opinion.

GLASGOW, *March*, 1889.

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ESSENTIALS OF PHYSICAL DIAGNOSIS OF THE CHEST AND ABDOMEN.

DISEASE expresses itself in many forms, but in only two essentially distinct ways. It may declare itself to him who bears it or to him who looks on ; to either alone or to both. Its indications to the sufferer are now technically known as *symptoms ;* those which the observer detects are called *signs.* It is with the latter alone that we are concerned here.

The signs are not always on the surface, nor are they always distinctive. On the contrary they are often equivocal and obscure. They must therefore be examined, and their physical examination occupies the first place in the inquiry. By means of a physical examination we make a physical diagnosis.

In making a strictly physical examination it must be clearly understood that we adopt only physical methods, we think only of physical conditions, and we describe these conditions only by physical terms. We examine, we think and speak of a mechanism, not an organism. Physical Diagnosis is, therefore, only a part, yet a distinct part, of Medical Diagnosis.

In carrying out our investigation it must always be carefully borne in mind that it is by comparison we most readily and certainly detect abnormal conditions. We compare a corresponding region or point say, on each side of the chest; and if one alone is normal we can measure, and only then definitely measure, the amount of departure from the normal on the other. Regions not corresponding may normally present very different physical characters.

But although the normal condition is not a fixed quantity, it varies within limits that should be familiar to us. From our physical standpoint they are fairly definite, and should be carefully studied by us. We cannot detect the exception if we do not know the rule.

If both sides seem to be alike abnormal the student must be guarded in his opinion. He must remember he has lost the only specific standard, the corresponding healthy point, that he can have. We refer here more particularly to the examination of the chest.

We usually make a physical examination by means of Inspection, Palpation, Percussion, and Auscultation; and systematically in that order. Mensuration is also employed, and occasionally Succussion.

THE PHYSICAL EXAMINATION OF THE LUNGS.

For the purpose of examination the patient may be either lying in bed or sitting on a chair. If the former, he must lie quite evenly on his back; if the latter, he should sit easily, supported lightly by the back of the chair. He should be in a good light for inspection, and had better not be in a corner of the room or ward if careful percussion has to be practised. The apartment should be of such a temperature that exposure of the chest will not prove injurious.

Regions of the Chest.—In order to make even a general reference to different parts of the chest wall, it is necessary to divide it into different regions. The following is the plan most commonly adopted:—Anteriorly on each side we have (1) the supra-clavicular, in which is the apex of the lung, rising as it does slightly above the clavicle; (2) the clavicular, includ-

ing not more than the inner half of the clavicle behind which the lung lies; (3) the infra-clavicular, extending from the clavicle to the lower border of the third rib, and inwards to the edge of the sternum; (4) the mammary, under the foregoing down to the upper border of the sixth rib; (5) the infra-mammary, under the mammary, and extending as far as the lower arch of the thorax.

Centrally there are (1) the upper sternal, and (2) the lower sternal regions, the dividing line being the horizontal boundary between the infra-clavicular and the mammary regions continued inwards to the middle line.

Laterally there are (1) the axillary, and (2), the infra-axillary regions, the dividing line being the horizontal boundary between the mammary and the infra-mammary regions continued outwards across this area.

Posteriorly there are the supra-scapular, the scapular, the infra-scapular, and the inter-scapular regions, whose relations to the scapula are sufficiently indicated by their names.

For special reference it is better to speak of the relation of the part to particular anatomical

points or lines ; for example, the second intercostal space, the vertical line of nipple, the angle of the scapula, etc. ; or better still, we can use outline diagrams of the chest on which the area or site of the disease can be definitely indicated.

INSPECTION.

Inspection is the use of the eyes systematised. By it we note I., THE FORM, and II., THE MOVEMENTS of the Chest.

I. THE FORM OF THE CHEST.

The ideal normal chest in the adult is in the form of an ellipse, the antero-posterior diameter being much less than the transverse, independently of the slight curving inwards which occurs towards the middle line posteriorly. It is perfectly symmetrical as regards the two sides. It is more nearly circular in the child, and tends to the circular also in the adult on full inspiration. But we never meet with a chest which is perfectly regular and symmetrical. The predominance of the right side of the body, and the accidents of growth and of existence generally, adequately account for this.

BILATERAL DEFORMITIES.

1. *The Pigeon Breast.*—In this case the ribs do not curve round to the front with the usual convexity outwards, but straighten forwards, forming a projecting narrow breast which the name sufficiently describes. The capacity of the chest in this deformity, as in the three immediately following, is lessened, and the lung is correspondingly smaller.

2. *The Rickety Chest.*—It differs from the pigeon breast in having the ribs not straightened forwards, still less having a convexity outwards, but presenting rather a concavity on each side from their actually falling in as they approach their articulation with the cartilages. Nor is the breast narrow and projecting as in the preceding. Further, there is that thickening of the ends of the ribs so characteristic of rickets, which gives to the chest wall on each side the peculiar beaded appearance known as the "rickety rosary."

The rickety chest seems to be an addition to the pigeon breast. In both there is a lateral falling in of the chest wall. In the former there is still considerable resistance in the ribs, so that in flattening they can force the breast out more or less to an apex; in the latter the ribs have less

resisting power, they yield more while the sternum is altered less, perhaps not at all.

3. *The Chest Transversely Furrowed.*—Here we have a well recognised concavity which runs from the lower end of the sternum downwards and outwards a greater or less distance along the fifth, sixth, and seventh ribs, or thereby. It varies in extent of surface and in degree of concavity, but always affects the lower part of the chest wall, its inferior limit corresponding pretty accurately with the base of the lung. The inferior margin of the thorax, which, of course, is still lower, is prevented from falling in by the subjacent abdominal viscera, the liver, stomach, and spleen.

The three varieties of deformity just mentioned are usually brought on during the early years of childhood. They are caused on the one hand by diseases which lessen the resisting power of the ribs, notably rickets, and on the other by those which impair the expansile character of the lung, as capillary bronchitis, emphysema, pulmonary collapse; and also paroxysmal cough, croup, and other affections of the larynx. If induced by the first class of

causes, the second, or any of them, superadded, will play all the greater havoc: for example, bronchitis in the child or adult who already has a chest deformed by rickets.

The mechanism of the formation of these deformities is rather complicated, but may, I think, be simply and fairly accurately illustrated in this way. A toy india-rubber ball, however flexible the walls, will expand equally by reason of its elasticity if we suppose it to be drawn outwards at every point; but only then. If drawn out at certain points it will fall in at others. But if it have an opening it will not fall in at any point, if the expansile force, the size of the opening, and the resistance of its walls have a due relation to each other. So it is with the healthy chest. All these conditions are in perfect relationship. The expansile force applied to the chest wall is sufficient to enlarge the chest, and along with it the lungs, to the required extent; the resistance of the chest wall is sufficient to prevent those parts not so directly drawn outwards from falling in; and the entrance for the air, the wind-pipe, is sufficiently free to prevent the other two forces from being unduly taxed. But in the production of deformity two of them are commonly at fault, the resistance of the walls, as in rickets, and the size of the opening, as in the obstructive forms of laryngeal disease (croup, whooping cough, etc.). On the same principle we can illustrate the mechanism of the more localised depressions such as form, for example, the Chest Transversely Furrowed. There we have, underlying, a limited portion of lung which will not expand. The air is shut off from that particular part, and as the other parts of the chest wall (and lung) expand on inspiration, that part necessarily falls in.

Harrison's Groove corresponds pretty much to the last mentioned deformity, but Harrison considered that while its lower limit marked the upper border of the liver, the furrow or sulcus was caused by the dragging inwards by the diaphragm which occurs in obstructed breathing.

4. *The Alar or Pterygoid Chest* (*ala*; πτέρυξ, υγος; a wing).—This was recognised by the oldest writers as the chest of phthisis. The thorax is small, and falls forwards owing to the increased obliquity of the ribs which invariably characterises the small chest. This causes the inferior angle of the scapula on each side to project outwards like a wing; hence the name. General and symmetrical diminution in the size of the thorax has only one cause, namely, small size of the lungs (Jenner). It may be that the lung is small congenitally, which rather predisposes to phthisis, or there may be present a chronic phthisis, inducing atrophy of the lung. In the latter case the contraction would not likely be symmetrical, probably not even bilateral.

We pass now from the bilateral contractions to a bilateral enlargement, namely:—

5. *The Emphysematous Chest.*—In hospital practice this is the one common deformity of

the chest as a whole. Its characters are as conspicuous and well defined as the etiology and pathology of Emphysema itself are obscure. It should therefore be carefully observed and studied by the junior student, though he may still know nothing of the nature of the disease which occasions it. No description of it is at once so concise and so suggestive as that of "the thorax of permanent inspiration." Let us suppose a deep breath is taken, and held in. We have then, increase of the antero-posterior diameter of the chest, a more horizontal direction of the ribs, increase in the depth of the intercostal spaces; the chest wall is altogether more circular and fixed. These are just the characters of the emphysematous chest, and have suggested the common phrase, "the barrel-shaped chest of emphysema." By and by the sternum becomes arched forwards, and not uncommonly the spinal column also. The upper two thirds of the thorax are alone, or at least most markedly, affected as a rule.

No doubt it is true, as Gee points out, we can never by forced inspiration make our chest so circular, etc., as it be-

comes from emphysema. But then we cannot *permanently* hold in our breath. And Duchenne has shown that an exaggerated action of the inspiratory intercostals can produce a marked increase of the antero-posterior diameter of chest, indeed a very marked approach to the circular form. On the other hand, the chest is contracted in patients whose intercostals no longer act.—*Selections from the works of Duchenne, New Syd. Soc.*, 1883, pp. 58, 59.

UNILATERAL DEFORMITIES.

These have a more direct and therefore a more evident cause than the deformities we have been considering. They are simply of two kinds, *Enlargements* and *Retractions.*

Enlargements are due to fluid (pleuritic effusion) or to air (pneumo-thorax) in the pleural cavity; either alone, or both in considerable amount. They may also be due to tumour of the lung, or even to hepatic or splenic enlargement of some kind, if it be situated low down in the thorax. Thoracic enlargement rarely occurs, and if so, very slightly in the pneumonic lung, or from hypertrophy compensatory to chronic impairment of the other lung.

Retractions.—One of the commonest and most marked forms of retraction is that which

results from a past chronic pleuritic effusion. Although the fluid has disappeared, the lung may not expand again, but remain bound down by adhesions. Falling in of the affected side then invariably occurs; the body inclines to that side and increases the deformity. A pretty general and pronounced subsidence of one or other side may be found in the chronic forms of pulmonary phthisis (fibroid). But it is the falling in of the apices of the lung in ordinary tubercular phthisis that becomes to the student a matter of daily observation in hospital, and with this, therefore, he is expected to be thoroughly familiar.

II. The Movements of the Chest (of Respiration).

We have now not merely a passive condition, but an active process to study, both normal and abnormal. In health these movements differ in the two sexes. In the male, respiration is chiefly abdominal (diaphragmatic) or lower thoracic; in the female, markedly upper thoracic. In man the number of respirations in the minute may be stated at from 14

to 16; in woman 16 to 18. The movements are regular; each is gradual, *i.e.*, not sudden, and, as regards the two sides, synchronous and equal. The chest circumference on full inspiration should not be less than two, and will not be more than three, inches greater than that of forced expiration. From careful observation, Walshe thinks that the duration of inspiratory movement may be reckoned as 5, the expiratory as 4, and the period of rest as 1. The normal pulse-respiration ratio is about 4 to 1.

This ratio is only noteworthy in order that exceptions to the rule which occur in certain diseases may be appreciated. In pneumonia, for example, the respirations may be so increased that their relation to the pulse may be as 1 to 2, but more commonly it is as 1 to $2\frac{3}{4}$ or 1 to 3.

In disease, the movements of respiration may be altered as regards rate and degree; there are also irregularities of movement.

The rate of respiration may be affected. It is increased in pleurisy frequently on account of the degree of respiration being restricted from the pain. It is increased more or less in all febrile conditions when it is but a part of the general increased action; also in anæmia,

from the greater demand for oxygen, and very commonly in diseases of the lungs which limit the respiratory area, as phthisis. Or the increase may be due to a pure neurosis, as in some cases of heart disease or of the whole nervous system.

I have seen a case in which the respirations were quite 70 in the minute, while the pulse was under 120. There was some obscure neurosis of the respiratory and other centres, and various symptoms usually classed as hysterical. The patient was a middle-aged man.

On the other hand, *the rate of respiration is sometimes lowered.* This may arise mechanically from direct obstruction, as in bronchitis, asthma, etc. In asthma the difficulty is chiefly, and I have known it to be exclusively, with expiration. The respiration is slower also in many cases of head injury, apoplexy, coma, etc., from diminished sensibility of the respiratory centres.

The degree of respiratory movement may be affected. It may be limited by pain, as in pleurisy, and then the rate will be increased, as we have just said. It may be limited in these neuroses also in which the rate is increased. Respiration, again, is restricted

under conditions which mechanically slow it, as in bronchitis, emphysema, pulmonary œdema, asthma, and laryngeal obstruction.

But the more striking and simpler forms of limited movement are those which are unilateral or partial. The impaired expansion of the phthisical apex, or apices, accompanies, or it may be precedes, the permanent subsidence of the part already referred to. There is diminished expansion of the affected side in pneumonia, pleuritic effusion, and pneumothorax, and generally in those cases where there is subsidence of the chest wall. Sudden and complete cessation of respiratory movement on both sides can hardly arise from anything except paralysis of the respiratory centres, and, occurring without obvious explanation, would point to the probability of hæmorrhage having occurred into the medulla or neighbouring parts.

The respiration may be irregular. It may be wholly thoracic, or it may be wholly abdominal. There may be retraction when and where we would expect expansion. The rhythm may be altered.

(*a*) Respiration will be wholly abdominal when there is paralysis of the thoracic muscles of respiration. The diseases in which this may occur are usually of the spinal cord, and require separate study; but it will be remembered that so long as the lesion does not extend upwards beyond the 6th or 5th cervical nerves, the phrenic will maintain abdominal respiration.

(*b*) Respiration will be wholly thoracic when there is paralysis of the diaphragm. If it be a true nervous paralysis, it will be a part, probably the last stage, of a more general form, as in progressive muscular atrophy. But the paralysis may be of inflammatory origin, as in diaphragmatic pleurisy, or it may be from mechanical pressure, as in ascites.

(*c*) We not unfrequently notice that with inspiration there is intercostal retraction or furrowing, particularly in the lateral aspects of the lower thorax. It may be that even the lower ribs and uniform cartilage are drawn in. This will occur unilaterally and bilaterally under exactly those conditions which are causing, or have caused, the permanent retrac-

tions of the chest wall to which we have already referred (Pulmonary Collapse).

(*d*) The rhythm of respiration may be altered. What is known as Cheyne-Stokes respiration virtually represents this. It may be shortly described as a gradual recession of the respiratory movement and rate till it seems as if breathing had altogether ceased, when it faintly reappears, and as gradually progresses till the respiration becomes in turn rather unduly marked. The same cycle is repeated again and again, each occupying one to two minutes. It was first described by Cheyne of Dublin in 1818, and again by Stokes in 1846. It occurs in conditions of coma, and, following Stokes' view, is held to be specially related to fatty degeneration of the heart, though in what way is not known.

In its typical form, as described by Cheyne and Stokes, this phenomenon is as rare as it is common in its grosser forms. In comatose states, however induced, the patient may be observed to breathe slower once or twice, appear to stop altogether, breathe again hurriedly a few times, and then gradually fall into the fainter and arrested respiration as before. It may be observed in this modified form during deep yet normal sleep ; also in dying by coma.

It depends simply on a diminished sensibility of the respiratory centres.

(*e*) Respiratory movements should be gradual. In certain asthenic forms of pulmonary disease, I have noticed a peculiar bounding movement of inspiration which, in the first instance, was forced upon my attention by the sudden impulse conveyed to my ear by the stethoscope when auscultating. I have not been able to assign to it any special significance. It is something like the gasping respiration of extreme asthenia, but I have noticed it when the patient was still able to walk some distance out of doors.

MENSURATION.

We may here interpolate the few remarks we intend to make with regard to mensuration. All the foregoing deformities can, for practical purposes, be sufficiently appreciated by the eye. This would be true even were mensuration reduced to a more simple and convenient art than it has yet been. There is, however a general agreement that, by the following simple modification of Woillez's cyrtometer, the shape of the chest wall at any particular level can be accurately enough taken. Two pieces of soft metal gas pipe are united at one end in such a way as to form a hinge. Placing this hinge at the middle line posteriorly, the

flexible pipe is brought round each side of the chest, being at the same time carefully moulded to the chest wall, so as to take a cast, as it were, at that particular level. The hinge admits of it then being opened, and again laid in position on a piece of paper, and an accurate tracing of it made. Double tape measures are also to be had by which the circumference of the two sides can be taken and compared at the same time, although an ordinary tape line will suffice if we carefully mark the middle line behind and in front.

PALPATION.

When we have completed a careful examination by means of the eye, the next step, naturally, is to corroborate or correct our impressions by means of the hands placed on the chest wall. This is, in the main, the use of palpation. It should follow inspection, yet go hand in hand with it. To take a very common case. A patient is suspected to have incipient phthisis. The apices seem to be flattened. Facing the patient, with our hands placed above the shoulder, the thumbs are

brought round to the front, and placed on the infra-clavicular regions. With a little experience the degree of expansion can in this way be appreciated with the greatest nicety; or the same thing may be done by standing behind the patient with the fingers placed on the apices. And we are reminded, perhaps, of the difference between a physical and a more general examination. The patient may present the general symptoms and signs that suggest pulmonary mischief, but the ample and equal expansion on both sides tells us that there is, not yet at least, any appreciable encroachment of the respiratory area. Conversely the fever, cough, and lassitude may long since be gone and forgotten, yet the imperfect expansion of one apex tells its own tale of a past and incurable physical disability. Independently of inspection, palpation as a test of pulmonary disease is usually employed with but one object, namely, to estimate what is known as the :—

Vocal Fremitus, or, as it is familiarly shortened, the V.Fr. The Vocal Fremitus is the voice vibration which is conveyed to the

chest wall, and we estimate its amount by placing the hand lightly on different parts of the chest. What we said at the outset about comparative rather than absolute conditions being the basis of our conclusions is particularly true regarding the V.Fr. There are so many circumstances common to both sides, and quite within healthy limits, which make it vary in different individuals. Of these the chief are (1) the quality (*timbre*) and pitch of the voice, and (2) the amount of soft tissue, fat especially, on the chest wall. A rich full voice and lower tones cause greater fremitus, and so of course will a thin chest wall. It is naturally more marked on the right than on the left side, where the heart breaks in some degree the sound waves.

In testing the vocal fremitus, it is best always to make the patient repeat the same sound. The numbers 23, 24, are commonly used, but 98, 99, are better sounds, as they give a purer open vowel tone.

In disease, the V.Fr. is determined practically by the same conditions which influence the vocal resonance, a test which we shall take

up by and by. It will be the more distinct, the more uniform the medium by which it is conveyed to the chest wall. Pulmonary consolidation, therefore, such as occurs in the course of tubercular disease and pneumonia, increases it. It may be increased over the upper areas of the chest where there is pleuritic effusion below. A superficial cavity in the lung, if it opens freely into a pretty large bronchus, will give distinctly increased vocal fremitus.

On the other hand, if the medium is complex, as when there is fluid, or even air, in the pleural cavity, the V.Fr. will be diminished, or it may be absent. As an exceptional circumstance, however, it is well to know that vocal fremitus may sometimes be carried to the right base posteriorly, even when there is a considerable amount of fluid in the pleural cavity (Walshe).

Pleural Fremitus is the vibration conveyed to the chest wall from a roughened pleural surface. It indicates an unusual degree of alteration of surface, a coarse roughness, which is likely felt by the patient himself, who may

be the first to call attention to it. If, as it usually is, of pleuritic origin, it will probably indicate a later stage of the disease when absorption has to a great extent taken place, and the now very roughened surfaces brought once more into contact. As we shall see again, in speaking of friction sound (page 71), it is most commonly made out over the lateral region, or round by the back. Alterations of the pleural surface from other causes are very rare, but they may occur as the result of tubercle or cancer of the part, and occasion distinct fremitus.

Bronchial Fremitus is the vibration set up by an abundant mucous secretion in the larger bronchi. It is readily altered or made to disappear by coughing. Children present it frequently, and very often it is supposed by the parents to indicate serious mischief. But, like the coarser mucous rales, it simply indicates a free bronchial exudation.

PERCUSSION.

With the exception of an incidental reference to one or two diseases, we have hitherto

been considering simple physical conditions, and we have been describing them in common terms. When we come to percussion it is different. We meet now with things that cannot be described in common terms. Probably before the student has opened a book on medicine he has tried his hand at percussion, and has already attached some meaning to the terms "clear percussion" and "dull percussion." But it has not likely occurred to him that he is not using these terms in their ordinary sense. In any case he is not, and he should understand that at the outset. Not that he is to trouble himself, because "dulness and clearness are not admitted among the properties of sound by acoustic philosophers." But he should understand before going further that these words are mere conventional terms which are current among us because they are short and handy. To get the impressions themselves, he, all of us, must listen, and, having got them, I think we may express them by any terms that are agreed upon.

How is the student to listen? He must first know how to produce the sounds; he must

know how to percuss. The most simple and obvious method is by striking the chest wall with one hand, or by the fingers of one hand. This is known as *immediate* percussion. It was this form that was adopted by Avenbrugger, who first systematically practised and described percussion (1761), but it is not now employed, except in the case of the clavicle, which we still percuss directly.

Mediate percussion is therefore now always understood when we speak of percussion. It may be practised either by the use of the fingers simply, or by means of certain instruments. Piorry, the distinguished pupil of Laennec, invented what is known as the *pleximeter*, a small plate of wood, more commonly now of ivory, which is applied to the chest wall, and receives the stroke from the fingers of the right hand. It is too common to need description. So is the hammer of Barry,[1] by which the percussion stroke may be given, and to the use of which Piorry also gave the weight of his authority.

[1] Generally but incorrectly ascribed to Wintrich (1841). But Piorry, in his *Percussion Médiale* (1828), refers to and describes the little hammer of M. Barry.

The prevailing opinion, however, in our country, and also on the Continent, is in favour of the use of the fingers alone. Even mechanically the fingers are well adapted to bring out the chest sound best, at the same time causing the least sound themselves on being struck; while, by the sense of touch impressions are caught as we percuss, which materially aid the sense of hearing. Further, the fingers can better adapt themselves to the chest wall than any one form of plexiimeter can.

Method of Percussion.

The student has now to consider how he is to use his fingers on percussing. If he is naturally "neat handed," he will soon percuss neatly, whether he strike with one or two fingers, whether these are the first and second, the second and third, or the whole three. Obviously the stronger the stroke that is needed, the greater must be the number of fingers that he employs. He should, however, practise on the following lines.

Aim at freedom in the use of the fingers so that any can be used if necessary. Always

percuss from the wrist, or in exceptional cases where a strong stroke is needed, with a slight movement of the forearm. Strike with the points of the fingers, and as nearly perpendicularly as the nails will allow. Let the percussing finger rebound gently from the finger struck: it does not follow that it need be what is called in music a *staccato* movement. Let the stroke be always the lightest that satisfies the practised ear, *i.e.*, the student's own ear, when he has had some experience to guide him.

Here we may note a modification of this last rule. The strength of the stroke must depend also on whether he is examining a superficial or a deep structure. Light percussion tries the former; strong percussion, the latter. A good example of the use of the two methods is afforded where the transverse colon lies in part over the lower border of the liver. If we percuss lightly we get only the "tympanitic" note (a term to be explained immediately) of the intestine; if we percuss strongly we bring out the duller liver tone.

The same freedom in placing the fingers of

the left hand on the chest wall is desirable. If light percussion or any detailed inquiry is wanted, one finger alone as a pleximeter is best, the others being raised from the surface of the chest. We can often conveniently compare adjacent parts by having all the fingers outspread in contact with the surface while we percuss each in turn, but, as a rule, the percussion medium should be small. The pressure should be always moderate and equal. When deeper structures are under examination we not only percuss with greater force, but we also make firmer pressure with the left hand. The posture of the patient has been already referred to (p. 4), and also the objection to having the patient in a corner of the room.

We come now to the question, How is the student to listen? We have pointed out that the various sounds cannot be described by so many terms, and that he must listen for himself. How should he begin? By listening to the sounds brought out from the normal chest by his teacher, and by trying for himself the percussion note of common objects

around him.[1] Broad contrasts that can easily be described are first elicited. He then passes to finer distinctions that can only be appreciated, not expressed. He will learn that what cannot be described absolutely can be stated comparatively. He will say that this note is rather clearer, or more hollow, or more solid than the other.

Percussion Sounds.

Before going further it will be well, in a sentence or two, to make some reference to sound itself, and to the acoustic terms we employ. Although the student need not, as we have already said, make a special study of higher acoustics, still he ought to know enough about sound to enable him to use certain terms with an accuracy sufficient for the purposes of his present study.

When a sound is heard the question first of all arises, What is its *amount* or *intensity?* What is its strength? We consider

[1] All students of Gairdner will remember how, on that solid foundation, he based his academic treatment of the subject of percussion.

this question of degree as ranging between strong and weak, loud and faint. Then we have the *quality* of a sound. It may be a mere noise or it may be a musical tone. And the quality of both a noise and a tone may be very different. A block of wood on being struck gives a different quality of noise from a bar of iron; a cornet gives a different quality of tone from a violin. And this difference of quality is recognised even though the same note be played on each; for musical tones, and they alone, have still another character, namely, *pitch*. This refers to the position the tone occupies in the musical scale: it may be high or low.[1] It will be

[1] A sound is musical when the wave impulses which constitute the sound repeat themselves with perfect regularity. The uniform and equal repetition is pleasing to us. A noise, on the other hand, is simply a jumble of impulses. "They dash confusedly into the ear," as Tyndall says, "and reproduce their own unpleasant confusion in our sensations." The intensity or loudness of a sound is quite another matter. It depends on the width or *amplitude* of the waves. A smooth, round, small stone let fall gently into the water, will cause a regularly repeating series of waves which correspond to a musical tone; a similar large stone would simply make larger waves of the same kind, which would correspond to a louder tone. A handful of

convenient for us also to speak of the *resonance* of a tone. It can hardly be included strictly under quality; at least, it is not the primary sound that is referred to by this term, but the *resound*, the resounding. But in practice it must be considered as an element in the quality of a tone. We are also accustomed to speak of a *tympanitic* note. It approaches a musical tone; but, indeed, it requires no description if we remember its origin. It is the note of tympanitis, an ancient word for a gaseous distension of the abdominal viscera. It is the note given by a distended, but not over-distended, stomach or transverse colon.

Perhaps the following illustration of dif-

gravel thrown into the water will correspond to a noise; a cartful of gravel, to a louder noise.

A simple illustration will show us further how *loudness* differs from *pitch*. Every one knows that a pendulum of a given length swings a certain number of times whether the *length of the swing* be great or small. But if we alter the *length of the pendulum*, we alter the *number* of swings in a given time; the rate of vibration is changed. And pitch depends simply on rapidity of vibration. The length of the swing then, determines, as it were, the loudness; the length of the pendulum, the pitch.

ferent tones will not be the less suggestive that it is homely. If we strike an old, disused rain-barrel it will give a sound whose *intensity* is determined by the force of the stroke, but it will be a noise at the best. There will be little musical quality about it and no pitch. But suppose one in good order and ready for use. It will give a tone of a comparatively musical quality, along with a large degree of resonance. We might call it a low tympanitic note. Now fill it one third full of water. Below the water line we get no tone or sound, beyond that of the stroke on our hand which is acting as the plexímeter. Above the water line there will be less resonance than before; we would call it duller; and the pitch will be higher. The note may still be tympanitic. Fill it two thirds full of water, and above the water line we get still less resonance; the tone will be yet higher in pitch, but altogether more imperfect; it may, indeed, have resolved itself into a mere noise. It will not now give exactly the impression of a tympanitic quality, but very probably one that is partly

tympanitic and partly dull, a tone that is not uncommonly met with in the affected chest, and, as we shall see shortly, is termed the *dull-tympanitic* note. That, however, is a sound which, like so many others, must be heard in a patient before it can be in any practical sense understood.

Sometimes a "wooden note" or "wooden resonance" is spoken of to describe a sound which is not unfrequently heard in certain morbid states. It has something of the character which its name indicates.

But the dull-tympanitic note is the basis of another of a much more defined character, the name of which is at once felt by even the beginner to be remarkably appropriate, that is, the *cracked-pot sound* (*Bruit de pot fêlé*). It was described first by Laennec, who compared it to the sound given out by a broken jar. He considered that a pulmonary cavity was essential to its production. Shortly afterwards, apparently first by Raynaud and Piorry, it was compared to the sound produced by striking the closed hands on the knee, and this has been ac-

cepted and copied, so far as I know, by every writer on the subject, whether British, Continental, or American.

The clinking, hissing sound produced by striking the clasped hands on the knees seems to me a very misleading comparison. The hissing quality is not an essential element, I venture to say is not an element at all, of the true cracked-pot sound. I think the dull-tympanitic note is solely and quite evidently the basis of the cracked-pot sound in its common form, whether arising from its common cause, or exceptionally, above the dulness of pleuritic effusion or of pneumonia. But I have never heard that simple form, what one might call the classical form, in bronchitis or in the crying child: and Walshe admits it is not *quite* the same in the latter. This bronchitic form, which is heard very readily in the young suffering from bronchial catarrh, and which disappears with the catarrh, approaches rather the "humoral" sound of Piorry, sometimes obtained on percussing a cavity containing both liquid and air.

A further development of the above sound, and altogether rarer is:—

The Metallic Ring. If the cracked-pot sound has for its basis the dull-tympanitic note, the metallic ring is founded on the amphoric note, a sound which will be referred to later (p. 43). Laennec recognised the metallic character of the cracked-pot sound also, and this view has always been

accepted; but since his time authorities have employed the term metallic ring to signify a tone with less crack and more ring.

The difficulties of the students have been immeasurably increased by attempted descriptions of fine distinctions, and by a varied nomenclature and classification. These sounds are as impossible to describe as they are easy to grasp if once actually heard. They shade off into uncertain sounds in many instances, but if once the typical forms are heard a few times they can hardly be forgotten.

Method of Percussion—(*continued*).

With these few observations on sound itself, and on the various percussion terms we employ, let us continue from page 30 our method of estimating the different sounds which we hear over the chest. We have seen that sounds which cannot be described absolutely may be stated comparatively. The student should remind himself once more that it is only by careful comparison that he can appreciate the slight departures from the normal. Passing from the percussion of different objects around him, to which we have already referred, he will still educate his ear with the broad distinctions found in

the human subject. The percussion note of the liver will seem absolutely dull compared with that of the infra-clavicular region, but it is not so devoid of all resonance as the thigh. He will find that the note of the precordial region comes between that of the liver and the lung. Trying next the pure pulmonary sound it will seem to him the acme of clearness, but he passes to the half-distended stomach and finds that it is even clearer, and that it has some other quality in addition; but what to call this will be his difficulty, unless the word "tympanitic" occurs to him. Lastly, he goes back again to the lung sound, and it seems now to be just a little dull. He will thus learn how difficult it must be to retain in one's mind an absolute impression of the natural tone of different parts, and how greatly he must depend on the comparison of corresponding points on the two sides.[1]

[1] Piorry attempted to found a standard nomenclature based on the natural percussion note of different parts of the body; for example *le son femoral, jecoral, cardial, pulmonal*, etc. But it proved equally needless and impracticable.

Percussion of the Lungs in Health.

The student will probably begin with the percussion of the upper chest in front. In any case he had better commence by percussing corresponding points on each side and compare them carefully as already explained. He may then take a more general survey of a particular region and compare it with the corresponding region in the same way. In some cases he might take this method first. But whatever plan he adopts he must see that all the conditions are similar. For example, there should be the same kind of stroke, especially as regards strength, the same finger or fingers applied to the chest, and he will not place one in and parallel with an intercostal space on one side and across a rib on the other.

It will be observed that apart altogether from the precordial region the percussion note is not the same at all parts. Let the clavicle itself be percussed, and it will be found that the outer half is duller than the inner, while again it becomes less resonant at the sternal articulation. Over the infra-clavicular region

there is less resonance and more resistance towards the sternum, till we find we are catching the dulness of the great vessels of the mediastinum. But such details are not to be committed to memory from books; they are to be sought out by each one for himself, not so much as facts, as contributing to the great principle that such differences occurring even over the same parts in different healthy individuals, demand not an absolute, but a comparative standard.

But the general features of the different regions should have some attention from the first. The right mammary region, with its commencing liver dulness, and the right infra-mammary, where that dulness is more marked; the cardiac dulness of the left mammary region, and the stomach tympanitic note of the left infra-mammary, should all be examined. But we reserve their detailed description till we come to the physical examination of the respective organs.

We would just add that the student must be prepared to find the percussion of the upper part of the posterior surface of the chest

comparatively unsatisfactory, at least over the scapulæ. It is difficult or impossible to make out finer distinctions over them, where the percussion stroke itself requires to be so much stronger to penetrate the greatly thickened parietes at that part. But he will have no difficulty with broader contrasts, and the finer will usually be sought for in front.

Percussion of the Lungs in Disease.

A mere enumeration of the more ordinary diseases that lead to an alteration in the percussion of note will here suffice. A full discussion belongs rather to the study of the diseases themselves, and rarer conditions may profitably be left out of account till the more common examples are thoroughly mastered. There may be :—

(*a*) *Complete absence of resonance,* or *absolute dulness.* This usually arises from fluid in the pleural cavity (pleuritic effusion, hydro-thorax); if it does not, it would suggest a tumour, or, if over the upper front of chest, to the right of the middle line especially, an aortic aneurism near the surface.

(*b*) *Diminished resonance*, or simply, *dulness*. The slight consolidation of incipient phthisis in the apex is the common cause of the least pronounced forms. In its more pronounced forms it may arise from tubercular or pneumonic consolidation; from the serous infiltration of pulmonary œdema; from fibro-plastic exudation (false membrane) in pleurisy without effusion; from pneumo-thorax, if the distension is extreme; or from aneurisms not very large or very near the surface.

(*c*) *Increased resonance*, or *hyper-resonance*. A hyper-resonant quality of percussion note is not common. Emphysema, pneumo-thorax (where the distension is moderate), pulmonary collapse and atrophy, are possible causes, but then the note is apt to be altered in character in the direction of the tympanitic quality. Perhaps the most undoubted cause of pure hyper-resonance is, *cæteris paribus*, emaciation of the chest wall. One may get pure hyper-resonance absolutely on the one side, the healthy, if there is extensive dulness, as from pleuritic exudation, on the other; but there is always the possibility in such a case of the

student being misled simply by the broad contrast.

(*d*) *Tympanitic*, or *dull-tympanitic* note. Percussing over the left infra-mammary region, we occasionally get a comparatively high degree of tympanitic sound conveyed from the stomach. This will be most apparent and most widely spread in cases of lung retraction which admit of the elevation, or favour the undue distension, of the stomach. It may be so high as to stop abruptly at the line of cardiac dulness. But as a pure pulmonary phenomenon it is best heard in a large well-defined superficial cavity.

Dull-tympanitic, though apparently a contradictory term, represents a sound that is fairly easy to get hold of, and it is one that is far from being uncommon. It is heard over cavities which are smaller and which are surrounded by consolidation. We may get it where there is consolidation and no cavity, in which case the tympanitic element must come from a larger underlying bronchus. Theoretically it is what we would expect from a cavity tensely filled with air, which, other-

wise, would have given the pure tympanitic note.

(*e*) *The cracked-pot sound* (*Bruit de pot fêle*). Laennec, who first described this sound, considered that it indicated a cavity near the surface of the lung, and stated that it was only obtained in spare subjects whose ribs were more than usually movable. This has always been accepted as the common condition under which it arises. But undoubtedly it can also occasionally be heard above the level of the dulness of pneumonia or of pleuritic effusion. It is stated to be heard sometimes in children with bronchitis, or in a healthy child while crying; also in cases of thoracic fistula, as after *paracentisis thoracis*. (See note p. 35.) In the adult it is only heard, we may say, in the infra-clavicular and upper half of the mammary regions. It is best brought out by firm percussion, during the act of expiration, and by the patient opening the mouth.

(*f*) *Amphoric resonance* (*amphora*, a jar). As the term implies, this is a clear ringing note, like that produced by striking an empty cask or jar. It is a musical ringing tone of a

metallic character, with a resonance that approaches an actual echo, so that it is sometimes called on that account "*metallic echo.*" It occurs in its most perfect form in pneumothorax, but here again the tension must not be excessive. If infra-pulmonary it can only indicate a very large cavity, having smooth unbroken walls and situated near the surface of the lung. Like the cracked-pot sound, it requires a degree of flexibility of the chest wall, and is, therefore, best heard when the cavity is just under the upper front of the chest and when the parietes have become considerably emaciated.

The Sense of Resistance, that is often brought out on percussion, must be referred to in concluding this part of our subject. It is a feeling of solidity conveyed to the percusser alone, which often gives him, insensibly it may be, an advantage over those who are merely listening. It conveys the simple impression of there being a more or less dense solid body under the finger, and it coincides practically with a corresponding degree of dull percussion.

AUSCULTATION.

Of the ordinary methods of physical examination we come now to the last in order of procedure, the last to be discovered, or, at least, to be systematically described and practised; the most applicable and delicate of all, Auscultation.

By this term is understood practically *mediate* auscultation, or auscultation through the medium of the stethoscope. We always speak of *immediate* auscultation when we refer to the direct application of the ear to the chest. This latter method in some irregular form has been practised from the earliest days of medicine, while mediate auscultation dates only from 1816, when Laennec first listened to the sounds of the heart with his improvised stethoscope, a roll of paper.[1]

Immediate auscultation being now quite exceptionally practised, its consideration may be dismissed in a few words at the outset. It is only suitable in the examination of the

[1] At the Clinique of Corvisart, Laennec had previously seen his fellow-student, Bayle, apply his ear directly to the chest to examine the heart.

back, and even with that limitation is seldom employed, except in the case of children, or in the adult whose weakness demands as rapid an examination as possible. In the common bronchitis of children all that is wanted by auscultation can be obtained by applying the ear to the back as the child lies on the nurse's lap; or, in the case of the adult, a rapid survey of the back can be made in the same way, as he sits for a second or two supported in bed, a towel being first laid smoothly on the back for the sake of cleanliness. Sounds are heard more loudly in this way, but they are drawn from a wider area; a more localised, more circumscribed range of sound is caught up by the stethoscope.

Mediate auscultation, or simply auscultation, implies the use of a stethoscope. We need not discuss the merits of the various kinds. We believe, as we were taught, that the best of all is one of light wood in one piece, with an ear plate that will best adapt itself to the particular ear, and a chest bell $1\frac{1}{4}$ inch in diameter, with a little breadth of

margin that will lie flatly on the chest wall where that is possible. Many prefer one of light metal. It conveys sound better, certainly, than vulcanite, and may in some circumstances do so better than one of wood. Stethoscopes that can be disjointed are more portable, but are not to be recommended on other grounds. Those made of materials of different density are very objectionable.

The flexible binaural stethoscope need hardly be described as it is a familiar enough object in the wards. It has no advantages that for a moment counterbalance the great disadvantage of training one's self to the employment of two such different methods of mediate auscultation; for surely few will hold that the exclusive use of the binaural is to be preferred to that of the simple ordinary form. The *differential* stethoscope is a binaural in which the tube of each earpiece is continued into a separate chestpiece. It may be convenient in some cases where we wish to compare rapidly two different parts of the chest.

In using the stethoscope there are one or

two obvious precautions that must be remembered. Possibly it is because they are so common-place that they are so habitually overlooked by beginners. Never press heavily with the stethoscope. It is a common occurrence for the tyro to cause the patient pain in this way; it is never done by the expert. Be careful always to adapt the bell of the stethoscope fairly to the chest. Carry the ear to the earpiece without moving the stethoscope in the least from its position. I would not mention such a thing were it not in my experience an every day occurrence with beginners. There is not a sound but what is thereby modified; and should it accidentally occur, the vibration of the air itself in the stethoscope is at once recognised by the practised ear, warning him that some inequality of the chest surface, we shall suppose, is displacing the bell of the stethoscope.

The auscultator should never put himself into an awkward position by bending so far over the patient as to listen, for example, round into the opposite lateral region. He may in this way, apparently from the rush

of blood to the head, quite fail to hear an otherwise fairly audible sound. Obviously, too, nothing should touch the stethoscope or rub against the patient's chest, or then the most startling friction sounds may be heard. Hair on the chest may produce fine crackling sounds from contact with the stethoscope. The simplest and most effectual plan to obviate this which I have seen practised, is to lay on the skin a small piece of wet blotting paper sufficiently large for the bell of the stethoscope.

Auscultation in Health.

As with the other methods of examination we have to study first the normal phenomena disclosed by auscultation. These are (1) the *breath sounds,* and (2) the *voice sounds.*

1. *Breath Sounds.*—By that we understand the sounds caused by the ingress and the egress of air along the whole course of the respiratory tract. That tract may be conveniently divided into three parts, furnishing us with three different classes of sound

known as *tracheal*, *bronchial*, and *vesicular*. We shall see by and by that the first is not studied for its own sake, but on account of what it may illustrate as a standard for comparison. Each of these three parts, then, has its own respiratory murmur; but when the "respiratory murmur" simply, or the "R.M.," is spoken of, the vesicular is usually understood.

The *Tracheal Sound.*—The student should leave description now and listen carefully for himself in a friend or patient. Let him then try to describe the sound. He will find it no easy matter, and the more familiar he becomes with it he will find that its adequate description becomes all the more difficult. He will learn that a description can only suggest. At the same time, after comparing it with the other respiratory sounds, he will probably understand that the tracheal sound is loud, harsh, hollow, very distinct, or a better word, *articulate*, with an evident interval between inspiration and expiration, the latter sound being rather the louder of the two.

The *Bronchial Sound.*—Here, again, it is best for the student simply to listen for himself in one or other inter-scapular region close to the vertebral column, between the level of the seventh cervical and the third or fourth dorsal vertebræ. He will observe that its character is less harsh, less articulate than the tracheal sound, but still distinctly hollow.

The *Vesicular Sound*, the *Respiratory Murmur*, or *R.M.*—What we have said of the study of the two foregoing sounds applies most of all to this one. The only way to know it is to listen to it habitually. It cannot be imitated, for any imitation we attempt has qualities, which are, compared with the sound itself, far too positive. It is simply air in motion. We know, indeed, that it is not really free, but there is always the sense of freedom. We may call it extremely soft and homogeneous, but it is best described negatively. It is not rough, not harsh, not hollow, not confined. Then the inspiration and expiration must be separately studied and compared. The latter is fainter and shorter than the former, being variously stated at

one third, one fourth, or only one sixth of the former. Indeed, Hyde Salter held that in the tranquil *unconscious* respiration of health there is no audible expiration sound at all, and Walshe thinks it is absent in one case out of four. The expiration sound is lower in pitch also.

The R.M. varies considerably within normal limits. It may hardly be heard at all; or again it may be that its intensity leads to the suspicion of incipient pulmonary mischief. The absence of any other evidence of disease and the equal character of the respiration itself over corresponding areas of each side will determine our opinion of its healthy character. Practically this equality must be held to be characteristic of healthy breathing. It is more distinct in the infra-clavicular regions and under the scapulæ posteriorly than elsewhere; or, as Walshe succinctly puts it, "The sounds are fuller superiorly than inferiorly and in front than behind." The student will not fail to notice how markedly emaciation of the chest walls intensifies all intra-thoracic sounds. In the rarer unilateral

atrophy of one or other muscle or set of muscles (for example, in *progressive muscular atrophy*) this has been strikingly demonstrated. On the other hand, the R.M. is diminished by a superabundance of subcutaneous tissue. "Fat and muscle," as Latham says, "damp the sound, where they abound above measure, as effectually as coats and waistcoats."

Origin of the Respiratory Murmur.—On applying the stethoscope to the chest "we hear," says Laennec, "during inspiration and expiration, a slight but extremely distinct murmur, answering to the entrance of the air into, and its expulsion from, the air cells of the lungs." One almost regrets that this simple statement of the origin of the R.M. was ever disputed. It remained virtually uncontradicted till 1834, when M. Beau vigorously defended the view, previously suggested by Chomel, that it was really the sound of the air passing through the narrow glottis which was heard by being conducted along the bronchi. Since then, the question has afforded an ample basis for speculation and experiment, with a balance of opinion rather in favour of Laennec's view. Dr. Joseph Coats had recently an exceptional opportunity of investigating the matter in a case in which Dr. Newman had successfully performed excision of the larynx for malignant disease. We need only give the finding of the committee appointed to co-operate with Dr. Coats, consisting of Prof. Gairdner, Drs. Newman and Lindsay Steven, which was to the effect "that it must be considered to be perfectly well established that the presence or absence of a glottis or of

any corresponding arrangement . . . . at the anatomical site of the larynx has no influence whatever in the production of the normal vesicular murmur."—*Glas. Med. Jr.* ii., 1886, p. 384.

Auscultation in Disease.

We have seen that the respiratory murmur differs in character and degree at different parts of the respiratory tract, and also that the vesicular respiratory murmur as heard over the chest generally, differs somewhat in different people. We have now to consider *abnormal alterations in the strictly vesicular R.M.*

Alterations in Degree.—(*a*) The R.M. may be simply diminished. Little air may be reaching that part of the lung. Of this there are a great number of possible causes, such as spasmodic stricture, as in asthma; inflammatory thickening, as in bronchitis; the pressure or the mere presence of an aneurism or other tumour. There may be little air current, as in emphysema, or in the restricted thoracic movement of painful pleurisy. The lung capacity may be invaded, as in partial collapse or consolidation.

(*b*) The R.M. may be completely suppressed. Any of the conditions just mentioned if aggravated will cause complete suppression over a greater or smaller area. Fluid or air in the pleural cavity, or false membrane over the pleural surface, will cause diminution or suppression of the R.M. by affecting the transmission of the breath sounds to the ear, or to some extent also, by modifying their production.

(*c*) The R.M. may be exaggerated. By this must be clearly understood simple loudness: not a change in character but in degree. It means that this part of the lung is doing extra work on account of other parts, or the other lung, being incapacitated. It is usually well marked when there is collapse, or consolidation, or considerable destruction, of other parts of the respiratory area. It is generally termed *supplementary* respiration. It is exactly like the natural breath sound in children, as Laennec pointed out, giving it on that account the name of "puerile respiration." We must remember then, more especially in view of what we are going to consider next, that by puerile or supplementary breathing we mean

simply respiration of increased intensity. Not that puerile breathing in the adult is always supplementary, but supplementary breathing is always puerile.

Wavy, Jerky, or Cog-wheel Respiration.—We have just been speaking of alterations in degree. We have now to consider abnormal alterations in character. To do this properly we must go back and start anew from the normal state. We notice not unfrequently in healthy people, particularly if they breathe slowly, that the R.M. is not quite uniform. It could not be called broken; one would rather say it is bending. As a matter of fact it is termed *wavy*.[1] It is quite recognised to be a normal phenomenon. But whenever we can say that the sound is actually interrupted, what would be, and is called, *jerky;* or still more, is so sharply and completely broken as to be sometimes termed *cog-wheel,* then we know that we have before us an almost positive sign of a form of in-

[1] The term wavy respiration was first used by Dr. Theophilus Thomson in his Clinical Lectures on Pulmonary Consumption (1854).

cipient disease. For it usually indicates early phthisis, particularly when heard, as it generally is, in one or other apex. It is believed to be due to infiltration of the air cells and reduction of the calibre of the minute bronchi from tumefaction of their mucous membrane. In a kind of diagrammatic way for purposes of study, it may be conveniently viewed as the first indication of a departure from health.

When heard under normal conditions in the neighbourhood of the heart this wavy breath sound seems to be due to the cardiac impulse. If it can be made out to be synchronous with the cardiac systole, it is sometimes called the *systolic-vesicular murmur*. But it is frequently heard over the right lung and in parts generally remote from the heart. In such circumstances it is found to be impossible to determine its relation to the heart's action; yet it is reasonable to suppose that, in many cases at least, it is due to the pulmonic capillary circulation, just as we see the ball of the thumb, or the foot of the leg which is resting on the other knee, moved by the systemic impulse. Roger and Barth believe that this "*respiration saccadée*," as it is termed by the French, is brought about in various ways—(1) Sometimes by an irregular or jerky movement of the thoracic walls; (2) Again, but more obscurely by an incomplete or tardy expansion of certain areas of the lung; (3) By the cardiac impulse as above noted, if heard in the left infra-clavicular region; and (4) A temporary irregularity in breathing induced by the mere stethoscopic examination.

Prolonged Expiration Sound.—This must be distinguished from prolonged expiration, which has reference to the whole act, and is, for example, a feature of Asthma. We are only now speaking of prolonged expiration *sound.* There is no reference to it by Laennec; and to Dr. Jackson, of Boston, is due the credit of its discovery in 1833. He recognised its ordinary significance, namely, early tubercular infiltration; and explained it by supposing that as the vesicular R.M. became thereby less and less possible, the bronchial element, itself unaltered, came as it were more and more to the front. But there are obvious difficulties in accepting this or any one explanation of a phenomenon occurring under such complex conditions. One can hardly believe it possible that so early a symptom of pulmonary phthisis can be due to such a degree of consolidation as we must suppose is necessary to materially increase the conducting power of the lung. But vesicular emphysema is also a great cause of prolonged expiration sound, and this has led to the supposition that diminished elasticity of the

alveolar walls is the explanation. Certainly in the latter malady it is a purer prolongation; in the former there is a change in quality, an approach to harshness also, which may be due, as has been supposed, to the tubercular deposition encroaching on the lumen of the minute bronchi.

Harsh Respiration.—There can be no doubt that this is entitled to separate consideration. It is more than puerile respiration, which is simply loud or strong. Harsh respiration concerns the expiratory, as well as, or even more than, the inspiratory act; and although Bronchial, and still more Tracheal, Respiration is harsh, harsh respiration *per se* is not hollow at all. As to its character, there is the well-known figure which compares the normal R.M. to the summer breeze playing in the leafy grove, and harsh respiration to the winter's blast coursing through the leafless tree tops. This may possibly convey to the student the kind of thing he has to expect, but the sound itself, like all the other sounds, must be really heard and studied to be really known.

As a sign of tubercular infiltration, harsh

R.M. may be considered to be an advance upon prolonged expiration. It points more particularly to that bronchial catarrh which is often the accompaniment of tubercle; it possibly arises sometimes from diminished secretion, sometimes from inflammatory thickening.

Bronchial Respiration.—By this we do not mean bronchial respiration where it exists naturally, for to this we have already referred, but bronchial breathing where we would expect vesicular breathing. It is harsh, but it is hollow as well. Harsh R.M. is more marked with expiration as a rule; in bronchial R.M., inspiration also is harder, drier, and rougher. But it needs little description, as it can be studied at its own normal situation in health.

It signifies either pulmonary infiltration or condensation. The former may be either tubercular or pneumonic; the latter (the condensation) is occasioned most commonly by the pressure of pleuritic effusion. Cancerous and other tumours are occasional causes of bronchial respiration, and may act in either of the ways just mentioned. The physical condition

common to both is a medium more uniform than the normal lung tissue with its contained air, and in this way the sound from the neighbouring unaffected bronchi is unduly carried to the chest surface and to the ear.

Tubular Respiration.—I venture to hold strongly with those who give to the term 'tubular breathing' a meaning distinct from 'bronchial breathing.' Unquestionably, one frequently hears in pneumonic consolidation a kind of breath sound that is never heard in normal bronchial respiration. It is more metallic or brassy; more like the sound of blowing through a brass or tin tube. Or better still, it gives to the listener the impression, as has been often said, of air being drawn from, and puffed back to, the ear in inspiration and expiration respectively.[1] The phenomena, as Walshe says, appear to occur in a space limited to the immediate neighbourhood of the part examined. Bronchial R.M. again is practically his "*diffused* blowing respiration."

[1] It was first described by Laennec, who termed it "*respiration soufflante*," *blowing* or *puffy respiration.*

Cavernous Respiration.—No description of this is needed; the term explains itself. The sound at once suggests a cavity. It is unmistakably hollow. There is more volume in the tone, and the pitch is lower, especially of expiration, than in any of the preceding groups. For its production it requires a cavity of considerable size near the lung surface or with surrounding condensation, containing little or no fluid, and communicating with one or more bronchi. In the great majority of cases it will be near the lung surface, and of tubercular origin. But it may proceed from a somewhat globular or ampullar dilatation of a bronchus; or still more rarely, the cavity may result from gangrene or abscess.

Amphoric Respiration.—This is the highest degree of pure hollow sound. Again the name explains its character; it is like the sound produced by blowing over the mouth of an amphora or jar. We are reminded of a deep musical tone with its pure, well-marked resonance, amounting almost to a true echo. It has also frequently a kind of metallic ring, and is always a highly articulate (close-to-the-

ear) sound. It can only be produced in a very large cavity, larger than one would readily expect to find in the lung tissue. Still it may be caused by an intra-pulmonary cavity, but it is said it must be of the size of the closed fist. Certainly all the conditions that lead to the cavernous breath sound must be here in the highest perfection.

A much more frequent cause of the typical amphoric sound is *pneumo-thorax.* An air containing cavity is always, of course, an essential. In the great majority of such cases, the air has been admitted by a fistulous opening, most commonly in the visceral pleura, the result of tubercular ulceration.

RÂLES.

Hitherto we have been dealing with modifications of the R.M. We have now to consider what are practically additions to it; what are truly adventitious sounds. The word "*râle*" was adopted by Laennec, it being the term commonly applied to the sound in the throat of the dying: the death-rattle, *le râle de la mort.* He gave to the word the wider significa-

tion which it has ever since borne, and which includes all abnormal sounds produced within the respiratory tract, whether by the presence of fluid secretion there in excess along with air in motion, or by the narrowing or roughening of the air passages themselves.

Râles may be heard with inspiration or expiration; with either alone, or with both. When we hear a râle, we form an opinion, of course, on its general character; such as its amount and loudness; but in particular we judge (1) Whether it is dry or moist, and (2) Whether it is coarse or fine.

The student will defer with advantage the study of the unnumbered classifications of râles, nor need he pursue, to the bitter end, the vexed question of what is to be held as a dry, and what as a moist, râle. Much difference of opinion is due apparently to the fact that some, very properly I think, consider only the sound itself, while others think of the cause of the sound. (See further under *Crepitant Râle.*)

The following classification of râles, practically that taught by Gairdner, seems to be very generally accepted. None could be at once more simple and more comprehensive. It includes—(A) *The Sonorous* or *Sibilant Râle;* (B) *The Mucous* or *Bubbling Râle;*

(C) *The Crepitant Râle;* and (D) *Mixed* or *Indeterminate Râles.* Also *Friction Râle.*

(A) *The Sonorous* or *Sibilant* (*snoring* or *whistling*) *Râle.*—This class includes low-toned snoring sounds up to those highest in the musical scale which become simply a whistle. They were classed separately by Laennec, but they differ only in pitch. It is always a dry râle, and always evidently so. It is the familiar cooing râle, and has always something of a musical quality. It may be heard both with inspiration and expiration. Gairdner, having regard both to their quality and mode of production, styles them "Organ-pipe Râles." The term suggests to us, what is undoubtedly the general rule, that the larger bronchi, like the larger organ-pipes, produce the lower tones, while the smaller bronchi can only form the higher tones.

These râles are so constantly associated with bronchitis, bronchial catarrh, and asthma, that we may assume they are caused by a swollen mucous membrane, a piece of occluding mucus or pus, or a spasmodically constricted bronchus, forming a fissure or

chink whose vibrating surface or edges occasion a musical tone. There is no necessity for supposing, as some do, that these râles are only, or even commonly, found at the bifurcation of a bronchus. They are easily coughed away if they arise from ordinary bronchial catarrh; even a deep breath may destroy them. Those of asthmatic origin will persist till the spasm disappears.[1]

(B) *The Mucous* or *Bubbling Râle.*—The râles of this class are as evidently moist as the foregoing are dry. They consist of a series of explosions of air through liquid. We speak of them as being large or small, or as coarse and fine. The smaller would be termed generally *mucous;* the larger, those that can be separately heard, probably rather *bubbling.* They are likely to be larger in the larger bronchi or in a cavity, but by no means necessarily so. Obviously the larger the bronchi in which they are, the more

[1] Some restrict the word *Rhonchus* to mean, not a râle generally, but this dry snoring râle. This has the merit of being etymologically more correct, but the word is not needed.

readily will they be modified or destroyed by coughing.

The *clicking* râle is of the same class. Here the fluid is simply thin, and so, as a consequence, are the walls of the air-bells. They therefore break with that sharper sound which the name indicates. It is, as a rule, but not constantly, a fine râle.

These râles always signify the presence of fluid in the air-passages. They constitute the ordinary sign of bronchitis in which there is a free secretion. They will probably be most abundant at the back, and towards the base of both lungs. So also in pulmonary œdema, congestion, etc.

Again, they are heard in tubercular softening, more particularly if that is rapidly advancing. In this case they are most likely to be about the apex of one lung, or at least most marked there. The clicking is more commonly the sign of the catarrh of tubercle. Fine moist râles lingering about an apex should never be overlooked.

(c) *The Crepitant Râle.*—The true crepitant râle has a very fixed character and is the

finest of all râles. It is typical of the first stage of lobar pneumonia; it is heard only with inspiration, and particularly towards the close of that act. It consists of a succession of minute rapidly evolved crackles, variable in number, but all perfectly similar in character. It was likened by the older Williams to the sound produced by rubbing the hair over the ear, and no better comparison has ever been made. Forced breathing, cough, or expectoration, have absolutely no influence upon it. It persists till pneumonic consolidation is complete, that is, until air can no longer enter the alveoli.

The râle is probably caused by the air-current separating the over moist and perhaps slightly adhering walls of the pulmonary parenchyma; but whether of the alveoli, or of them and the ultimate bronchi in addition, it is impossible to say.

The junior student should thoroughly familiarise himself with the above account of the crepitant râle before he proceeds to the study of exceptions. Some affirm that this râle may occasionally be heard with expiration also. So very rare must this be that probably the statement has "originated in the confusion which long prevailed between

the crepitant râle of pneumonia and the small bubbling râle of capillary bronchitis" (Walshe). Very possibly the alleged occurrence in rare instances of this râle in pulmonary œdema is to be explained in the same way. At the same time, whatever be the explanation, it is not unfrequently heard in the aged or the very weak who have been for some time confined to bed; but in that case it can be made to disappear by taking one or two deep inspirations.

The true crepitant râle, considered as a sound, should surely, we think, be called *dry*. Is the sound produced by rubbing the hair over the ear not a dry sound? No doubt if we believe that the crepitant râle is caused by the separation of the viscid walls of the bronchioles and alveoli, *and think of that*, we may be led to call it moist. But we positively lose something by this interpretation, as we shall see immediately.

(D) *Mixed* or *Indeterminate Râles.*—When a mucous râle is very fine, it has probably also lost much of its liquid character, and altogether it frequently becomes very difficult to say whether it is a mucous or a crepitant sound. To such a râle the name "*sub-crepitant*" (somewhat crepitant) has been pretty generally applied, or the term "*muco-crepitant,*" which indicates its hybrid character.

The student will understand now how greatly the force of this compound term, "muco-crepitant," is lost if we cannot consider the mucous râle to be moist and the crepitant râle to be dry. By muco-crepitant we just mean

that we cannot say whether the râle is moist or dry. We therefore only add to the confusion already existing if the one part of the word is not fitted to express the idea of the one quality, while the other part denotes the suspicion which we have that there is something of the opposite character as well.

The Crackling Râle, which constitutes according to Walshe a special class, calls for no particular reference. Its name adequately describes its character. It may be viewed as the dry râle which corresponds to the moist clicking râle. Nor do cavernous, amphoric, etc., râles need separate study. Just as these terms represent, as we have already seen, various qualities of the R.M., so do they indicate mere varieties of râle. We can understand a mucous râle with a cavernous quality having even a quasi-special character, and being styled a *gurgling* râle; and a clicking râle with an amphoric quality becoming a *metallic* râle.

The metallic sounds are separately classed by some writers. Certainly in their most typical form they constitute a very striking and exceptional variety. We have incidentally referred to them already but would here specially take note of two—*metallic tinkling* and *metallic bell sound*. Pure metallic tinkling was compared by Laennec to the sound caused by letting fall a pin or a grain of sand

into a metal or glass cup, and as a morbid phenomenon has been supposed to be caused by drops falling from the roof of an air-filled cavity (pulmonary, or in pneumo-thorax) into the fluid below. It is very doubtful if this tinkling is ever exactly so caused. It probably arises rather from the bursting of large bubbles in large air-filled cavities.

The metallic bell sound is a term applied to the clear ringing metallic sound which is heard if one auscultates over a pneumo-thorax while an assistant strikes a coin placed on the chest wall with another of a similar kind. The resulting sound heard is sometimes, as Gee says, not much inferior to the chime of a small clock.

The sounds which have just been under discussion, known technically as râles, are all, it will be noticed, intra-pulmonary. We pass now to one that is extra-pulmonary, which is connected with the pleura and is not usually termed a râle but simply a sound:—

Friction Sound (*Friction Râle*—Gairdner). In health there is absolutely no sound caused by the play of the two pleural surfaces on each other. The movement is perfectly free. But let either surface lose its perfect softness and polish, and friction sound, "the pleuritic rub" as it has been called, becomes possible. In its ordinary form it can hardly be mistaken. What it really is, the sound of one roughened

surface rubbing over another, is self-evident to the ear that can catch the sound at all. It conveys, as Fagge says, "the impression of something catching or dragging against an obstruction and then slipping, but only to catch or drag once more." It may be heard either with inspiration or expiration or with both. It may be heard only towards the end of either, and, what seems to have attracted little notice, may sometimes be distinctly heard after the act of expiration, so far as thoracic movement is concerned, is complete; as if the surface had caught at the end of expiration and then, being elastic, had recovered itself.

If the roughness is considerable, the patient himself may feel it, and it will be readily made out by palpation at the affected part. (See p. 23.) It is most commonly heard over the lower half of the chest, about the lateral region or posteriorly. But it must be remembered, that should the friction be very fine, it may not be with certainty recognisable as such. It may be impossible to say whether the sound is extra or intra-pulmonary, to say

whether even as a sound it is moist or dry, and we express our difficulty by the convenient word "sub-crepitant" or "muco-crepitant."

Categorically friction sound is described as being—(1) Superficial in character, (2) Generally limited in area, (3) Never influenced by coughing, and (4) Possibly modified by posture. Râles, as a rule, present exactly the opposite characters.

Vocal Resonance.

Having completed our consideration of the breath sounds we pass now to the Voice Sounds, or:—

Vocal Resonance. By this we mean the sound of another's voice as heard on applying the ear or the stethoscope to the surface of his chest. In the healthy chest, if we keep away from the main bronchi, we find that the spoken words resolve themselves into a mere confused buzzing. The character of the sound will differ but slightly in different people. It is louder in the male, but a little less indistinct in the female. It is the more

pronounced the deeper the tone of voice, the more capacious the chest, and the thinner the chest wall. Fat and muscle interfere with the transmission of the sound.

In testing the Vocal Resonance, or the V.R., it is usual to employ a uniform set of words or numbers, such as "one, two, three," or "ninety-eight, ninety-nine," which we ask the patient to repeat. If we listen in the areas over the right and left bronchi, over the right especially, we find the V.R. is more loudly, more directly conveyed to our ear than elsewhere. We have in this situation "increased V.R.," as we say, and if we heard it similarly increased at any other part of the chest, we would say there is *bronchophony*.

In disease the V.R. may be altered both in degree and quality.

The V.R. may be increased. There must be, in that case, a more uniform medium of conduction than there is naturally. Practically it must be either consolidation or cavity. Pneumonic and tubercular consolidation are the two most common forms; but a lung compressed against the chest wall posteriorly,

as by fluid, is a not unfrequent cause. But the larger bronchi or many of the smaller, must not be occluded, for then the waves of sound from the larynx are to a greater or less degree stopped. These are just the conditions which determine, as we have seen, the amount of V.Fr.

A pulmonic cavity is also a cause of increased V.R. It need not be large, but there must be the same free communication with the larynx that we have just seen is essential in the case of consolidation. The cavity must also be either near the surface of the lung, or else have a conducting layer of consolidation between itself and the surface. A cavity, unlike consolidation, is not usually so large as to lead to increased V.Fr.

There are two words which express with comparative exactness the extent of the increase. *Bronchophony* we have already noted, but the highest degree of increase is called *pectoriloquy*, conveying, as it does, the impression that the patient is speaking right from his chest into the stethoscope. Like the R.M. or a râle, under such conditions,

the sound is articulate. Mere intensity of conduction, mere loudness, is not exactly the element that we consider here, but distinctness; and loudness of the voice itself only confuses the point at issue. We try rather the whispered voice, and we find that it elicits the articulate quality in the highest degree. Each term stands for a definite enough phenomenon and the beginner should simply apply the test suggested by its derivation.

The V.R. may be diminished. This is most likely to be due to the presence of liquid or air in the pleural cavity. Or the wave of sound may be intercepted in a main bronchus which is occluded in some way, as by the pressure of an aortic aneurism or other tumour about the root of the lung; or it may be that several smaller bronchi are filled with secretion. If the amount of fluid is considerable the V.R. is altogether suppressed.

Baccelli has shown that the more fluid and homogeneous the effusion, the more easily and completely is it penetrated by the vocal vibrations, and that, in favourable circumstances, even a whisper may be audible through the effusion; but through fibrinous and particularly through purulent exudation the waves of sound pass with difficulty

or not at all. Douglas Powell says this statement only holds true in certain cases, and that the whisper may sometimes be heard through purulent fluid. To appreciate these differences in conduction Baccelli recommends that the auscultating ear should be pressed firmly against the chest, that the other ear should be closed with the point of the finger, and that when the patient speaks he should turn away from the examiner.

The V.R. may be altered in quality. Various ill-defined changes in quality may be heard along with bronchophony; sometimes a kind of concentrated buzzing, or again rather a sniffing sound. Several times in lobar-pneumonia it has seemed to me exactly like the sound obtained by blowing on a comb covered with silk paper.

It has been likened also to the voice heard through a speaking-trumpet, or to the sound we make when attempting to speak with something between the lips and the teeth. But all these forms may be classed under one universally recognised title, namely: Ægophony (*αἴξ, αἰγός*, a goat; *φωνή*, a sound), the bleating sound, or punchinello voice. Such illustrations as have just been given, will convey to the student a better idea of the kind of sound he is to expect than any

detailed description can do. It will be understood that the sounds are not always the same or even similar, yet a tremulous, bleating, nasal character pervades them all. It is heard over a much more limited area than bronchophony or pectoriloquy. It is practically confined to the neighbourhood of the inferior angle of the scapula, although, in rare cases, it may be heard round almost to the nipple (Walshe). True ægophony is considered to be characteristic of pleuritic effusion in moderate amount, and it is believed to mark the upper limit of the fluid, or where it is still forming but a thin layer between the pleural surfaces. Its peculiar character is believed to depend on the voice causing a vibration of the walls of the bronchi, flattened and compressed by the liquid effusion, and these vibrations coming through a thin layer of fluid to the ear acquire a nasal character (Guttmann).

SUCCUSSION.

We need only refer to this in a sentence or two. If a large cavity contains both liquid and air (and we have the best example of this

in the disease called *hydro-pneumo-thorax*), and the patient is shaken or moves himself freely while we listen with our ear to the chest, a splashing sound may often be heard such as we get by shaking a glass vessel in which there is a little water. It may be so distinct that the patient, and even those standing near his bed, may hear it. This method of diagnosis was practised by Hippocrates and is therefore generally called *Hippocratic Succussion.*

THE PHYSICAL EXAMINATION OF THE HEART.

In the examination of the heart we proceed by the same methods and in the same order as in the case of the lungs, namely, by inspection, palpation, percussion, and auscultation. The heart, however, more than the lungs, requires a ready reference to particular points on the chest wall. The student should therefore make himself familiar with the ribs and spaces anteriorly so as to be able to recognise any one of them without difficulty.

Normal Relation of the Heart to the Chest Wall.

The most certain and also the most rapid method of counting the ribs and spaces, say on the left side, is to place the palm of the left hand on the sternum, and, keeping the little finger in the first intercostal space, run the other fingers down the corresponding spaces, till the thumb is placed on the fifth, in which

we shall find the normal inferior limit of the heart itself.

The apex beat at once arrests our attention. From every standpoint it is the most conspicuous, the most significant, and in the normal condition, the most constant feature of cardiac physiognomy. It is the key to the position of the heart. It tells us most readily of the disturbing forces that are attacking the heart either from within or from without, for while the base is the most fixed, the apex is the most free to move or be moved in any direction.

Position of the apex beat.—Normally it is situated in the fifth intercostal space, or just behind the upper border of the sixth rib on the left side. It should be a little further below the nipple than it is within the vertical nipple line, or about $1\frac{1}{2}$ inch below and $\frac{3}{4}$ inch to the right of the nipple; for it will be remembered that the latter does not occupy a fixed point. The beat extends over an area of about an inch square, and it is formed in the main by a small portion of the left ventricle.

If the apex beat is rather diffused, then the

point of pulsation furthest to the left is to be regarded as the apex. By lying on the left side the apex is brought nearer the chest wall and the impulse made more distinct; it is, at the same time, carried a very little towards the left. We therefore move the patient on to his left side if the beat is faint or imperceptible in the dorsal position; and if still in doubt, we endeavour to ascertain its position by auscultation. The apex beat terminates the long axis of the heart, the long axis itself being directed downwards, slightly forwards and markedly to the left.

The base of the heart.—This measures about three inches, and is pretty equally divided by the middle line. Being at right angles to the long axis, it looks, not directly upwards, but somewhat to the right so that the left auricle is the higher of the two. It reaches almost to the lower edge of the second left costal cartilage; the right only to the upper border of the third right costal cartilage.

The left border of the heart will be pretty accurately followed by drawing, from the left extremity of the base line, a line convex out-

wards so as almost to touch the nipple, and then curving it slightly inwards to the apex. The right border cannot be so definitely sketched, as the heart rounds gradually backwards, but the furthest point to the right is about midway between the mesial and right nipple lines, or an inch fully to the right of the sternum. The inferior border of the heart ascends with but a slight departure from the horizontal to join the right border. The above may be taken as the normal outline of the heart, always remembering that the apex beat is the only point we are able actually, that is clinically, to fix.

INSPECTION.

In Health, there is no precordial bulging of the chest wall. In the dorsal decubitus, the impulse, if visible at all, is confined to the apex beat, unless the patient be of spare build, when it may be seen also in the space above: there is practically never epigastric pulsation.

In Disease.—Bulging of the precordial region indicates that there has been undue impulse over a considerable period while the

chest wall was comparatively plastic. In children, therefore, and still more readily in children suffering from rickets, cardiac hypertrophy, or pericardial effusion may induce this deformity. It is rare to find it occurring in adult life. It is likely to be associated with widening of the intercostal spaces; indeed this may occur from cardiac hypertrophy although there is no bulging.

The impulse area is increased, but within normal precordial limits, by physical or mental excitement; and permanently when there is retraction of the over-lapping pulmonary border. The impulse may then be seen in the fourth or even the third intercostal space. Or it may be diffused beyond the normal cardiac area from hypertrophy or dilatation.

The impulse area is diminished or disappears when the cardiac action is weakened, as from prolonged illness or in the later stages of an acute disease. Or it may be that an emphysematous lung or pleuritic effusion comes between the heart and the chest wall. In pericardial effusion also, we may find the

intercostal spaces levelled and the parietes raised from the heart as it were, so that the apex beat becomes possibly imperceptible. But it might, on the other hand, be simply owing to excess of fat in the parietes of the chest.

The impulse area is displaced.—The most potent cause of this is pleuritic effusion. It pushes the heart before it as a whole, and therefore the apex most markedly, to one or other side. Left pleuritic effusion may cause the apex beat to be felt even in the right nipple line. Effusion on the right side may carry it to the left axillary line. Air in one or other pleural cavity acts in the same way.

Aneurism of the ascending aorta, if large, will displace the heart downwards in its long axis; and generally whatever raises or lowers the diaphragm, raises or lowers the heart, and therefore the apex beat. Pericardial effusion, if in considerable amount and uncomplicated, raises and carries outwards the apex beat, so that it might possibly be felt in the fourth intercostal space and in the nipple line, if indeed it could be made out at all.

PALPATION.

In the physical examination of the heart inspection and palpation go hand in hand. The one supplements and, it may be, corrects the other. We try again if the beat is sharp or prolonged, punctuate or diffuse. But palpation does more. It tests the force of the impulse, and we also feel if there is anything like a thrill or vibration conveyed to the chest wall. This impulse marks the beginning of the ventricular systole, a fact that, as we shall see, may be of great value in verifying the rhythm of a cardiac murmur. The ventricular contraction is synchronous on both sides; it is a movement towards the chest wall and also downwards, with a slight wave from left to right.

In Disease.

The Impulse Force is increased. The great cause of this is hypertrophy, the degree of force being strictly according to the degree of *pure* hypertrophy, that is hypertrophy without dilatation or degeneration of the cardiac

wall. If this forcible impulse is carried downwards and outwards, namely, in the axis of the heart, prolonged possibly to the seventh or even the eighth intercostal space, it will point to hypertrophy of the left ventricle. If it is more a transverse increase, being rather carried down by the sternum, or perhaps into the epigastrium, it will indicate right ventricular hypertrophy. It is likely to be more forcible and heavier in the former than in the latter case, as the left side has naturally thickened walls and greater contractile power than the right.

The impulse area is increased without corresponding increase in force.—Here dilatation is suggested. The purer the dilatation—that is, the less there is of hypertrophy—the weaker, the shorter, the more fluttering the impulse. There is no longer the idea of power as in hypertrophy; there is the reality of failure, and the heart trembles. Other physical signs are brought out by auscultation as we shall see shortly.

It must be remembered that hypertrophy and dilatation are as a rule combined and in

varying proportions, and that we can only judge approximately of these proportions by a careful study of both symptoms and signs. But as Walshe summarises it, having regard to palpation alone, "pure hypertrophy increases to its maximum the force of impulse; hypertrophy with dilatation, the force and area combined; dilatation weakens force, extends area."

Whether or not the auricles can be so hypertrophied as by themselves to cause a precordial impulse is not agreed. If we could make out a pulsation over either auricle, which preceded by an instant the ventricular impulse, it would lend support to an affirmative answer.

Cardiac Thrills are cardiac murmurs and cardiac friction sounds which are felt as well as heard. It is better therefore to study them in connection with the sounds themselves, and we need only here make a general reference to them. The thrill of endo-cardial origin frequently gives to the hand a sensation which was likened by Laennec to the purring of a cat, and it has since been pretty generally

known as the *frémissement cataire.* It occurs most usually at the apex, running up to and ending with the first sound; but it may be felt during any part of the cardiac cycle. Exceptionally the valvular disorder may be of such a character as to produce a distinct rasping fremitus through the *manubrium sterni.* Pericardial thrill is simply an accident of pericardial friction. (See p. 119.)

I have felt what was distinctly a vibration over the precordium when no cardiac murmur whatever could be made out.

PERCUSSION.

In Health.

The percussion of the heart is hardly of the same character as that of the lung. It is not so much to test the individual part as to mark the outline of the whole. And this is not so easy. From all sides the lung flows and ebbs on its surface with every act of respiration; and while one form of pulmonary disease may leave the heart unduly exposed, another may completely cover it in. Nor does the heart present a flat surface for examination, but one

which has a strong convex curve transversely as the heart rounds deeply within the chest. These conditions once more demand a constant study of the normal heart to which the following directions can at best be only a guide. Two areas must be carefully distinguished; the exposed surface of the heart, and the parts overlapped by lung.

1. *The exposed surface of the heart.*—This consists practically of the right ventricle, the apex being the only part of the left ventricle which comes round to the front. It is somewhat triangular, and extends upwards to the level of the upper margin of the fourth costal cartilage in the middle line. Thence its right border falls perpendicularly, that is, down the middle line, while the left runs straight to the apex. The base coincides with the inferior border of the heart as far to the right as the middle line. This forms the area of *superficial* or *absolute dulness.* Obviously it is affected by respiration; indeed by forced inspiration the heart may be completely overlapped by lung. The area we have been assuming, and have just described, is that of

moderate inspiration. Under ordinary circumstances the actual dulness hardly extends to the middle line on account of the percussion vibrations of the sternum itself. This could be in part corrected, were there any need for it, by making the patient incline inconveniently forward, thus bringing the heart in closer contact with the chest wall.

2. *The lung-covered surface of the heart.* —This forms the area of *deep* or *comparative dulness.* Here there are insuperable difficulties in the way of accurate demarcation. The heart rapidly recedes on the right side under the sternum, which yields its own note on percussion. To the lower right there is the hepatic dulness with which that of the heart is continuous. Sometimes a distinction, sometimes an actual break in the character of the dulness can be made out by experts, although the discrimination is possibly materially aided by knowing that a line drawn along the upper margin of hepatic dulness to the apex of the heart will traverse the cardiac boundary. Nor can much be made of any alteration that would readily occur about the base of the

heart. For these reasons it is usually the area of superficial dulness that is examined in cardiac disease.

In Disease.

The superficial area of dulness may first of all be altered from pulmonary disease. In phthisis, collapse, or any form of contraction of the lung, there may be undue exposure of the heart, while pulmonary emphysema, especially of the anterior borders may completely cover in the heart. In that rare disease also, pneumo-pericardium, a more or less tympanitic note obtains over the precordial region.

The great causes of increased cardiac dulness are hypertrophy and dilatation. After what was said under Palpation, it is hardly necessary to describe the directions in which the increase may occur.

For practical purposes it is usual to percuss the heart vertically one inch to the left of the sternum, by which we avoid the main vessels at the base, and transversely along the level of the lower margin of the fourth rib. For the diagnosis of left ventricular enlargement Fagge

recommended percussing in a line from the fourth costal cartilage, near the sternum to the site of the apex beat, and then along another line, at right angles to the former, drawn from the lower end of the sternum, upwards and outwards, to a point at which the absolute cardiac dulness ceases. Normally, the first line will not exceed 2½ inches, while in enlargement it may extend to 4 or 5 inches. The second line should measure about 1½ inch: it may be increased to more than 2 inches.

Pericardial effusion is another cause of increased cardiac dulness, and should the amount of fluid be considerable, the area of dulness will assume a characteristic cone-shaped form, the base of which will be below and the apex above. This depends on the fact that the pericardial base is on the level of the cardiac apex, and the pericardial apex at the cardiac base. More correctly, the dulness will reach the level of the lower margin of the sixth rib. In extreme cases the effusion may push down the diaphragm, extend from the right of sternum to the left axillary region, widely separate the lungs where they normally

approximate, and reach higher than the cardiac base. The pathognomonic sign of pericardial effusion is the fact of dulness extending to the left of the apex beat.

AUSCULTATION.

The auscultation of the heart is the master-subject of physical diagnosis. So exact, so elaborate, so refined has it grown, that the student instinctively approaches it with misgiving. Here again there is but one way. We must first study the normal state, then the grosser departures from health, and then the intricacies of finer and more subtle disorders. And so beginning with healthy phenomena we consider first :—

Cardiac Sounds. Each beat of the heart as we all know is made up of two sounds followed by a pause ; this complete revolution is usually termed the cardiac cycle. The two sounds are evidently not alike. The first is prolonged, with more volume, yet duller; the second is short yet sharp. The word "lubb-tup" is usually selected to imitate them. Wherever the sounds are heard, it will be noticed that as

regards *quantity* the first sound is always long and the second always short; but it is not so as regards *accent*. With a little care the accent can be made out to be on the first sound at the apex (lubb′-tup), while at the base it is on the second sound (lubb-tup′).

It is misleading to say that at the apex the rhythm is trochaic (— ⏑), and at the base iambic (⏑ —). It is not so in the classical sense, and in musical rhythm, time and accent are, of course, quite different things. It is far from being a mere scholastic distinction. On the contrary it will not be unprofitable for the student to endeavour to make out clearly, that while the first sound is always long in quantity, it may or may not be accentuated.

The first sound is coincident with the beginning of the ventricular systole, the second sound with the beginning of the ventricular diastole, while during the pause, or perhaps only towards the end of the pause, the auricles are silently contracting.

The relative duration of the different periods within the cardiac cycle cannot be exactly estimated. In the case of the normally beating heart the pause is longer than either the ventricular systole or diastole, but probably hardly so long as the two combined. The

diastole is shorter than the systole. The auricular systole is generally believed to occupy a very short period immediately before the first sound. If the heart's action is quickened it is chiefly the period of rest that is shortened.

The physical cause of the heart sounds is a physiological rather than a clinical question. Still the clinical student, with possibly a fading recollection of the numerous and diverse theories that have been advanced, will with advantage remember this, that muscular contraction plays at least a considerable part in the production of the first sound (closure of the auriculo-ventricular valves is generally held to be the main factor), and that the second sound is due to the closure of the aortic and pulmonary semi-lunar valves. This should be recalled when studying the altered sounds of cardiac hypertrophy and dilatation (p. 99).

As to the valvular element in the sounds it is generally agreed at what points the different parts of the sound produced at each orifice may best be heard. But again the student will first of all remind himself of their anatomical

situation. A line drawn from the upper border of the third left sterno-costal articulation to the fourth right intercostal space will cross the pulmonary, aortic, mitral, and tricuspid orifices, and in the order named. A superficial area of half an inch square, or the bell of the stethoscope, will cover a portion of all four (Walshe).

But it is not here that we listen to the sound of each orifice. Overlapped by lung and lying at various depths in the thorax, their sounds are conducted to very different points on the chest wall. These points are as follows:—(1) Mitral sounds are sought for at the apex; (2) Those of the tricuspid valve at the lower end of the sternum; (3) The aortic in the second right, and (4) The pulmonary in the second left intercostal space close to the sternum.[1] This has a still more practical connection with the study of cardiac murmurs. (See p. 110, note.)

[1] The second right costal cartilage is commonly called the "aortic cartilage," as there we frequently listen to the aortic diastolic sound or murmur.

Alterations in the Heart Sounds.

The heart sounds may be altered in *amount* and in *character*.

1. *In Amount.*—Whatever weakens the heart, weakens the sounds, the first sound especially (Gee). General debility, therefore, faintness, febrile prostration, and of the heart itself, fatty degeneration, may all be manifested in this way. Both sounds of the heart are weakened rather by some intervening medium which lessens their conduction, as excess of fat or muscle in the chest wall, and pericardial effusion.

On the other hand both sounds are intensified in patients of spare build, and comparatively, in the young; also by mental or physical excitement; and in certain neuroses, as *exophthalmic goître.* When impulse and sound increase together there is probably no hypertrophy, but only a more forcible action generally. It is more characteristic of cardiac disease when one or other sound alone is affected, unless the alteration in the intensity of the two sounds is in different directions.

Hypertrophy weakens the first sound absolutely, or imparts a dull or muffled quality to the sound while conveying the impression of increased volume. On the other hand a short, sharp, clearer first sound indicates dilatation; the sound will be smaller but more defined. If it is both loud and sharp there is probably hypertrophy and dilatation combined.

We see now how the effect of hypertrophy and of dilatation on the first sound is better understood by remembering the two elements in its production (p. 96). The thickened heavy wall of hypertrophy will give a fuller yet slower and duller sound itself, at the same time concealing the valvular element, while the purer the dilatation the more will the short, sharp valvular sound predominate.

The second sound may also be altered in amount. It is exaggerated or accentuated by cardiac hypertrophy. It should be listened to both over the aortic and pulmonary area, and the two sounds compared. A preponderance of the pulmonary, or a marked preponderance of the aortic sound, points to hypertrophy of the corresponding ventricle, the aortic sound being normally only slightly the louder of the two. But as hypertrophy probably always means the presence of undue obstruction felt by the heart,

it follows that the causes of such obstruction become the causes of this accentuation. Here we need only mention two. Chronic Bright's disease is well known to induce left cardiac hypertrophy, while mitral disease is a great cause of right cardiac hypertrophy. In the two cases, therefore, we have respectively the aortic and the pulmonary sound accentuated, and this arises from increased vascular tension, in the one case systemic, in the other pulmonary.

Further details belong rather to Hypertrophy as a special disease. The apparent difficulty of the subject becomes its surpassing interest only when we become familiar with those diseases which affect the circulation, and understand how the integrity of the whole depends on that of any one part. This will be referred to more fully in speaking of cardiac murmurs.

The second sound of the heart is rarely weakened apart from the first. Mitral disease may, however, weaken the aortic second sound by lessening the amount of blood which is driven into the aorta, and consequently the amount which recoils on the valve.

2. The heart sounds may be altered in

character. The most obvious change in this respect is *Reduplication*. By this is meant a doubling (rarely a trebling) of one or other heart sound (rarely of both sounds). It is fairly common, not very difficult to detect, and not always a sign of disease. Reduplication of the second sound is the more common of the two, and that sound being naturally the more defined, the repeat, like a faint echo of the original, is readily made out, especially if the cardiac action is slow. Reduplication of the second sound is of common occurrence with mitral disease, with diseases of the lung which impede its circulation, and is therefore commonly associated with accentuation of that sound. It occurs sometimes in health when a little exercise readily dispels it by quickening the heart's action. Some forms of reduplication run into murmurs when the heart's action is thus increased.

A cantering action (the *bruit de galop* of Potain) of the heart is occasioned sometimes by a doubling of the first sound. It is heard down the left border of sternum or towards

the apex, and seems to be formed by a fainter pre-systolic sound being added to the normal systolic. It has been described by some as occurring in the middle of the pause. Potain believed it to be commonly associated with cardiac hypertrophy from cirrhosis of the kidney. More recently (1885) he has considered it to be due to sudden diastolic tension of the ventricular wall, rather than from hypertrophy of the auricle as he formerly held.

Its immediate cause can only be a matter of theory. This winter I heard a distinct slow canter-sound (reduplication of the first sound) just under the middle third of the clavicle in a young man who was under my care in the Royal Infirmary suffering from a trifling complaint not connected with the heart. The reduplication became less distinct towards the aortic cartilage where it was just audible. Below this point it could not be heard, and it disappeared altogether by making the patient sit up in bed, thereby quickening the cardiac action.

The mechanism of all forms of reduplication is purely a matter of inference. There are two generally accepted theories:—

(1) *Non-synchronous contraction of the two ventricles.* Against this there is the fact that it is extremely rare to find both sounds

doubled, and it fails to account for the occasional trebling of one sound, which is known as the "drum-beat" or the "rat-tat-tat" sound. (2) In the case of the first sound, *non-synchronous tension of the different valve segments of the auriculo-ventricular orifice*, and in the case of the second sound, probably *a non-synchronous action of the aortic and pulmonary valves as a whole.* Whatever be the correct view, there can be little doubt that unequal tension of the two systems, the systemic and the pulmonary, is apt to induce reduplication. Doubling of the second sound is a common occurrence in those conditions which cause, or in which we would expect accentuation, such as mitral disease or chronic pulmonary disease in which the pulmonic circulation is impeded, that is, its tension increased. Similarly renal disease, such as cirrhosis of the kidney, by increasing the systemic tension, causes, as we have seen, reduplication of the first sound.

The only other pure change of character in the cardiac sound that need be mentioned is:—

A metallic or ringing quality. This character is readily imparted to the cardiac sounds by the presence of a neighbouring cavity. Pneumo-thorax or a large pulmonary cavity is most likely to do this, but a distended stomach may occasionally be the cause. In pneumo-pericardium, Guttmann says the sounds acquire this quality to the highest degree; but this is a very rare condition, and one still more rarely admitting of physical examination.

In addition we frequently hear indeterminate departures from the normal quality of heart sound that might or might not be considered a murmur. It might become unmistakably one by a little physical exercise; more rarely this causes the suspected murmur to disappear.

CARDIAC MURMURS.

A cardiac murmur may be defined as a sound added to or supplanting the cardiac sound. As in the case of the pulmonary râle the fundamental sound need not be the normal one, but whether it be or not, the murmur is something more than simply a change in the

quality of that sound, though practically it may be, as we have just seen, difficult or impossible sometimes to say whether we have before us the one or the other. Murmurs like râles are of the most varied character. Of all degrees of intensity, they are usually of a smooth blowing quality, though often rough, harsh, or hissing. Sometimes they give a perfect musical tone of definite pitch. But unlike râles their character is not their most important feature and they are not classified on that basis.

We have first of all a broad anatomical division into ENDOCARDIAL and PERICARDIAL MURMURS. We shall consider first:—

ENDOCARDIAL MURMURS. They may be caused (1) *By any organic or structural change that affects the competence of an orifice.* These are therefore termed *organic murmurs.* They again may be, and commonly are, induced by direct valvular disease, as we would expect; but sometimes the valves and the orifice altogether are healthy, but are rendered incompetent by neighbouring mischief, as by the traction of a

dilated ventricle on one side, or of an aneurism of the first part of the ascending aorta on the other.

Endocardial Murmurs again may be caused (2) *By a mere functional irregularity of cardiac tone or contraction.* These are therefore termed *inorganic* or *functional* murmurs (*anæmic, hæmic, etc.*). An endocardial, as distinguished from a pericardial murmur, is always exactly synchronous with the accompanying cardiac movement.

To proceed now in our practical line of inquiry, when we hear a murmur, particularly though not exclusively an endocardial murmur, we consider three things in the order named:—1st. Its rhythm; 2nd. Its area and point of maximum intensity; and 3rd. Its conduction.

1. *Rhythm.*—This must always be not only the first question regarding a murmur, but a distinct part or stage of the whole inquiry. By the term 'rhythm,' is meant the place in the cardiac cycle which the murmur occupies; in other words, the relation which the murmur bears to one or other heart sound.

But the murmur itself may occasion a new difficulty. It may be no easy matter to say which is first and which is second sound. Should there be even only one murmur present, a slight change in the quality of the remaining sound or in its accentuation, may make it impossible to say by the ear alone which sound it is we are hearing, and consequently at what part in the cardiac cycle the murmur comes in. We must then either note the systolic impulse, which we can usually feel on our ear as we auscultate, or place our finger on the carotid artery and note the impulse there. Either of course coincides with the first sound. The radial pulse must never be taken for such a purpose; there is too distinct an interval between it and the ventricular systole.

Now as regards Rhythm there are three distinct kinds. We shall consider as the first of the three:—

1. *The Pre-systolic Murmur* (Auricular-systolic, or A.S. murmur—Gairdner).—This murmur precedes, runs up to, but does not displace the first sound, with which it ends

abruptly. It does not supplant or displace the sound. In character it is *rough* or *purring*, rather than soft or blowing, and this special feature contributes to its detection when associated with others so that the rhythm is obscured. The thrill may be distinctly communicated to the chest wall.

This murmur may begin early in the cardiac pause, but is usually confined to the latter part of that period, increasing in intensity and roughness up to the first sound. It is the least stable of endocardial murmurs, becoming more marked with increased cardiac action or disappearing as the heart quietens down.

2. *The Systolic Murmur* (Ventricular-systolic, or V.S. murmur—Gairdner).—This is the most common murmur of the three. It replaces and follows or shades off from the first sound. It and those of the third group are *blowing* or *hissing* rather than rough, but the systolic murmur is usually louder but less prolonged than those of the next group.

3. *The Diastolic Murmur* (Ventricular-

diastolic, or V.D. murmur—Gairdner).—This murmur follows or shades off from the second sound, and therefore encroaches on the pause. It is of a soft blowing, or sometimes of a hissing, quality.

Of the foregoing three classes, any two or all of them may be combined. If the pre-systolic and the systolic are together a break is seldom discernible by which they can be separated. What is heard is one long murmur, the first part of which is distinctly rough and the second blowing. The first sound itself is practically lost in the murmur. With the systolic and the diastolic murmur it is different. Although there is not the complete second sound between them, there is a distinct break which along with the softer quality and greater prolongation of the diastolic, makes the recognition of the combination a matter of no great difficulty.

The Area or Site of Murmur.—Having satisfied ourselves as to the rhythm, we come now to a distinct, and what should always be a subsequent, inquiry, namely, which of the four orifices is affected, or are

affected, for there may be more than one.[1] With this question it will be convenient to associate also the *conduction* of the murmur.

(A) *The murmur is best heard at the apex.* This indicates mitral disease, and now from the standpoint, not of rhythm but of situation, it is termed a mitral murmur. It will usually be found that the murmur is pretty much limited to that area and is quite inaudible at the base. Having made out that the murmur is of mitral origin, we add to that fact the rhythm of the murmur in order to find out more exactly the nature of the lesion.

Here we must make a digression as to the method in which the inquiry should be made. There is but one way, and that is to become thoroughly familiar with the cardiac action and circulation in relation to the cardiac sounds. There must be few who have felt the influence of Gairdner's teaching

[1] The question of area cannot be kept quite apart from the study of a murmur's rhythm, but the recollection of the areas of the different cardiac sounds (p. 97) will have suggested the various points at which the murmur may be heard.

on this subject, who have ever had recourse to any artificial aid to their recollection of cardiac murmurs. "It is necessary," says that authority, "not only to know the rhythm of the heart as a matter of theory, but to have such a vivid conception of it as calls up immediately, in connection with any single phenomenon, the whole of the others with which it is in relation."

For example, keeping strictly to the rhythm in the first instance, we come to the conclusion that the murmur is systolic, *i.e.*, that it follows the first sound. We then note that it is at the apex we hear it, or hear it best, and so it must be mitral. What is the heart doing immediately after the first sound? It is contracting. And if in place of getting the normal sound of the mitral valve closure, we get a murmur, it must be that the contracting ventricle is driving some of the blood back through the auriculo-ventricular orifice into the auricle, or, as we say, "It is a case of mitral regurgitation," speaking with reference to the blood, or "mitral insufficiency," referring to the orifice.

As to the conduction of the mitral regurgitant murmur, it is usually carried outwards towards the nipple line or beyond it into the axillary region. The murmur may be conducted even round to the back, so as to be heard below the angle of the scapula, or upwards along the vertebral column.

The mitral regurgitant murmur, according to Naunyn, is not unfrequently heard at the base, and this depends, he thinks, on a consequent hypertrophy of the left auricle, causing the appendix to impinge on the parietes. It will do so in the second intercostal space about an inch and a half to the left of the sternum, and to this point it will tend to conduct the sound. (See also note on functional murmurs, p. 118.)

Let us suppose once more that while the area is still mitral, the rhythm of the murmur is pre-systolic, *i.e.*, it precedes or runs up to the first sound. What is the heart doing immediately before the first sound is heard? Its auricle is contracting.[1] And if that act in place of being a noiseless one, is accompanied by a murmur, it must be that the blood is

[1] It is better to learn the different murmurs, in the first instance as if there were but one auricle and one ventricle, the left. For the very same reasoning applies to the right heart, and it reminds us at the same time how greatly more common are left than right cardiac murmurs.

meeting with some obstruction in passing into the ventricle through the auriculo-systolic orifice; and so we say, "It is a case of mitral obstruction," referring to the blood, or of mitral stenosis (constriction), having regard to the orifice.

The mitral obstructive murmur can hardly be said to be conducted at all. If not strictly limited to the apex, it is carried slightly downwards and inwards. It is rarely heard posteriorly.

Still confining our attention to the left heart, suppose next we find that:—(B) *The murmur is best heard at the base.* We call it an aortic murmur. This murmur, while heard at the base generally, is usually best heard at the *manubrium sterni*, or possibly to the right of this in the second right intercostal space, or over the second right costal cartilage, called for that reason the "aortic cartilage."

Before investigating more particularly the area and conduction of this murmur, we once more proceed, following out the plan already laid down, to inquire about its rhythm. We find it is systolic, and by the process of reason-

ing already described, we know it must be aortic obstruction (or stenosis).

This murmur is not likely to be best heard to the right of the sternum, for although the aortic orifice is almost directly under the pulmonary, we remember how murmurs are most readily conducted in the direction which the blood current is taking at the moment. As to conduction, it is characteristic of this murmur to be carried upwards towards the clavicle, or into the vessels of the neck. It is not usually conveyed in any other direction, although it is this murmur which is occasionally carried a long distance, as up and out to the shoulder, and even, as I once heard it, down to the elbow.

Suppose, again, that while the murmur is at the base it is not systolic, but diastolic in rhythm, that is, it displaces and follows the second sound, we conclude it is an aortic regurgitant murmur, or a case of aortic insufficiency. Its conduction is in exactly the opposite direction to that of the aortic obstructive. In place of being carried upwards, it is carried down the sternum, and is some-

times heard most distinctly, or at least with undiminished intensity at the xiphoid cartilage. But there it always ends abruptly downwards, though it is sometimes carried a little to the left towards the apex.

It will be understood now that if there be two murmurs at the base, a systolic and a diastolic, whose characters we have already noted, it is simply aortic obstruction and regurgitation combined, just as a prolonged murmur at the apex, whose first part is rough, leads us to conclude there is mitral obstruction and regurgitation combined.

The student having carefully studied and thought out cardiac murmurs as if they were always solely on the left side of the heart, will now take up right cardiac murmurs. He will remember that a right cardiac murmur rarely occurs alone, and that the accompanying left cardiac murmur will almost certainly so preponderate as to conceal the one on the right. The significance of the particular rhythm is of course the same whatever be the side affected, so that we need only in a word refer to the two right orifices, the tricuspid and the pulmonic.

The Tricuspid Murmur.—It is usually stated to be best heard at the lower end of the sternum, or, according to Gairdner, practically over the exposed part of the right ventricle—in other words, the area of superficial cardiac dulness. On this area the aortic murmur obviously may encroach, but it will not be limited above by the third or fourth rib as this one is. The tricuspid systolic (or regurgitant) is much more common than the pre-systolic (or obstructive).

The valvular incompetence in the case of the right heart is not so likely to be from direct structural disease as in the case of the left side. Rather it will be some form of mitral disease, or a chronic pulmonary affection, that opposes the onward current of the blood, and so leads to right ventricular dilatation, which, in turn, will have induced some kind of tension or dislocation, and therefore incompetence, of the tricuspid orifice.

The Pulmonic Murmur.—This murmur is of limited area, and is usually best heard just where we hear the pulmonic sound, namely, in the second left intercostal space, close to the

sternum. It is rarely carried along the sternum or into the vessels at the neck. The murmur has usually a superficial character, and is systolic in rhythm. The pulmonic diastolic is admitted to be the rarest of all murmurs.

We must bear in mind that we are not to conclude, because we hear a systolic murmur best to the left of the sternum, that it is necessarily a case of stenosis of the pulmonic orifice. Remembering the rarity of right murmurs, we shall rather infer that some accidental circumstance, probably in the relation of the heart to the chest wall or to the lung at that point, has led to what is really an aortic murmur being best heard to the left, in place of to the right of the sternum.

From the Organic endocardial murmur we pass now to the Inorganic, or, as it is usually termed :—

The Functional or Anæmic Murmur.—It is so called, as we already said, because it depends on a mere functional irregularity of cardiac tone or contraction. No organic change is ever found in the heart, and, as it occurs in the weak and anæmic, it is reasonable to suppose that the murmur is caused simply by a departure from that perfect co-ordinate contraction of the heart that is characteristic

of the normal state; or, as Guttmann tersely puts it, "uniform vibration yields sounds; non-uniform vibration, murmurs." This murmur is always systolic, and of a feeble soft quality. It comes and goes more readily or completely than any structural murmur will likely do, becoming more feeble as patient's strength increases, or it may be disappearing independently of any improvement in the patient's condition. It is practically always heard at the base of the heart, sometimes in the aortic, but more commonly in the pulmonic area. It is occasionally carried upwards into the vessels of the neck.

Dr. Balfour, of Edinburgh, says, with Hayden, that this murmur has no definite line of propagation; and that it is best heard in the second intercostal space, one and a half inch or more to the left of the sternum, just where the hypertrophied left auricle would impinge on the chest wall. Following Naunyn, he considers, therefore, that functional murmurs depend on mitral regurgitation. (See previous note on Mitral Regurgitation.) The above view is not generally held.

Having completed our reference to murmurs produced within the heart, we pass to one that is formed on the surface, namely:—

The Pericardial Murmur.—The healthy pericardium, like the pleura, is soft and smooth, and the play of its two surfaces is perfectly noiseless. But disease may interfere, and so affect these surfaces as to induce this form of murmur. The pericardial murmur has very distinctive features. It is grating or rubbing, as pleural friction usually is, and is never soft and blowing, like the endocardial murmur. Compared with the latter, it has a superficial articulate character. It is not like the endocardial murmur decisive, absolutely synchronous with the cardiac movement, but lagging—shuffling, I think, is the best word—like one who cannot keep time. It is the "to-and-fro" sound of Sir Thomas Watson, the murmur being nearly always double: if it is not double it will accompany the first sound. It is likely to be altered by changing the position of the patient; for example, it may be abolished by making the patient lie on his back, or be intensified by turning him on his left side. It may be affected also by a varying pressure of the stethoscope.

Pericardial murmurs are usually heard over

the exposed surface of the heart, and are not carried upwards into the vessels of the neck or downwards to the xiphoid cartilage. Pericardial friction is distinguished from pleural friction by the latter ceasing when the patient holds his breath. But we may remind ourselves, very much as a curiosity, that the sound might not cease on holding the breath, and yet depend on a roughening of a part of the pleural surface in contact with the healthy pericardium.

Latham pointed out long ago, and Guttmann endorses the statement, that even an endocardial murmur may, in rare cases, be made louder by the pressure of the stethoscope. Endocardial murmurs, too, as is sometimes said of pericardial, may be influenced by respiration. One can with a little care and experience make out, I think not unfrequently, that endocardial murmurs may diminish in intensity with inspiration and increase with expiration.

Arterial Sounds.—Over the carotid and subclavian arteries the two sounds of the heart are usually heard in health. It is generally considered that they are simply the heart sounds transmitted, though there are grounds for supposing that the first may be in part developed locally. I once heard, and it was

corroborated by several senior students, a reduplication of the first sound over the third part of the right subclavian artery. It was hardly audible at the base of the heart on the same side, and quite inaudible lower down, or to the left.

Arterial Murmurs.—These may also be heard at the root of the neck in the same arteries. The murmur may be brought out here, as elsewhere, by the pressure of the stethoscope, and may also, as we have already seen, be transmitted from the heart. But in many cases it is spontaneously developed, although in what way is not very clear. The murmur is certainly often associated with consolidation of the apex, and may after all be caused simply by the pressure of the subjacent lung.

Venous Stasis and Pulsation.—At the root of the neck the external jugular vein may sometimes be seen to be greatly distended. This may be but a part of a general venous plethora from intra-thoracic pressure (aneurism, malignant disease, etc.); or it may arise directly from distension of the right auricle.

Again, actual pulsation of the external jugular, systolic in rhythm, is not an uncommon phenomenon. In some cases it would seem to be communicated from the neighbouring arteries, though the typical cause is tricuspid regurgitation. Sometimes the pulsation is pre-systolic in rhythm, and is supposed to be due to the contraction of the right auricle.

Venous Murmurs.—They are also chiefly heard in the external jugular. They may be audible to some degree in health, but are commonly and always most markedly heard in anæmic women. They are essentially *continuous*, and, being of a musical quality, the murmur is known as "the humming-top sound," or the *bruit de diable*. They are much better heard on the right side, and when the patient is erect.

THE PHYSICAL EXAMINATION OF THE ABDOMEN.

THE physical examination of the abdomen, though conducted on the same principles and by the same methods as that of the thorax, admits of a greater use of certain of these methods, such as palpation, and of the almost complete exclusion of one of them, namely, auscultation. The more yielding character of the abdominal wall permits much more being made out by inspection and palpation, while the busy action of the thoracic viscera calls for a larger employment of the stethoscope than do the silent processes of the organs within the abdomen.

In order to facilitate the examination of the abdomen the patient should be in bed, lying on his back, with the head and shoulders raised and the legs drawn up, supported in such a way that all tension of the abdominal wall is removed. He should breathe freely and easily; and it will be

found that the period of expiration, especially towards the end of the act, is the most favourable, at least for palpation. In some rare cases anæsthetics may be required.

Regions of the Abdomen.—The abdomen, like the thorax, has been artificially divided into regions, though with more reason, for we have now not only to locate certain lesions in an organ, but a number of different organs all included within this great division of the body. The sub-division is usually made by the following lines.

The first line is drawn transversely at the level of the most prominent point of the lower costal cartilages on either side, and the second parallel to this at the level of the crest of the ilium. These lines are again crossed at right angles by two lines, each of which falls perpendicularly from the arch of the thorax to the centre of Poupart's ligament.

We have thus three zones, each of which is divided by the perpendicular lines into three parts.

In the upper zone we have the right and

left hypochondrium, with the epigastric region between; in the middle zone, the right and left lumbar regions, with the umbilical region between; and in the lower zone, the right and left iliac regions, with the hypogastrium between.

In the epigastric region there is the body and pyloric end of the stomach, and the left lobe of the liver; and, more deeply, the pancreas, the hepatic vessels, the cœliac axis and part of the aorta. In the right hypochondric region, the right lobe of the liver and the gall-bladder; in the left hypochondric region, the cardiac end of the stomach and the spleen. In the umbilical region there is the transverse colon and part of the mesentery, omentum, and small intestine; in the right lumbar region, the ascending, and in the left, the descending colon, with the corresponding kidney in each. In the hypogastric region there is the small intestine, and into it ascends the distended bladder. In the left iliac region there is the cœcum, and in the right the sigmoid flexure of the colon.

INSPECTION.

The general contour of the abdomen varies within normal limits in different individuals to a greater degree than any other part of the body. This depends chiefly on the amount of fat there is in the parietes, though it is also frequently owing to intestinal distension. Attention must be paid to the general nutrition in order to judge what is natural, and what is actually disease. We might find other evidence of disease to guide us in our opinion, such as enlargement of the superficial veins of the abdomen, or dropsy of the lower limbs. The abdomen is larger relatively to the size of the chest in children, and in them the contrast often becomes very striking.

Enlargement.—If arising from a considerable amount of sub-cutaneous fat or œdema, the umbilicus will be sunken; if from an amount of fluid in the peritoneal cavity, sufficiently great to cause a like uniform distension, unaltered by change of posture, the umbilicus will be protruded and the super-

ficial veins, more or less distended, will be seen, through the tense and thinned skin radiating in all directions from the umbilical region.

When this fluid in the peritoneal cavity (*ascites*) is less in amount, there is lateral bulging as the patient lies on his back, and on a change of posture a prominence will be observed at the most dependent part. On the other hand, if the enlargement be from gaseous distension (*meteorism, tympanitis*) it will be uniform in all positions. This condition is one of the abdominal features of enteric fever, and in children it is a symptom of *tabes mesenterica,* although in them it may often depend on simple atony of the parts. Localised bulging or non-symmetrical swelling, will indicate rather an enlargement connected with some particular organ. The distension that commonly accompanies intestinal obstruction becomes sooner or later general, but in the earlier stages is more likely to be just above the seat of the obstruction. In these circumstances periodic peristaltic movement also is frequently distinctly seen accompanied by more or less pain.

Depression or retraction of the abdomen may be a part of general emaciation; it is strikingly so in malignant obstructive disease of the stomach or upper bowel. It is characteristic of the later stage of tubercular meningitis in children; the abdomen is "boat-shaped," as it is termed. This is thought to be due to intestinal contraction from irritation of the nerve centres which control the bowel.

The movements of respiration should be noted. Apart from the difference in the sexes already referred to, they are lessened or quite arrested in painful abdominal affections, such as acute peritonitis; or they may be mechanically impeded as in extreme ascitic distension. On the other hand, abdominal movement is increased when pulmonary disease restricts thoracic movement. Any abnormality in the appearance of the skin itself would, of course, receive attention.

MENSURATION.

The girth of the abdomen at a particular level, for example at or so many inches

above or below the umbilicus, is often taken from time to time in cases of enlargement in order to note any increase or decrease as the case may be. We would thus judge if a tumour is growing, if an ascites is decreasing, and so on.

PALPATION.

In the case of the abdomen, palpation occupies the first place; just as auscultation does in the examination of the lungs. The patient must be lying in bed with the legs placed as already indicated, and much care and tact may be required to get that perfect relaxation of the abdominal walls, that is so essential to a thorough investigation by this method. The patient should breathe freely, and the end of each expiration, which must, however, be natural and not forced, will be found to be the most favourable moment for examination. The attention of the patient, if he be nervous or excitable, may be diverted by conversation.

In acute inflammations of the abdominal viscera, and more particularly of the peri-

toneum, there is always pain on pressure; and firm pressure is simply unbearable. The painful area may be general or localised, and there will be a corresponding degree of tension of the parietes accompanying. Pain arising, on the other hand, from intestinal spasm, distension, or, still more characteristically, of a neuralgic character, will be more likely to be relieved by steady, firm pressure. Circumscribed median pain on pressure in the epigastrium is very characteristic of gastric ulcer.

By palpation we make out the situation, outline, and consistence of viscera, especially when they are enlarged, and of underlying tumours. These latter may be in the parietes, and if so, they are comparatively fixed : they do not rise up and down with the respiratory movement of the diaphragm, nor change their position with an altered position of the patient. The tumour may be within the rectus muscle itself, and this can be recognised, as Dr. Douglas Powell remarks, by keeping the hand over the tumour, and making the patient raise himself half to the sitting posture, when the tumour will start forward along with the con-

tracting recti. Small nodular growths are often puzzling. It may be very difficult to say whether they are in the abdominal wall, or are cancerous, tubercular, or other growths, in the peritoneum or its folds.

In thin people, with relaxed walls, the pulsation of the abdominal aorta may be very readily felt, and give rise to the suspicion of aneurism; and not unfrequently the nervous dyspeptic himself associates this 'beating' with the peristaltic movement of the transverse colon, and imagines that at last he has discovered the dreadful cause of all his trouble.

A particular form of palpation is practised in the diagnosis of ascites. If the amount of fluid be considerable, so that we have a condition just short of extreme tension, the slightest fillip or tap on one side of the abdomen causes a wave which is distinctly felt by the hand placed on the other side. Should the parietes, however, be loaded with fat, or be otherwise unwieldy, the wave will be greatly obscured. The fat itself may give rise to a sense of fluctuation, and, in these circumstances, it is recommended that another's

hand, or a piece of card-board, be firmly pressed edgewise on the surface between our two hands, so that any possible wave from the fatty tissue may be thereby prevented.

Should the fluid come between the moderately lax abdominal wall and a solid organ, such as the liver, we may be able, by a sudden vertical plunge of the fingers, to get through the fluid, as it were, and come suddenly on the hard unyielding mass beneath. This is easily done, and its significance readily appreciated. It has been called "dipping for the liver."

PERCUSSION.

The normal percussion note of the abdomen is emphatically tympanitic. Theoretically, it should be of higher pitch over the colon than over the stomach, and highest of all over the small intestine; but practically, this distinction is of little avail, so variable is the amount of their solid, fluid, and gaseous contents, absolutely and relatively.

Percussion, like palpation, is practised for the delimitation of organs and morbid growths,

and for the recognition of fluid in the peritoneal cavity. In the case of solid bodies particularly, palpation is an essential accompaniment of percussion, for considering the effect of the overlapping or even adjacent bowel, it will often keep us right when percussion alone would have proved a doubtful guide.

We shall only at this point refer further to the percussion note in *ascites*. Here the uniform rule and guide to us is, that we shall get dull percussion wherever there is underlying fluid, and that the fluid being free in the abdominal cavity, the limits of dulness will vary with the varied position of the patient. But here again the hollow viscera must be reckoned with. While they will always tend to rise to the surface of the fluid, they may be bound down to some extent by adhesions, or may be compressed by the large amount of fluid, the great tension of the parietes contributing to the already uniform dulness. The amount of fluid may be so slight that it can only be detected by making the patient rest on his knees and elbows, and

so cause it to gravitate to the upper anterior region of the abdomen.

AUSCULTATION.

Auscultation of the abdomen is of little direct value, but we should undoubtedly be familiar with the gastro-intestinal sounds in order that we may not be misled when they are conducted as they often are some distance into the thorax. Vascular murmurs are occasionally heard with uterine and ovarian tumours, and friction sounds not unfrequently arise from inflammatory or malignant disease affecting the peritoneum over the liver, spleen, etc., or the surface of these viscera themselves.

It will be well now to pass to the examination of the individual organs of the abdomen; of those at least that usually come within the province of the physician. We shall consider first:—

The Liver.

As the liver winds round by the ribs to the right, and to the left is greatly lost in the dulness of the heart, it is the upper and

lower boundaries which present to us the most definite outline. But neither is very well defined. Above, the lung dips down a little way in front, while below we have the transverse colon and the stomach now obtruding their tympanitic note, and now by their more solid contents obscuring the natural line of liver dulness. Still in ordinary circumstances the depth of the normal liver in front is easily estimated.

Following a definite method the student will do well to begin by percussing in the vertical line of the right nipple. Being always careful to percuss from clear to dull, he will do this from above downwards, and about the fifth intercostal space he will be sensible of a commencing comparative dulness. This superficial or comparative dulness, indicating the area where the lung overlaps the liver, will only extend to an inch or even less downwards, when the area of absolute hepatic dulness will be reached. Percussing now from below upwards he will usually find that in this vertical line the lower margin corresponds exactly with the arch of the

thorax, and that the depth of the hepatic dulness measures there 4 inches or rather more. From this line the upper margin slightly falls and the lower margin rises, till, in the middle line, the vertical dulness measures only 3 inches; roughly speaking, it extends slightly above and below the xiphoid cartilage. Towards the axillary line the upper margin rises very slightly, and on reaching it, attains also its highest level, while the lower border, although it descends a little, leaves the arch of the thorax which descends still more rapidly. The vertical measurement in the axillary line is therefore greater still, being from $4\frac{1}{2}$ to 5 inches, that is from the seventh intercostal space above to the tenth intercostal space below. Posteriorly the upper border reaches the level of the tenth or eleventh dorsal vertebra, while the lower border is lost in the dulness of the kidney. We have already given the line of separation between heart and liver as indicated by continuing the upper margin of hepatic dulness to the cardiac apex. In making a rapid survey of the liver in the erect posture we

must allow for a little depression of the whole viscus.

For purposes of diagnosis, especially from pulmonary disease, the upper border of the normal liver should be familiar to the student; he should always remember that it forms a curved line, and one not usually altered by disease of the liver itself. It is the lower margin that is materially altered both in the case of *enlargements* and *contractions*.

Before referring to these we must note that the liver may be apparently enlarged. It is naturally larger in the child relatively, and in the case of the rickety chest it may appear to be enlarged absolutely by being displaced downwards by the thoracic deformity. Tight-lacing may greatly displace the liver, and it may be pushed downwards slightly by pulmonary emphysema, pleuritic effusion, etc. In the case of pleuritic effusion the upper limit of dulness will be formed by the fluid, and will thus necessarily assume a straight and not a curved line when the patient sits upright.

The liver may undergo either enlargement

or contraction; the surface may retain its normal smooth character, or become nodular or otherwise irregular. Palpation is now of greater service. The soft, smooth, uniformly enlarged fatty liver with its rounded lower margin, perhaps as low as the transverse line of the umbilicus, can thus be made out, and also the amyloid liver, similarly but probably more enlarged, of firmer consistence, and with sharper, more defined edge. Abscess and advanced hydatid tumour of the liver will tend to present a yielding globular distension from out the otherwise enlarged hepatic area. In the case of the latter, by placing three fingers over the swelling and percussing the middle one we may get the characteristic vibration known as *hydatid fremitus*. As regards malignant disease we usually find some, and often the most distinct, irregularity of surface or outline. There is probably pain, and there may be greater enlargement than is met with in any other hepatic affection—upwards possibly, which is always the exception, as well as downwards, which is the rule. Sometimes no unevenness of surface

can be made out; then the rapidity of growth and pain would suggest malignant disease.

The contractions of the liver (*acute yellow atrophy*, and *chronic atrophy* or *cirrhosis*) do not present much ground for physical examination. When the student is thoroughly familiar with the hepatic dulness in the mammary line, he will readily detect the suspicion or the certainty of atrophy as the case may be: the vertical measurement of absolute dulness may be no more than a finger's breadth. The presence of *ascites* and enlargement of the superficial veins would corroborate the diagnosis of chronic atrophy.

No one can study the physical examination of the liver without being greatly aided by Murchison's classical exposition of the subject in his Clinical Lectures on Diseases of the Liver. Nothing can be more simple than his division of *enlargements* into *painless* and *painful*, the former including simple hypertrophy, fatty liver, and hydatid tumour; and the latter, congestion, catarrh of the bile ducts, hepatitis, abscess, and cancer. The number of exceptions one meets with in the case of cancer does not, in my opinion, prove any objection to his classification. The exceptions impress on our minds the fact that even malignant disease *may* be absolutely painless. Perhaps "painless," as applied to hydatid tumour, is rather misleading; at least, the student should understand that before he sees

the case, that is, before it is likely to have attracted much attention, it will probably have become painful in some degree.

The Stomach.

The peculiarity of the normal stomach is its continually varying dimensions. The description of it usually given is that of the organ moderately filled. It lies immediately under the anterior wall of the abdomen, shaped very much like a bent cone; with its base or fundus in the left hypochondrium, the body in the epigastrium, and the pyloric end in the right hypochondrium. The base or fundus rises well up in the thorax, reaching at its upper border to about the level of the seventh rib, while the pyloric orifice will be found a little below the lower border of the liver, within a line drawn from the right nipple to the umbilicus (Loomis). The stomach measures from 12 to 15 inches in length and 4 or 5 inches in depth. One fourth of the viscus lies to the left of the cardiac orifice. Besides the possibility of great distension, the attachments of the stomach admit of its being greatly displaced. It may be pushed down

into the hypogastrium, or allowed to rise high up into the lateral region of the thorax.

It is mainly by percussion and succussion that we make a physical examination of the stomach. We have already referred to the tympanitic note of gaseous distension rising frequently as it does to the base of the heart, and elsewhere running into the similar note of the surrounding intestines. Obviously a dull percussion note running into that of the liver and spleen will be brought out if there be much contained solid or liquid food, whose presence can be further corroborated by succussion. This occurs to the greatest degree in pyloric obstruction, usually malignant, and in chronic dilatation (*atony*) of the stomach. Fagge describes an acute dilatation of the stomach and says the signs are—(1) A rapidly increasing distension of the abdomen, which is unsymmetrical, the left hypochondrium being full while the right is comparatively flattened. (2) The presence of a surface marking, which descends obliquely from the left hypochondrium towards the umbilicus, and which corresponds with the lesser curvature of the

stomach. This seems to move up and down each time the patient breathes. (3) Dulness and fluctuation in the pubic region with resonance over the front of the abdomen. (4) The production of a splashing sound on manipulation. (*Principles and Practice of Medicine*, vol. ii. p. 118.)

The nodular thickening of cancer of the pylorus is usually made out easily enough by palpation, but malignant disease of the body of the stomach does not as a rule yield very evident signs, while implication of the cardiac orifice is beyond the reach of any kind of external examination.

The Spleen.

The spleen does not greatly obtrude itself on our attention by proclaiming either its presence or its function: it is accordingly rather neglected. It lies obliquely in the left postero-lateral region pretty much in the line of the ribs; its upper and anterior border following the upper margin of the ninth rib, while its lower and posterior border coincides with the lower margin of the eleventh rib, or practically

with the lower border of the thorax. Its upper posterior border comes near to the vertebral column, although this cannot be made out clinically; the lower anterior extremity will end pretty much with the eleventh rib. But it must be remembered that the organ varies considerably within normal limits.

Within these limits we can only avail ourselves of percussion in tracing its outline, and even by that method we must not expect to get the broad contrast of absolute dulness which the much more bulky liver affords. Its upper and anterior border is the most readily distinguished in contrast with the tympanitic note of the stomach and bowel, and more posteriorly we come down upon the spleen gradually from the pulmonary resonance above. If it gets below the arch of the thorax, palpation comes to our aid, except well round to the back, where it lies in contact with the kidney.

The only changes we need consider are enlargements. As these take place downwards and forwards, a rough-and-ready test is to see if we get an uninterrupted line of clear per-

cussion from the anterior border of the left axilla down to the umbilicus. The spleen should not come nearly so far round to the front as to encroach on that line.

An enlarged spleen is easily made out independently of percussion. Its smooth surface, and rounded, yet distinct, edge, which is often notched anteriorly, and the fact that it can often be felt in the lumbar region as a solid movable mass between the two hands, make it usually easy to recognise. In still greater degrees of enlargement it may occupy nearly all the left side of the abdomen.

The spleen is enlarged in constitutional diseases, that is, those in which the blood seems to be primarily affected. In the acute fevers, for example, and more particularly in the very chronic malarial cachexia with its recurring attacks of ague, we have almost certainly this enlargement. But in the disorder of sanguification, known as *leucocythemia,* we have the spleen attaining its greatest degree of enlargement, having in some cases so completely filled the left side of the abdomen as to have been mistaken for ovarian

tumour. The spleen, like the liver and kidney, is liable to amyloid enlargement, the combined implication of the three viscera being an important element in the diagnosis. Malignant disease is the only other affection likely to be diagnosed by physical examination. It is said by Guttmann that a spleen of normal size may be greatly displaced; even downwards and forwards into the left iliac fossa.

The Kidneys.

These organs lie close to the spinal column, at about the level of the two lowest dorsal, and the two highest lumbar vertebræ, the right being rather the higher of the two. They are always embedded in a considerable quantity of fat, and being also beneath the thick lumbar muscles they are in the normal state beyond the reach of either inspection or palpation. Only about the lower half of the outer convex margin can be defined by percussion from the adjacent colon.

In diseased conditions inspection can only be of service by way of contrasting the two

sides. By this means, aided by palpation, great enlargement, as from cancer or hydronephrosis, might be made out. Conversely we might recognise the absence of the kidney from its normal situation, it being displaced. But by palpation less degrees of enlargement can be recognised by placing the patient in the usual position on his back. We may thus with one hand posteriorly be able to tilt the tumour forwards on the other hand pressed firmly down in front, or even catch the solid body between the two hands.

We can rarely by physical examination alone, determine between the different forms of enlargement. They need not be here enumerated in full; but the most common or pronounced are cancer of the kidney, *Hydronephrosis* (distension of the pelvis of the kidney by retained urine), and *Pyonephrosis* (retention of pus). In the case of perinephritic abscess, one would probably be able to recognise its more superficial character, and possibly be able to make out suppuration, but we would be also guided very much by the greater pain on pressure and the higher fever.

Enlargement of the right kidney might be mistaken for fæcal accumulation in the ascending colon, cancer of the pylorus, a mesenteric tumour, or enlargement of the right ovary. Enlargement of the left kidney might be thought to be an enlargement of the spleen or of the left ovary, or fæcal accumulation in the descending colon.

One kidney, or even both, may become displaced and fall quite out of its normal site, downwards or forwards. The right kidney is much more commonly dislodged; and this occurs much more frequently in women. The diagnosis may be difficult from fæcal accumulation, mesenteric tumour, enlarged spleen, distended gall-bladder, etc., but its peculiar shape and the facility with which it falls forward on the patient leaning forward or even on sitting up, or again glides away from the hand back into its normal situation, is very characteristic, besides the altered physical conditions at its natural site. One would be guided also by the sense of dragging, or weight, the sickening pain, etc.

The Pancreas.

This organ lies too deep for physical examination with any degree of certainty. Cancerous enlargement may sometimes be detected in the epigastrium as a hard, deep, and firmly rooted mass, but the disease is seldom primary, *i.e.* solitary, and therefore anything approaching a positive diagnosis is impossible.

Ovarian Tumour.

These tumours would hardly come within the province of the physician were it not that, being as a rule cystic, they must be diagnosed from ordinary ascites. The patient does not usually present herself while the tumour is still distinctly unilateral and low down in the inguinal region, but we would endeavour to make out whether or not there was a history of this kind. Quite likely no reliable information could be given on that point. Placing the patient in the dorsal position, we would then endeavour to make out if there is lateral bulging, as in ascites, or if the abdomen still retains its undue projection forwards, as in

ovarian tumour. Then on percussion in the same position we would expect in the case of ascites to get dulness in the flanks, and a clear tympanitic note centrally in front, which dulness would change to the most dependent part with a change in the position of the patient. All this would negative an ovarian cyst, in which we would expect dulness centrally, and clear percussion in the flanks. We would endeavour further to ascertain if the wave on percussion could be made to pass beyond the limits of the dulness, as in ascites, or if the limit of fluctuation and of dulness corresponded, as in ovarian disease. A less superficial character of wave impulse would also suggest a cyst. But the two conditions may be combined, and then only an exhaustive general inquiry beyond the limits of a mere physical examination, would suffice to effect a diagnosis.

APPENDIX.

THE Junior Student who wishes to begin the independent reporting of Medical Cases may derive some assistance from the accompanying Outline. He will not complain of its being too short, and I am convinced that when the Student gets beyond it he should be guided by his knowledge of individual diseases.

The words within curved brackets relate to what is occasional or accidental; those within square brackets are explanatory.

OUTLINE FOR REPORTING.

Name, age, occupation (residence) "admitted.....
complaining of....."

"Patient states that," etc. [how present illness began, *e.g.*, relation to work, confinement to bed, etc.; *when* (suddenly or gradually).]

PERSONAL HISTORY.—[Scrofula; syphilis; acute fevers from childhood onwards; Injuries; General Hygienic conditions, *e.g.*, Habits, occupation, etc.] (Confinements and Lactation.)

FAMILY HISTORY.—Ages of those living; Deaths and causes. *N.B.*—Hereditary diseases, *e.g.*, Cancer, Tuberculosis, Rheumatism, Gout, Syphilis; Nervous and Mental Diseases; Malformations.

Put ailments in patient's own words in "———"
e.g., "bronchitis" may be phthisis.

PHYSICAL EXAMINATION.—General appearance, *e.g.*, well nourished or emaciated; pale or florid. Cyanosis; Jaundice; Bronzing. Expression, *e.g.*, as to pain, etc. Condition of skin, *e.g.*, hot or dry, cold or clammy, and perspiration. Cicatrices. Temperature, Respiration. (Height and Weight.)

———

Begin with the System chiefly affected.

RESPIRATORY SYSTEM.—*Symptoms*, Pain, Cough, Dyspnœa, etc. *Signs*, Decubitus, number and character of respirations. [Inspection, Palpation, Percussion, and Auscultation, (Mensuration and Succussion)]; Sputum.

CIRCULATORY SYSTEM.—Symptoms and signs as above. Rate and character of pulse.

DIGESTIVE SYSTEM.—Appetite, Nausea, Vomiting, Pain; their reference to food. Signs as above, but rarely Auscultation. Tongue. Stools.

NERVOUS SYSTEM.—Pain and other sensory phenomena; Motor phenomena; Trophic changes; Incöordination; Spasms, clonic or tonic: all these may be general or partial or unilateral. Intellectual, emotional or Moral disorder.

GENITO-URINARY SYSTEM.—Pain, difficulty, frequency, etc., as regards Micturition or Menstruation. Pain independently; its character, direction, etc.

Urine—Colour, transparency, specific gravity, deposit, reaction, amount. Albumen, sugar, bile, blood.

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