The Methods of Diagnosis employed in Diseases of the Thoracic Organs

A Thesis for the degree of Doctor of Medicine

by

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I hereby declare that the accompanying Thesis has, with the exception of the quotations marked, been composed by myself. Also, that since graduating as M.B., and C.M., I have been engaged in Medical and surgical practice for nearly five years.

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The Thoracic organs are so placed as to be entirely removed from sight and touch: we cannot inspect the lungs or the heart or handle them to the same extent even as the organs situated in the abdominal cavity, and Inspection and Palpation can only be applied to the walls of the chamber in which these organs lie. By a careful study of all the conditions present, these methods of examination may be made to render valuable aid. We are able thus to determine, the rate, character, and sufficiency of the inspiration in procuring the circulation of the blood; by the examination of the arteries we determine the rate and force with which the circulation is being carried on, and can form an idea of the condition of the
great central organ of the circulation—the heart; by the thermometer (a valuable aid to palpation) we determine exactly the temperature of the body and obtain valuable information of the manner in which the economic processes of the body are being carried on, but—it is only when we employ the purely physical methods of percussion and auscultation that the condition of the organs themselves can be satisfactorily made out, and the information obtained which will enable the physician to arrive at a complete and correct diagnosis.

The word Diagnosis (Diagnose) implies a thorough knowledge of each individual case and it is therefore not sufficient merely to give a name to the disease from which a patient is suffering, but the full extent and effects of each disease not only on the diseased organ, but on the system generally should be clearly made out. It is not enough for example, to diagnose a case as Pneumonia without determining exactly the extent of lung affected, the stage to which the disease has advanced, the effect of the disease on the system of the patient, and determining as far as possible the recuperative power of the patient, for it must be remembered that though
though the diagnosis is of great importance to
the physician, as determining the treatment to be
applied, the prognosis is of far greater import to
the patient. To accomplish this requires in a
physician the possession of a small amount
of tact and patience, as well as skill and powers
of observation only acquired by careful training
and practice. How important this is of that all
the faculties of the student should be trained from
his first entry at college, and especially during
that part of his curriculum spent in the hospital
wards, so that he may be possessed of those
powers of accurate observation, of an eye trained
to observe the natural as well as the morbid
appearances of the body, of an ear capable of
differentiating, the finest inequalities of pulse and
tone, and a touch from yet delicate, as well as a
knowledge of the anatomical, physiological, and
pathological conditions of the human body.

Of the importance of early clinical teaching
nothing could be more decided than the lecture
prepared to Dr. Graves course of clinical lectures given
in Dublin, in which he says:—*

* I am not drawing a
picture from my imagination alone; I have had occasion
too often to shudder at the original, too often to

* Graves Clinical Medicine pp. 7-8. (Syd. Soc.)
Deline the sad effects resulting from well meant but totally mistaken treatment employed by young men and often have suspected that under the present system of practice, experience is only to be acquired at a considerable expense of human life. Then it is, indeed, the concealing the truth, that numbers of lives are annually lost in consequence of malpractice. * * *

This charge of inexperience is not necessary confined to the beginner; it applies equally to many an old practitioner, whose errors have grown, and have increased in strength, during a long succession of years, because from a defect in his original education—from the absence of a properly directed clinical instruction—he commenced practice without having previously acquired the power or the habit of accurate observation; because he had not, in his youth, been taught to reason quietly upon the facts presented to his view; because not having learned in the beginning to think accurately, he contracted a loose and careless mode of examining the progress of disease and the effects of remedies; and, consequently, the lapse of time has had no other effect than that of rendering them more inveterate. * * *

Many circumstances concur to produce this effect; but the most influential is undoubtedly that which now occupies our attention, I mean a system of clinical instruction radically wrong, because it does not teach the actual practice of medicine.
Since this was written clinical teaching has advanced rapidly, but even the less are Graves' words valid in the present day, when medical knowledge has obtained a position of scientific accuracy never before equalled; the danger exists still lest student should leave our universities without acquiring that knowledge of disease and its treatment only to be obtained at the bedside.

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The Basis of Diagnosis

Although it is without doubt possible in some cases to make a correct diagnosis at a glance, in the majority of cases it is only all the facts of the case before us, and then applying our individual knowledge and power of reasoning that we are able to arrive at a correct conclusion. Speaking broadly our diagnosis may be said to rest on three factors viz.:

First--History (a) of the patient's family (b) of his previous health (c) of the present attack

Second--The symptoms, or the facts told us by the patient, or his relatives previous to, and during the attack

Third--The Physical Examination, or the facts observed by the physician
In order to obtain the facts of a case under these heads, it is advisable and necessary to follow a fixed method of case-taking and case-recording such as the following:

**Method of Case Taking.**

I. Preliminary Facts.
   - Name, Age, Sex, Married or Single, Occupation.
   - Residence (full post address) — If in hospital, Date of Admission, No. of Ward and Bed.

II. Complaints (the symptoms which bring patient to consult physician) (a) as stated by patient or (b) reported by friends.

III. The History —
   1. Of the Present Illness — Date of commencement, Mode of commencement, Character of the symptoms and order of their appearance, Supposed cause, Previous treatment, Record Temperature especially in acute cases.
   2. The Health History prior to the commencement of the present attack — Especially of disease or injury likely to be followed by disease of the heart, lungs, etc. Habits, mode of life, general surroundings, social conditions, special conditions of employment. A comparison of weight at different times when possible.
   3. Family History — The presence or absence of
Heart or Lung affection in man relations—Hereditary transmission of scrofula, phthisis, rheumatism &c.

IV Present Condition


(b) Symptoms referable to disease

(1) Of the Heart or great vessels:—pain or uneasy sensations in cardiac region—tachycardia—painfulness—breathlessness on exertion.

(2) Of the Respiratory organs:—Cough—dyspnoea—pain—expectoration.

(3) Of remote organs (secondary to disease of thoracic organs) Resulting from disturbance of circulations—venous engorgement—dropsy &c. or deficient aeration of the blood—somnolence—headache &c.

(c) Physical Examination of the Thorax

(1) Of the Heart and Circulatory Organs

(2) Of the Lungs and Respiratory Organs.
Circulatory System

(Chiefly follows the method given by Dr. W. Sommell, Pt. 3 & 4, Part 4, Head.)

Physical Examination of the Heart—

Inspection of the Premedical Region:—
(a) Its form and configuration
(b) Position, extent and character of the visible impulse, especially the position of the apex beat
(c) The condition of the integument over the precardiac region

Palpation of the Heart
(a) The exact position of the apex beat
(b) The character of the cardiac contractions (force, rhythm, clarify)
(c) The presence of precardiac thrill, or friction friction
(d) The presence of pain or tenderness on pressure over precardiac

Percussion of the Heart—
(a) The area of superficial or absolute dulness
(b) The area of deep or relative cardiac dulness

 Auscultation of the Heart:—
(a) The rhythm of the heart, whether regular or not
(b) The character of the individual (first & second) sounds in the tricuspid, aortic, pulmonary, and mitral blood

Areas, as regards:—

(c) Where a murmur is present—observe:—
   (1) Its Rhythm
   (2) Its point of differential maximum intensity
   (3) Its sound characters
   (4) Its duration in which it is propagated

(d) In young persons, take particular care to distinguish and note the following:

   Expiration
   (1) Any form of murmur
   (2) Any form of friction
The Physical Examination of the Aorta and Great Vessels.

Inspection

The conformation of these parts of the thorax which are superficial to the Aorta and great vessels must be observed, particularly the presence of any prominence, pulsation or tumour.

Note (a)

Palpation. The presence of any undue pulsation in the suprasternal notch, in the thorax or abdomen.

(b) The presence of thrill, tenderness or pressure in the course of the great vessels.

Percussion

Note. The presence of dulness on percussion in the course of the Aorta or great vessels, its exact outline, extent.

Auscultation

Observe: The character of the heart sounds, and the presence or absence of murmurs over the course of the Aorta or great vessels (their rhythm, direction of propagation etc).

The Examination of the Superficial Arteries Note the condition of the superficial arteries such as the Carotids, Radial, Temporals etc. by inspection and if necessary by palpation and auscultation and particularly observe the condition of the pulse.
in the Radial Artery

(a) By the finger (palpation) as regards:
   Its frequency
   Rhythm
   Volume

   Its compressibility or Tension

   The special characters of each pulse wave
   (celerity, diastasis etc.) and the condition
   of the vessel in respect of fulness during the
   diastole of the ventricle

   The condition of the arterial coats

   The comparison of the conditions on the two sides
   of the body (i.e. the comparison of the two Radial
   arteries).

(b) By the eye (inspection)

(c) By the sphygmograph

The Examination of the Venous system

Inspection

Note: — The condition of the superficial veins, and
particularly observe the condition of the jugulars as
regards fulness, the presence of pulsation etc.

Auscultation

Note: — The presence or absence of a venous hum
in the neck, over the orbit, Sycular Aerophyllic etc.
Respiratory System

Physical Examination of the Thorax

Inspection

A. Shape of the Thorax - Bilateral Symmetry
1. Development - rotation - integuments
   Muscles - superficial circulation
2. Dilatation - enlargements - bulging
   unilaterial, bilateral, or local
3. Contraction - diminution in size - depressions
   unilaterial, bilateral, or local
4. Deformities - (not dependent on disease of the respiratory organs)
   The Paralytic form
   The Rickets Thorax
   That due to Vertebal disease

B. Movements of the Thorax
1. Type of Respiration - Thoracic - Abdominal
2. Respiratory movements - Frequency -
   Extent - whether bilaterally equal
   Quality - Deep - Shallow - Hurried - Slow
   Painful
   If there is appearance of effort due to the muscles brought into action
3. Stethography - The graphic representation of the movements of respiration
4. Plethysmography - Estimation of the vital capacity of the lungs
5. Pneumotachometry - Measurement of the force of respiration
Percussion

A. Limits of the Lungs
   Upper, Anterior, and Lower
B Percussion of the Regions of the Chest

1. Infra-ternal
2. Upper sternal
3. Lower sternal
4. Right & left Infra-Clavicular
5. Right & left Clavicular
6. Right & left Infra Clavicular
7. Right & left Mammary
8. Right & left Infra-Mammary

C The Percussion Note

1. Resonance - Clear - Impaired - Dullness
2. Dullness - Absolute - Impaired
3. Pitch of Note - High - Low
4. Timbre - Quality of Note
5. Sympathetic Note
6. Cracked post sound
7. Amphitonic Resonance
8. Metachoric Resonance

D Sense of Resistance in Percussion

E Phonometry by tuning fork (Baas)
Note: In percussion a comparison of the two sides should always be made.

Auscultation

A Respiratory Murmur - during Inspiration and Expiration
1. Vesicular
2. Bronchial or Tubular
B Accompaniments to the Respiratory Guymer

1. Râles & Ronchi
   a. Character, distinct, sonorous, obscurant et al.
   b. Time of occurrence
   c. Effect of coughing on these
   d. Size of Râles - large, small, intermediate

2. Friction

3. Shakshing sounds (succession)

C Vocal Resonance - Increased - decreased
   1. Bronchophony
   2. Oesophony

D The Voice

Examination of the Sputa

A. Visible examination
   Note the
   a. Colour
   b. Consistence - watery, frothing, viscid
   c. Presence of casts, opalescent masses etc

B. Chemical Examination
   To test - 1. Blood
      2. Puts
   To prepare for microscopical examination

C. Microscopic Examination
   Note
   1. Epithelium - pavement, columnar, ciliated
   2. Red corpuscles
   3. White corpuscles, phagocytes, granular masses
   4. Blood Corpuscles
   5. Elastic fibres of lung tissue
   6. Fibrinous casts
(7) Crystals of fat, acids, haematoidin, cholesterol, tyrosin

(8) Fungous growths
   (1) Chlamydia buccalis
   (2) Oidium albicans

(9) Vibrions
   (1) Bacilli of Phthisis
   (2) Sarcoma
   (3) Bacteria

(10) Echinococcus - vesicle, brooklet, etc.

Examination of the nervous, alimentary - genital urinary and integumentary systems

The Diagnosis

The Prognosis

The Treatment

Subsequent course of events

Result - If fatal, and post-mortem examination made, state particulars.

Though in the method of case taking just described a certain order of procedure is laid down, it is by no means necessary to adhere to that order in the examination of a patient. It is merely for the convenience of obtaining a clear record of our cases.
Alterations in the Percussion Note —

Loudness — This depends on the strength of percussion, a clear note as a rule being heard if percussion is made with some force, but it must be remembered that if the lung be thin or a solid body be present beneath the note will be absent by deep percussion and only brought out by striking very lightly.

2d. On the thickness of the chest wall — If the chest walls be enveloped in fat, or the muscles very well developed, the resonance is only feebly heard or in some cases hardly to be made out at all. When the mammae are largely developed it is impossible to obtain a resonant note over that area. On the other hand when the thoracic walls are emaciated and free from fat the note is loud and clear.

3d. On the amount of lung tissue present and the air present in the vessels. The note is louder where there is a considerable thickness of lung present, thus it is louder below the clavicles than above it, and over the substance of the lung than over the margins. When the lungs are fully inflated and the air cells distended with air the percussion note is increased in intensity and is clearer, and this becomes still more evident when the breath is held and expiratory pressure made, the pitch of the note being then slightly raised.

From the above it will be seen that the absolute depu
of loudness was no special value in diagnosis provided that a decrease is not accompanied by dulness; it is quite possible to have a very soft note which is utterly resonant.

Impaired resonance, smudging of the note, absolute

Dullness.

These alterations in the percussion note may be caused by changes in the lungs themselves, in the pleura, or in the thoracic parietes. The resonance is produced by the vibration of the chest walls and of the air in the pulmonary pacicles, it follows that any change which prevents this or damps their vibration will cause either an absence of resonance or an impairment in the note.

The changes which may cause this are:

1. In the lungs. Exudation into the air cells which may be the result of inflammation, or of changes in the heart (venous); hematoma replacing the air and blocking the air cells and small branches; degenerative change in the lung substance; increased displacement of the solid thoracic organs; and the presence of solid growth or collection of fluid in the lung substance, collapse of lungs tissue, presence.

2. In the Pleura. Thickening of the pleurabone
3. In the thoracic walls: — Thickening by new growth or increase in the natural elements of the chest wall will if of sufficient extent cause an impairment in the resonance or in extreme cases absolute dulness.

4. Changes in the lung substance. — The diseases of the lungs in which dulness occurs are: pneumonia, emphysema and catarrhal, caseous degeneration, oedema of the lungs, haemorrhage (pulmonary apoplexy), consolidation of lung (variable); and collapse.

The most marked changes occur during the different stages of pneumonia, beginning with a normal note as the disease advances percussion produces all varieties of impaired resonance until dulness is reached, and then the series is reversed until the note becomes clear when absorption is complete.

In the first stage, that of engagement — before any expiration has occurred the note is normal and remains so for some time after the commencement of the disease. At the earliest part of the second stage, the sound, according to Stetson, becomes diminished in intensity and acquires a tympanitic character, due to...
Fig. 27: Microphotograph of the 2nd Stage of Pneumonia x 300

Fig. 28: Microphotograph of the 3rd Stage of Pneumonia x 200
to the diminution in the tension of the air in the pulmonary tissue. This is not often heard but it occurs sometimes at the beginning of evacuation and at the period of absorption. As the second stage (Fig. 27) advances the note diminishes in resonance and becomes dull and muffled in character. The area of the lung affected can be mapped out, and it is generally found to affect the lower lobes on one side only. This distribution is not invariable, and occasionally the disease can affect the exclusion of other parts, and the disease sometimes affects both lungs at the same time. Absolute dulness does not occur till the third stage, that of grey hepatization, is clearly developed. The note then is devoid of resonance and resembles the sound produced by percussing over the liver - the consistence of the lung is liver-like, due to the evacuation completely filling the air cells, which now are entirely devoid of air. As the disease subsides the evacuation becomes absorbed and the dulness disappears and the normal note returns, occasionally a tympanitic note being heard before absorption is complete. This is the normal course of pneumonia but the disease may not follow so regularly a course. It may become chronic, abscesses may form, part of
the lung may become gangrenous, or cascous degeneration occur and cavities form. In such cases the character of the percussion note is various; in chronic pneumonia the dulness lasts longer but is rarely absolute and the area affected is not so large as in the acute form; in abstract there will be dulness over its seat provided it is large enough a man enough the surface to be diatonic. A gangrenous area is still until part of the pulmonic tissue is effaced but will vary according to whether air or fluid predominates in the affected area. When cascous degeneration occurs, until cavities are formed the note on percussion is dull, but as cavitation occurs the note will vary with the contents of the cavity, being dull if it is filled with fluid, but tympanitic or amphonic if air be present and what is known as the "cracked-pan sound" may be elicited.

In catarhal pneumonia the disease occurs in fevers and it is only when they are comparatively large or several appears coalesce that they become recognizable on percussion. This disease is known by the name of lobular pneumonia, which expresses its habit of affecting isolated lobules; and also broncho pneumonia which indicates its causation, as in many cases the disease is an extension of cataract from the bronchial tubes. Dulness is rarely detected till condensation is complete or until
the lobule is collapsed owing to the attendant bronchitis, blocking the tubules. It often varies from day to day as the lobule is collapsed or expanded. The basal portion of the lung is most frequently affected but any area may become the seat of disease. A chronic form of catarrhal pneumonia occurs in the afrii and is then described as catarrhal abcesses.

Pneumonia degeneration with formation of cavities has been noticed as occurring in pneumonia. The results of pneumoconiosis are the same when the disease occurs as a distinct affection, but the afrii are most often affected and the disease creeps on insidiously.

Edema of the lungs does not cause very well-marked dulness, as the air cells are not entirely filled with fluid and air is always present; but absolute dulness is not infrequently present, due to the exudation of serous fluid into the pleura. The edema affects both lungs and the alteration in the percussion note is best marked at the bases to which upon the fluid gravitates.

Haemorrhage into the air cells, haemorrhagic emphysema and pulmonary asphyxia. The presence of blood in the air cells or in the lung tissue will cause dulness on percussion, just as pneumonic exudation does, provided that the area affected is large enough to be detected and is consolidated, for a considerable amount of blood may
be present without causing any alteration in the percussion note.

The change in the lung due to consolidation are various. There is a gradual increase in the fibrous tissue of the lung and the organ is greatly contracted and the chest-wall is drawn in to meet it. By the contraction of the contractile tissue the bronchi are dilated often into distinct cavities. With such conditions it is obvious that the percussion note must vary in different situations. In consolidation areas the note is dull, over other parts where the lung tissue is not so much affected the note is only impaired, while in others (dilated bronchi) it is tympanitic or may have a cracked-pot sound.

Solid growth in the lungs (cancer) if near the surface and of sufficient size will cause dulness which will vary in extent and amount according to the size and situation of the tumour, being more marked the nearer the tumour lies to the surface, but if the new growth is situated deep in the lung substance, and be small in size, it may cause a very slight impairment of the normal resonance, or remain undetectable by physical methods, though its presence may be indicated by the symptoms.

Collapse of lung & Atelectasis - These conditions,
they affect the lung to an appreciable extent will give rise to dull areas. Collapse of the lung is most often seen in pleurisy and empyema; it also occurs in pneumothorax the presence of air allowing the lung to collapse as it does when removed from the body. Another form of collapse is seen in some cases of bronchitis where the tubules have become blocked by secretions, and the patient's strength not being sufficient to expel the fluid, the area behind contracts. The condition is apt to occur in all cases of extreme debility, where the bronchial secretions are of a very adhesive character. Atretic that is, non-expansion of parts of the lung after birth, may be detected in young subjects, and if of slight extent may give rise to air aspirations.

With the exception of the cases just mentioned (pleurisy etc.) the collapsed portions are of small extent and are scattered over the lung. Both sides may be affected and the dulness is almost always of very limited extent. The dulness caused by the collapse of the lung in pleurisy or empyema is concealed by the presence of the exudation but is after its absorption the lung fails to expand the chest—still giving a dull note owing to the presence of dense, resonant, carciified lung beneath.
Fig 29  Pleurisy

dark shading indicates the position of exudation.

From a Sagittal section one inch to the right of the median plane
of a child aged about six years - Organs (lung liver, kidney, heart).
The fluid has gravitated to this
posterior part.

(Sympson's Edin. Med. Journal) March 1886 P. 836
Collapse due to pneumothorax does not cause dullness but the side being filled with air the chest is hyper-resonant or tympanitic.

2 Affectio of the Pleura - Pleurisy with effusion and Empyema - Hydrothorax

In the early stage of pleurisy the resonance remains unaltered and if no effusion occur (dry pleurisy) may remain throughout the course of the disease. Usually however a copious exudation of serous fluid takes place into the affected sac and the side becomes absolutely dull. A large amount of fluid may be present without causing dulness and a layer of half an inch in thickness interferes between the lung and the chest wall does not prevent resonance from being heard through the note is muffled.

As the fluid increases the dulness becomes absolute over the area occupied by fluid, which of course gravitates to the lowest parts and consequently the dulness is first and for the longest time heard at the base posteriorly on the left side being heard when normally the resonance of the stomach was heard, and on the right above the level of the hepatic dulness. The line of dulness is not straight but rises somewhat posteriorly towards the spinal column and of there should be adhesion present between the two
surface of the pleurae the area of dulness will be seriously altered, the fluid rising only in those parts that are free from adhesions, the parts of lung bound down being resonant or only slightly dull. When the lung is free to move in the thorax it is possible to change the level of dulness by changing the position of the thorax, thus if the patient lies on the side not affected the lung will rise to the highest point and if percussion be made in the axillary line the note will be great resonant while towards the spine & middle line dulness is evident. As the fluid is absorbed, the lung expands and the chest again becomes resonant, but when the pleura has become much thickened, the note remains muffled for some time after the fluid has all been absorbed. The lung may not expand, and the thorax will be drawn down to its level, and in such a case the percussion note is either muffled or absolutely dull. Local pleurisy occurs with the presence of exudation in limited areas being shut off from the pleural cavity by adhesions, the area affected is dull on percussion and all the physical signs of dulness may be detected.
that such order has been adopted, the points themselves being gradually ascertained in the course of the examination of the patient. In some of the London hospitals it is customary to place the history of the patient after the physical examination, and in practice this is generally done:—for instance, when a patient comes to us or is visited in his own home, we naturally begin by asking what are his complaints, and we ask a few necessary questions, we have time to notice the general appearance of the patient, the state of his nutrition, expression, and then proceed to the examination of the system to which our attention is called by the patient's statement of his case, and afterwards enquire into his history circumstances. In general practice a great deal of this is known to the medical attendant owing to his acquaintance with the family and how the ‘family doctor’ has a great advantage over the consultant who has to learn all these particulars and draw his conclusions in the course of a short interview.
In Empyema the fluid present, instead of being simply toxic, is prevalent. As a rule it comes on slowly, increases less rapidly, and is only removed by absorption to a very small extent. As in pleurisy only one side is affected and the dulness corresponds to the area occupied by fluid. The lung is much more apt to remain expanded after the withdrawal of the fluid and therefore decompensation and permanent impairment of the percussive note are more apt to occur. Hydrothorax or thoracic droopy occurs in the course of some cardiac cases, and forms part of a general droopy. The fluid in the pleural sac causes the same percussive phenomena as in pleurisy. Both sides are however affected and frequently fluid is present in the pericardium as well and there is general droopy of the pericardium and cellular tissue.

Dulness from change in the position or size of the heart or pericardium will be discussed later.

Bronchial or tracheal affection never cause dulness provided the lungs are healthy and the airs cell are not collapsed.
3 Change in the thoracic walls. As already noticed, thick walls will cause a diminution in the loudness of the percussion note, and may greatly impair the resonance and in some cases cause absolute dulness. It is obvious that dulness from this cause, which is generally bilateral does not indicate pulmonary disease, but sometimes it may be a cause of difficulty, as when the muscles and tissues on one side are wasted, owing to certain nerves lying the note on one side is less resonant than on the other. The absence of symptoms and the other physical signs of pulmonary disease, and the presence of atrophy and paralysis in other parts will generally clear up any doubts.

Increase in Resonance.

With healthy lungs, the percussion note is more resonant when the thoracic walls are thin and consequently more easily thrown into vibration, also at the end of inspiration when the air cells are distended. The case of resonance is increased, the apices are higher above the clavicles, the heart more overlapped by lung-tissue and the resonance at the base
descends lower. In emphysema—whether affecting the whole of the lungs, or only limited areas, the note for the diseased part is more resonant than normal and is generally pitched higher and approaches and occasionally is truly of a tympanitic character. Our cavities too, being to give an amphoric or tympanitic note, the resonance may be increased unless the cavity be filled with fluid or other products when the percussion note will be rather impaired.

Tympanitic Percussion Sound. This is the name given from its drum-like character to the note produced by percussing over the stomach and other abdominal viscera which contain air. In the thorax it is never heard when the lungs are healthy and the pleural sacs do not contain air or gas, but in disease it is present under several different conditions. It is best marked in—

1. Pneumothorax, where air is present in large amount in the pleura.
2. In some cases of emphysema but never to the same extent.
3. Our cavities in the lungs which contain air.
4. Under certain conditions of consolidation or partial collapse of the lungs.
Pneumothorax. Air may enter the pleura either through a wound in the thoracic parietes or through a fistulous opening from the lungs which may be produced by the bursting of an abscess into the pleural cavity or by destructive processes going on in the lungs. The tympanitic area varies with the amount of air present; the whole side may lose its normal vesicular character, the lung being collapsed, or the air may be confined by adhesions to a very limited site, and this is especially the case where the pneumothorax has been caused by the entrance of air through a fistula in the lung. When due to an external wound scarring further may follow, and the air be gradually absorbed and the site become normal as the lung expands, but under the other conditions already named the pneumothorax is generally rapidly followed by irritative or inflammatory processes in the pleura with the exudation of serum or more frequently purulent matter and suppuration. In this case there is dulness on percussion over the region occupied by fluid while above this the note is tympanitic.
If the air and fluid be free to move and not confined by adhesions between the pleural surfaces, the percussion note will vary with the change of position of the patient; the fluid gravitating to the lowest part, while the higher region is always tympanitic. As the fluid increases the air becomes and may disappear altogether. In some cases when the affected area is small and there is a free communication with a bronchus, the fluid becomes mixed with air bubbles, and on pressing over into an intercostal space, a peculiar crepitant sensation is produced on to the bursting of the air bubbles.

(2) Empysemia. In some cases the note is distinctly tympanitic, though more often of a character which Prof. Flint describes as vesicular-tympanitic (Clinical Medicine?), that is, the note has some of the features of tympanitic, but is altered by the vesicles, which may be said to damp the musical sound. The percussion note is generally tympanitic over regions where large bullae exist, which sometimes simulate an excavated cavity in their percussion phenomenon.
3) CAVITIES. Excavations in the lung substance or cavities due to dilatation of the bronchi, if of sufficient size and near to the surface of the lung, and whose walls smooth, will give a tympanitic note on percussion unless at the time they should be filled with fluid or lung detrituses. Deep seated cavities cannot be detected and considered superficial, if they are much less than a pigeon's egg in size, then tympanitic note cannot be demonstrated. If the walls be ragged and destruction is going on rapidly in the lung, the note is not generally tympanitic but the resonance is increased if air be present and dull if the contents be fluid. The pitch of the note is higher in small cavities than in large, and higher than in pneumothorax. It is altered with respiration, being higher during inspiration than during expiration owing to the alteration in the tension of the air. When the mouth is open the note is also higher and in some cases has a cracked or fractured, or "fruit de fist fole".

4) Condition of condensation or collapse of the lungs. A tympanitic note is sometime heard at the beginning of pneumoconiosis, or when consolidation has occurred, over the normal lung, in contact with the
In consolidated tissue (b) in consolidation at the apex. (c) In edema of the lung (d) in pleurisy above the dull area.

The explanation of this phenomenon as various. Thus, Prof. Schütz (Clinical Medicine) describes the tympanitic sound to the vibration of the air in the larger bronchi, under the consolidated tissue, though which the vibration can be transmitted from the external walls to the bronchi, and the sound so produced not being impaired by consolidated tissue as it is by the normal vesicular breathing, is in character tympanitic. This would account for the production of a tympanitic note in the infraclavicular regions, while the stomach note heard through the condensed tissue of pneumonia would explain its presence at the base or the left side at any rate.

Juttmann on the other hand ascribes the tympanicity to lowering of the tension of the air in the vesicles. The tympanitic note is lost in any air containing cavity if the tension be too high and is regained when the tension is lowered to a certain degree, being again lost if lowered too much. The tension is lowered in the air cells in the neighborhood of consolidated tissue or when the vesicles are only partially filled with exudation (beginning of pneumonia), in edema
of the lungs and in the collapsed lung of pleurisy.

This affords a satisfactory explanation of the tympanitic quality of the note, but a lowered tension would be accompanied by a lowering in the pitch of the note which in all cases of tympanicity is somewhat raised.

This elevation however will be explained by the decrease in the area of resonance as Bristow remarks, "proving that (other things being equal) the smaller the vibrating area becomes the higher will be the fundamental tone it yields, and seeing that such a diminution of vibrating area necessarily takes place where there is extensive consolidation or fluid effusion, and not improbably occurs in the first stage of pneumonia over the affected portion of lung; it seems reasonable to assume that mainly in these considerations is to be sought the explanation of the aeronastic phenomenon in question. It must not be forgotten however that the increase of tension which in pneumothorax, and in a less degree in pleurisy with effusion, the thoracic walls experience, also tends to the production of a higher note."

(Bristow Practice of Medicine p. 360 Third edition)

Metallie percussion sound. Amphonie resonance.

This is a variety of the tympanitic sound and resembles it in some of its characters but is more metallic. It can be imitated by striking the cheek when the mouth is closed and distended with air, or by striking an
or when two claws are used one as hammer the other as pleximeter.
empty jar or bottle. The conditions necessary for its production are a cavity of large size containing air, with smooth walls, and close to the thoracic surface. It is heard in phthisical cavities where destructive processes are not going on and sometimes in those of bronchitic origin, and also in pneumothorax. In cavities in the lung substance it is best heard when the patient lies on his back with his mouth open and when the glottis is struck by some hard body at the unprotected end of the percussion hammer. In pneumothorax it is heard when the tension of the air is increased and the walls thin but it is only in some cases that the metallic sound is heard, the note generally being tympanitic.

Cracked pot sound. Bruit de pot-flefl.

This is a sound produced by special conditions of the lung with reference to the escape of air from its secret or from a cavity in its substance. The sound heard on percussion is exactly that produced by striking the hands clasped together or the knee. The resonant or tympanitic sound of an air-containing cavity is heard, and along with that a 'click' or metallic hissing sound produced by the sudden escape of air. It is heard even when there is no disease of the thoracic...
viscera, when the thorax is thickly covered with hair or when percussion is made through a woollen garment, disappearing when the hair is removed or the garment removed.

In disease it is heard under the following conditions:
1. When there are cavities of a certain size in the lung substance which communicate freely with a bronchus. The walls of the cavity should be firm and smooth and near the surface and the bronchus communicating with the cavity free from obstruction. Then, from percussion is made (and here the hammer is most useful) over such a cavity, and the patient keeps his mouth wide open, the air will be forced out suddenly through the narrow opening of the bronchus with a sound such as is described above. The cracked gur sound will disappear if the bronchus be obstructed and will return when the obstruction is removed.

2. In pleurisy above the level of the fluid, it is sometimes heard and especially when the note assumes the tympanitic character. It is probably due to air forced out of a large bronchus by percussion forcibly over the collapsed lung.

3. In pneumonia it may also occasionally be heard when the percussion note is tympanitic, and the explanation is similar to that given in pleurisy.
I. Endeavour to gain the confidence of the patient.

With children this is of more importance than with adults, but in all cases we are more likely to get a true statement of the patient's symptoms and to form a correct opinion as to his case if at an early period we are admitted into his confidence.

II. Ally as far as possible the patient's nervousness and anxiety.

The nervous agitation occasioned by the physician's visit, or by the dread of serious illness, not infrequently causes the appearance of symptoms misleading, and altogether foreign to the case, which may mask the true nature of the symptoms present, and possibly lead to an erroneous conclusion. A few cheering words will often suffice to reassure the patient, and the medical attendant should always be careful that nothing in his own conduct or words is likely to cause the patient unnecessary alarm.

III. Make the examination as thorough as possible.

While doing this be careful not to go beyond the necessities of the case, avoiding all questions which
Breathed out sounds may be easily produced in the healthy chests of young children when the walls are yielding and consequently the air is easily forced from one part to another.

The occurrence of this sound will point to the presence of a cavity in the lungs, but care is required to exclude those cases in which it is due to other causes.

Sense of Resistance.

In percussing a perfectly normal chest a yielding or springy sensation is felt due to the elasticity of the thoracic walls. It is felt to a certain extent all over the thorax but is much less over the areas occupied by solid viscera, than in those occupied by the lungs. Over the exposed surface of the heart and over the liver a sense of resistance is met with - the chest wall does not vibrate to a pitch but feels as if a dead weight were struck.

The elasticity of the chest walls may alter under various conditions affecting the walls themselves or the contained organs. Thus when the bones are thickened, the cartilage fatty and stiff, and the chest walls drawn in or rigid the sense of resistance is greatly increased and the sensation of yielding is lost.
Also when consolidation occurs in the lungs from any of the causes which have been mentioned as causing dulness on percussion, when fluid is present in the pleura or even when the membrane is much thinned, the sensation experienced resembles that produced by percussion over the liver or by striking a drum which has been dampened by placing a resistant body below the parchment.

Increase in the sense of resistance corresponds to decrease in resonance or to dulness, and is experienced over those areas where the percussion sounds are impaired, but cannot be relied on to the same extent as the production of sound, in forming an opinion of the condition of the organ below.

Diminished resistance does not often occur but in cases where the quantity of air in the thorax is largely increased as in Pneumothorax and Emphysema it is sometimes observed. It is probably due to the fact that air in large amount is more easily compressed or thrown into vibration than when contained in the normal pulmonary vessels. As so much depends on the condition of the thoracic walls, diminished resistance has no great diagnostic importance.

The pitch of the percussion sound remains to be noticed.
The pitch varies in different individuals so that the standard can be set down as normal. It also varies slightly with the condition of respiration and with the position of the individual, being higher at the end of deep inspiration and lower at the close of extreme expiration, while during ordinary quiet respiration it remains practically unchanged. The pitche at least in the front of the chest is lower when lying than when sitting or standing, probably due to the diminished tension in the thoracic wall in the recumbent position. The pitch is also different at different periods in the chest, being slightly higher over the portions of lung as over the diaphragm and at the upper marges, especially those near solid organs, so that the note is higher near the spine or the right side, or over the thin borders of the lung overlapping the heart, or the left side.

In Disease the pitch may be lowered or raised. Lowering of the pitch occurs when the tension of the lung tissue is diminished, and the disease causing this an asperminous or pleurisy of moderate intensity (Krause quoted Fettman, L., et al. 1889). In Pleurisy it occurs over partially collapsed lung above the expiratory, and Pneumonia over the healthy tissue above the
consolidated area. This condition of the fluid is not invariable and occasionally it becomes raised over the same area from the increase in the tension of the chest wall, or from the decrease in the amount of resonant tissue.

Elevation in the fluid, accompanies tympanism and also the approaches to absolute dulness, and never occurs alone. It is therefore of itself of no importance.

Phonometry. This is a method of testing the condition of the organs by tone produced when a vibrating tuning fork is placed, handle downwards, in contact with the chest wall. It was contended that the sound was loudly heard over organs permeable to air and feebly over solid organs. This method has never come into general use, as the results obtained were always open to doubt and the amount of information gained, could easily be obtained by the other more convenient means we possess.

Auscultation of the Thorax.

By Auscultation is meant listening to the sounds produced in the thorax either with the unaided ear or with some conductor. (Bristow loc. cit. P. 351) The patient should be so placed that the auscultator
can apply the ear or stethoscope easily, and with precision, to the post-cerior examination. It may be sitting, standing, or lying—the latter being very convenient for the examination of the front of the chest—but in auscultating the posterior surface, it is better that the patient should be seated or standing.

The skin should in all cases possibly be uncovered but occasionally it is necessary to have some covering; when this is the case, it should be thin and of some clinging material which will not occasion much error by wetting or rubbing when the patient breathes.

Auscultation with the unclosed ear. This method of examination possesses many advantages, but there are also many objections to its use which have caused it to be superseded by the stethoscope. The sounds produced in the thorax are better heard and more correctly estimated when the ear is applied directly to the chest, and there are fewer extraneous sounds produced with this method than when any instrument is employed. It is very useful when rapid examination is necessary especially of the posterior surface, when the weakness of the patient prevents his sitting for any length of time. Also when the patient is restless, uncased, or engaged in any noise, the precluding breath and rubbing noises which the stethoscope does, so that we are enabled to make a superficial examination, at all events, with less trouble to
Stethoscopes with various forms of ear-piece

Fig. 30
the patient and a saving of time to the physician, a

great point in general practice; in all cases, however,
making a complete examination, when any abnormal
sounds are heard.

The disadvantages of using the unaided ear are that it
cannot be applied to all surfaces as for instance to the
shoe, and cleanliness will often forbid its use in
some classes of patients and matters of delicacy in others.

The Stethoscope. Fig. 30. Discovered in the year 1816
by Laennec whose first stethoscope consisted of
a roll of paper. The different forms of this
instrument have now become exemplified. The chief
object aimed at in its construction are – good conductive
properties and portability.

There are three chief varieties of stethoscope:
1. The Binaural, for use with one ear of which there
are (the rigid stem stethoscope and the flexible.)
2. The Binaural Stethoscope
3. The Differential Stethoscope.

The rigid stem stethoscope in its simplest form (Fig. 30)
consists of a column of wood or other material
with expanded ends, one of which is applied to the
chest, the other to the ear. From this simple form
have arisen the multitude of varieties now in use.
The stem is generally made thin and hollow, but some
consider the solid stem to be a better conductor. The piece
Flexible Clinical Stethoscope (Reid & Morrison's)
to be applied to the chest— is expanded, trumpet-shaped, the
rounded extremity being about the size of a shilling, the
edges of which must be carefully rounded, and in some
instruments are protected with india rubber. The shape
of the ear-piece is a special point with some physicians.
The size of the disc should be sufficient to rest comfortably
on the ear and may be flattened, slightly concave
or bell-shaped, the latter form being a favorite with
some as the sounds are said to be amplified and
more easily heard. The instrument is made of different
kinds of wood, of ivory, caoutchouc, metal, celluloid,
but it doubtfull whether one material or one particular
form has much advantage over the others, each observer
as a rule hearing best with that form of stethoscope
with which he is accustomed.

The flexible stethoscope. This instrument consists
of a chest-piece similar to that of the rigid instrument
to which is attached a flexible tube ending in a rounded
extremity which fits into the entrance of the trachea.
It has the advantages that the ear piece remains in position
while the chest piece can be moved rapidly from point to
point, and auscultation can be performed without moving
the patient, except for the prsonal aspect of the chest, and
the physician has no difficulty in applying the end of the
stethoscope exactly, and little pressure is made on the surface.
Fig 32
Binaural Stethoscope

Fig 33
Differential Stethoscope
The Binocular Stethoscope

This instrument consists of a single chest piece as in the last form to which is attached a short flexible tube connected with a rectal tube which divides into two branches, which when the instrument is in use lie one on each side of the head, their extremities being curved inward and placed one into each ear. Of this instrument there are many modifications and it is made so as to be convertible into the differential stethoscope.

The advantages of the binocular stethoscope are—Ease and rapidity of examination, greater intensity of sound, and greater nicety in the localization of sound.

The disadvantages are—Noises are occasionally in the ears by the presence of the tubes; and extraneous sounds are very apt to be generated by the slightest movement of the instrument or by the hand holding the chest piece.

The differential stethoscope resembles the last instrument but each ear tube is continued separate and provided with a distinct chest piece. With this instrument it is possible more exactly to differentiate the relative intensity of sounds, and also the tone of their production, it is therefore of more value in the examination of the heart than of the lungs.

Rules to be observed in auscultation:
1. The room should be as quiet as possible, and if silence cannot be obtained it is useful to block the ear to which...
2. The chest should be uncovered except when exposure would be likely to injure the patient.
3. Make as little pressure with the stethoscope as possible.
4. Make the examination in a regular and systematic manner, always comparing the sound on each side, with that opposite.

Normal Phenomena of Auscultation

There are two distinct types of sound heard in auscultating the normal chest: (a) the tubular or bronchial murmur and (b) the vesicular murmurs.

(a) The Tubular Murmur. If the stethoscope be applied at any point in the course of the trachea or over the division of the bronchi a loud, harsh murmur of a blowing character is heard, similar to that produced by forcing the lips together and blowing with sufficient force to make a noise but not so strong as to produce a whistling sound. The intensity of the sound diminishes slightly as we proceed downwards and is lost over the substance of the lungs. The Inspiratory sound is louder and rather longer than the Expiratory sound being heard up to the close of inspiration, while the Expiratory sound is heard only at the beginning of expiration and dies away towards its close, a distinct pause separating the inspiratory from the expiratory.
Production of the Inspiratory Murmur.

Air passing through a tube at a low pressure, and if there be inequalities in the walls of the tube, produces no sound, but if the air is driven forcibly through a narrow orifice, either a distant musical sound is produced or a series of a coarse blowing or hissing character. In the trachea and bronchi as long as their walls are healthy no sound can be produced, unless the air be driven through them at a much greater pressure than occurs during inspiration, when their walls might be made to vibrate and produce a sound, but as the air passes through the narrow opening of the glottis, it is thrown into indefinite waves by the lax vocal cords and the blowing sound above described is produced. This sound is heard loudly and clearly over the larynx and then can be little doubted that the Inspiratory Murmur is simply the conduct of the laryngeal murmur along the tube. The greater intensity of the Inspiratory Murmur is accounted for by the fact that in inspiration the sound is drawn towards the observer by the current of air and during expiration it is carried away from him.

3) The Vesicular Murmur.

The sound produced over the regions of the thorax occupied by the substance of the lungs, by the air entering the air cells in a gentle seeping character and has often been likened to the sound produced by the rustling of the
to avoid by word or deed offending the modesty of the patient.

If the result of the examination be favourable the patient should be told at once, but if not, it is better to give a guarded reply to the patient, for the physician himself, than by taking away hope, to aid in bringing about the fulfylment of this own prophecy. "It is cruel to banish from the sick man's bedside, his sole remaining comfort; it is unmerciful to steal away hope - his only consolation during hours of pain and watching. We ought never to allow any expression to escape from us which could possibly add the terrors of apprehension to the weight of actual suffering" (Greaves' Clinical Medicine P9 Syd Soc). If danger be present, one of the relatives or attendant may be informed, and only when the patient's affairs are cut settled should the dangerous nature of his case be laid before him. When, as in some cases of heart disease, it is necessary to warn him, so that he may exercise due care and caution in his mode of living.

The length of visit and frequency of visits are questions which must be settled on the merits of
leaves in the evening breeze. It can be produced by gently drawing the air inwards with lips almost closed. The sound is heard with slightly varying intensity over the whole substance of the lungs. With quiet inspiration the sound is very faint and heard only on inspiration, but if the inspiration be deeply drawn and with some force, the vesicular murmur is increased in intensity and is heard with expiration at its commencement, but always fainter and farther off, as it were, than the inspiratory murmur and only if the chest wall be thin and capable of conducting sound well.

The presence of the vesicular murmur shows that the air in the lungs is which it is heard is permeable to air and if symptoms of pulmonary disease are absent, it is fair to conclude that the lungs are healthy, but disease may advance considerably without causing attention in the sound, if the area affected be small.

Production of the Vesicular Murmur.
The various theories as to the causation of the vesicular murmur may be briefly stated.

1st. That it is produced by the conduction of the lung sounds along the bronchi and bronchioles, unattenuated in character but diminishing in intensity, and that the sound is broken up on passing through the air cells.

2nd. That the sound is produced in the finer air tubes and modified by the movement of the air in the vessels as they expand. It is not improbable that the cause of the murmur is to be found by combining these two theories and that both enter into the production of the murmur.
3rd That it is due to the sudden tension of the walls of the air cells as they expand. The air is drawn into the lungs by the expansion of the pulmonary vesicles and the tension produced thus will with the entrance of the air throw them into vibration and produce a murmur, just as the heart sounds are produced by the tension of the valves.

4th That it is caused by the friction of the air against the walls of the alveoli.

5th That it is caused by the vibration of the air entering the airway comparatively wider alveoli from the narrow bronchioles.

It is impossible to say certainly which of these theories is the correct one, as the amount of sound produced by each of the different causes mentioned cannot be estimated as it is impossible to test them separately.

The sound is loudest and best heard when the chest walls are thinnest and the lung not fully expanded, as in the infra-clavicular region. It is feebler in those places where the amount of lung present is small and not well expanded, as over the spine in the infra-clavicular regions, and where the covering of the thoracic walls is thick, as over the scapulae. It varies according to the strength with which inspiration is carried on, the sound being soft when the inspiration is quiet and slow, but harsher and louder if the breathing be deep and hurried.

In children the murmur is always much harsher than in adults, the normal soft murmur being acquired about the time of puberty or even later.
Alterations in the vesicular murmur.

Increase in tenderness. This occurs when the covering of the chest become thin, but is of no diagnostic importance in the absence of other signs.

Roughness or harshness. This character is developed in the murmur when the bronchial cuneous membrane is thrown into folds which by their clefts produce a murmur in the tubes, heard over a large or small area of the chest according to the extent of the bronchial catarrh. The vesicular murmur is either obscured by the frothy sound, or if the “conduction” theory of its production be true, it is simply altered in character.

A harsh murmur recurring equally over the two sides of the chest in an adult points to catarrh of the bronchii—the presence of cough will generally suffice to make the diagnosis certain.

A rough murmur over a limited area, as in the apex is a sign strongly suspicious of incipient phthisis. Experience shows that catarrh of the apes has a peculiar tendency to attack the walls of the bronchi and their lateral and terminal alveoli. The catarrh extends along the bronchi and a harsh murmur is sometimes produced long before the condensation has extended sufficiently to be discovered by percussion or auscultation (Bronchial guttating or rales).

A harsh murmur is also heard with expiration in cases of bronchial catarrh and indicates that there is some difficulty in the air leaving the lungs, and for this reason
the murmur is prolonged, and may equal or even exceed the length of the inspiratory murmur. Rales and rhonchi are generally present with both sounds.

Prolonged expiratory murmur is heard in conditions of the lungs, and in emphysema or bronchial catarrh is present.

**Diminished Vesicular Murmur.** The sound is diminished in loudness when from any cause the thoracic walls fail to conduct the sound clearly. Thus when fat is present in large quantity or the muscle is largely developed, the murmur is only faintly heard. Similarly when the pleurae are thickened or a thin layer of fluid or air separates the two surfaces the vesicular murmur though still heard with inspiration is greatly diminished in intensity, but if the amount of fluid or air be large the vesicular murmur is abolished. The sound is likewise diminished when any obstruction to the entrance of air exists as when the trachea or bronchi become contracted by cicatricial tissue. The presence of a plug of mucus in a bronchus will diminish, and if the obstruction be complete, abolish the sound altogether.

**Interrupted or Waving Respiration.** Even when the lungs are perfectly healthy, if the breathing be very slow, the murmur heard with inspiration proves of being continuous, is broken and jerking; the explanation being, that the lobule of the lung do not expand equally, or part being fully distended before the air has begun to enter the other. This phenomenon is absent when the
in inspirations are made quickly so that the whole lung
becomes expanded almost simultaneously.

Intermittent respiration occurs in diseases when the
apexes or other limited area of the lungs becomes partially
inflated and the air passages slightly obstructed. The air
does not enter the air cells fully, but in a broken and jerking
manner. After coughing this disappears and after a time returns.
It is not absolutely diagnostic but if heard over a particular
area for some time it points strongly to commencing
carcinoma in the part where it is heard, and is especially
important in members of a family where phthisis has
occurred.

Bronchial or Tubular Respiration

Sounds of a blowing, rushing or ‘tubular’ character,
as it is termed, have already been described as occurring over
the trachea and primary bronchi. As soon as the latter
become embedded in the vesicular structure of the lungs
the sound is lost, but doubtless even the ultimate
bronchial divisions expand and some conducting apparatus
applied between them and the ear, similar sound but
diminished in intensity would be heard. Under
certain circumstances, this tubular or bronchial sound
can be heard over extensive or small areas of the lungs.
In the normal lung the bronchial sound is obliterated
or altered in character by passing through the vesicular
substance but when bronchial breathing is heard, the
Condition is reversed the vesicular murmur is lost and the tubular sound is conducted to the ear.

The suppression of the vesicular murmur is not the only condition necessary, for this occurs in pleurisy when fluid is present without the production of tubular respiration, but—a good conducting medium between the bronchial tubes and the chest wall must be present—and this occurs under the following condition:

1. Condensation of the lung substance, as in pneumonia, empyema, catarhhal or interstitial.
2. The cause of degeneration of pneumonia, fibrosis.
3. Compression or encapsulation the result of pressure—pleurisy, empyema, pneumonia; and collapse of lung substance from other causes.
4. The pulmonary cavities—bronchietasis and evacuation of lung substance.
5. Empyema in lung substance.

In croupous pneumonia and in the more chronic varieties, the sounds on auscultation are bronchial in character, so soon as the air cells are filled with exudation. In acute croupous pneumonia it is heard as ced xiphophlebitis advances and so long as the stage of gray xiphophlebitis lasts—passing off as resolution occurs. In catarhhal and interstitial pneumonia it is not so evident as in the croupous variety and is only present when the areas infiltrated are sufficiently large. In cavities of the lung the vesicular murmurs
For some areas is bronchial while over others it is cavernous or amphoric showing the presence of dilated bronchi or excavations. The distribution of bronchial breathing is often distinctive. In pneumonia, the area where it is heard is generally confined to the lower lobe of one side. In cataract, pneumonic the areas of bronchial inspiration are scattered and often surrounded by regions where the auscultatory sounds are normal. In phthisis, the apices are the parts most affected and therefore it is in these regions we most frequently find bronchial breathing.

2. When the lungs is collapsed owing to the presence of fluid or air in the cavity of the pleura, tubular breathing may sometimes be heard over the compressed lung. The bronchial tubes must therefore be patent, not blocked by secretion or collapsed by pressure and the consolidated lung must be in contact with the chest wall. The sound can only be heard above the level of the fluid and is most often heard where the lung is bound by adhesions to the chest wall. Bronchial breathing is heard subject to the same conditions as regards the bronchi and portion of the lung in pneumothorax and emphysema. The lung may be partially collapsed by other causes.
such as the presence of a tumour either mediastinal or in the lung substance, by great hypertrophy or dilatation of the heart, or by the presence of an enormous pericardial effusion. Then the area where bronchial breathing is heard is limited to the parts surrounding the cause of compression, and the quality of the respiratory sound will depend greatly on the relation of the larger bronchi to the constricted area.

Pulmonary cavities — Tubular breathing or one of its varieties — cavernous or emphonic breathing may generally be heard when excavation has taken place. In the sound to be purely tubular the cavity must not be too large, the walls must be firm and smooth, and the condensed tissue surrounding it must reach to the surface of the lung, and the cavity must be in free communication with a bronchus. If the cavity be of large size the sound is generally cavernous, if the walls are ragged and uneven the sound loses its tubular character and is of an indefinite nature, while if the cavity lies under a layer of healthy tissue or the bronchial tube be plugged, the sound is lost.
altogether. Tubular breathing is not absolutely diagnostic of a cavity as it may be produced by a bronchus passing through a mass of condensed tissue, but when heard in the apexes, it forms an important item amongst the phenomena which indicate the existence of a cavity.

**Production of Tubular Respiration.**

1. **Conduction of the Laryngeal sound.** Under ordinary conditions the tubular sound, propagated through the tubular part of the lungs, is lost in passing through the smaller intercostal substance, but when condensation takes place by collapse of the air cells or by their distension with exudation the breath sounds are conducted unchanged to the ear. That the condensed tissue is a better conductor of sound is shown by the heart sounds being heard over regions where normally they are inaudible.

2. **That the sound is produced by the movement of the air through the tubes in the condensed tissue.** When the tissue of the lung is consolidated little or no air is drawn into the affected part, so that the current of air cannot be sufficiently strong to cause the loud sound which is heard, for example, over a pneumonic lung.
3rd Skoda's Theory - That the laryngeal sounds are taken up by the bronchial tubes, and increased in intensity by their resonance. The theory rests on the fact that if a note be struck in the neighborhood of a resonator, or body capable of vibrating in the same key, the sound is reproduced and in some cases increased in intensity. This may be true of musical tones, but the laryngeal breath-sounds have no musical value and the bronchial sounds heard over the thoracic surface, except in the stertotic sounds heard over some cavities, have none either, and the sound is not louder than that heard over the larynx.

The first explanation is probably the correct one – The air tubes serve simply as sound conductors, as a speaking tube, as a stethoscope does, and the consolidation of the lung tissue obliterated the normal vascular murmur and conducts the sound practically unaltered to the ear.

Leavesmons, Amphoric, or Musical Breathing. This is a variety of Bronchial breathing and is more or less tubular in character, with the addition of a distinctly metallic or musical ring. The sound resembles that produced by blowing over the mouth of a jar or bottle – hence the term 'Amphoric'.
of each individual case. A visit should be long enough for a thorough examination to be made, without appearance of hurry or carelessness, and after the necessary instructions are given, the sooner he leaves the house the better, though a few minutes of general conversation are a kindly conclusion to a physician visit. Visits should not be so frequent as to deserve the imputation of making more than an agreed, nor so few as to give suspicions of neglect—but no definite rule can be given. “The liability to error in the number of visits is in making too few rather than too many for the reason that Physicians are generally loth in regard to an imputation of making more than are required” (Smith Clin. Med. 158).

Sources of Error in Diagnosis.

(1) Incomplete facts—

As a rule the difficulty does not lie in the patient’s patience but rather in his verbosity. He has a tendency to give too much information, though often out of the kind that is wanted, but just furnishes his own ideas of the case, and does not give straightforward answers to the questions asked. Exaggeration of symptoms is another difficulty, some people delighting in telling of their sufferings
It is heard both with inspiration and expiration, but generally better with one than the other, most often with inspiration alone. The vesicular sound heard as an addition to tetalonic breathing is diagnostic of the presence of a cavity, but its absence does not disprove the existence of such a cavity.

The sound is produced entirely by the reverberation of the sound produced by the air entering the cavity, or by consonance of the walls of the cavity with the lung-leaf sound.

It is best heard over large cavities but may be produced in those of small dimensions such as the size of a walnut, and for its production, a free communication with a bronchus is necessary especially if the sound be due to the resonance produced by air entering the cavity; if it be due to consonance alone such a communication is not necessary.

The sound is lost or modified by the presence of a large quantity of fluid, and in some instances by the playing of the bronches leading to it or passing near the cavity, the sound returning along the path is removed by coughing.

Cavernous breathing may sometimes be heard in
Pneumothorax where the opening from the lung is free and the current of air sufficient to throw the air in pleural cavity into oscillating waves. Its occurrence is rare.

This sound has also been heard in dysphonia by the respirations being made with the mouth wide open, the sound being lost when the mouth was closed.

Friedrich asserts that in some aged persons an amphonie respiratory murmur may be heard "between the shoulder blades unconnected with dysphonia - or cavities being present." (Sattmer, loc. cit. P. 41)

The sound heard on Auscultation cannot always be classed as vesicular, bronchial, or cavernous but may partake of the characters of one or other of them; thus we have an "impaired vesicular murmur" or a sound "somewhat bronchial", or bronch cavernous, or the sound may be observed by the accompanying indistinct sounds (Rales). These sounds are sometimes classed separability as "Indeterminate Murmur".

They may be due to imperfect expansion of the lungs. This will account for the imperfect vesicular murmur, and if some consolidation be present, for the bronchial sound being imperfect.

To complete a partial obstruction of the.
Bronchi - This will be sufficient to obliterate the sound altogether, and diminish the intensity of the sound, or cause some additional sound to be produced.

3. Absence of the accompanying sounds - When these are present in great amount and loud in character the breath sounds may be obscured. Coughing by clearing the tussis and vesicles, followed by a deep inspiration will often serve to clear up the nature of the sound.

"The Gutamorphosing Respiratory Murmur" (Suttman, p. 130)

This is a modification of bronchial respiration and occurs with inspiration only. It is characterized at first by extreme harshness resembling the sound heard in stenosis of the bronchi. "This harshness lasts about one third of the inspiratory period, then it suddenly ceases and is replaced, during the rest of the inspiration, by bronchial breathing, accompanied by a "metallic echo", or to ordinary voices. It occurs in cases of cavity, and is probably due to air entering the cavity through a narrow orifice diminished by mucous secretion which are removed by forcible inspiration dilating the orifice. It is not a constant symptom of cavity and in the majority of cases is absent - much more frequently there is an excavation of the upper lobes, a respiratory murmur which resembles it in its character. It begins with a short, sharp, hissing sound, followed by "rattles" and indeterminate respiration."
The Accompaniments of the Respiratory Sounds.

**Rales and Rhonchi**

In the healthy lungs there are no sounds heard except the Bantoni and Velicular murmurs already described, but when pathological changes occur which increase the amount of fluid present in the tubes or air cells, or cause swelling of the mucous lining other sounds are added. Rales, cracking or bubbling sounds are produced by the bursting of air bubbles, which are produced whenever the tubes or alveoli contain fluid and it is a matter of indifference whether the fluid be serum, sputum, pus, or blood. Rhonchi, growling or wheezing sounds, are produced by narrowing of the lumen of the air tubes and may be the result of swelling of the mucous membrane or of viscid mucus adhering to the walls of the bronchi.

Rales are described according to the size of the air bubbles producing them, large, medium or fine rales, or according to the character of the sound produced—bubbling, gurgling, eructant, subeructant and mucous rales.

The stage of respiration in which they occur—Rales produced in the larger tubes, when fluid is of large amount and the breathing strong, are heard both with inspiration.
and expiration and throughout the whole of both acts; when fluid is not so abundant they are only heard towards the close of inspiration and at the commencement of expiration. In the smaller tubes this latter is also the time at which the rales occur, sometimes they only occur with inspiration and occasionally only with expiration. Rales produced in the alveoli are heard at the end of inspiration only, and sometimes only when the inspiration is deep.

Fine Rales - Fine Croupitation. This sound produced in the alveolar cells or finest bronchioles resembles the noise made by rubbing a piece of hair between the fingers. For the production of this sound the presence of fluid and the bursting of bubbles is not necessary, but it is often caused by forcible expiration of the air cells, whose walls are rendered adhesive by secretion. Sometimes it may be heard on very deep inspiration, over the apices or their margins of healthy lungs. Fine croupitation uniform in size is heard during the first stage of Pneumonia before condensation is complete, and during the stage of resolution, and may be regarded as diagnostic of that disease. This form of croupitation is unaffected by coughing during the 12th
stage, but during resolution they may be lessened or increased slightly. In the first stages of consolidation in phthisis pneumaticization is heard, but the rales are not uniform in size, and only a few are heard once, staccato and larger rales, produced in the tubular structures, being heard at the same time.

A few isolated rales in the apex are always highly suspicious of commencement of phthisis especially if cough or emaciation are present, but as already mentioned these sounds may sometimes be heard in healthy lungs.

Fine rales are also produced in the larger tubes, formed by the bursting of minute air bubbles and the majority of the sounds are larger in size when produced in these tubes are also of a muscular character.

Medium sized rales, or sub-rupturant rales, are often heard over the greater part of the chest in bronchial catarrh. They are caused by the presence of fluid in tubes of medium size and in the large branches. In the smaller tubes the lesser rales predominate and only few of larger size are heard, while in tubes of large calibre the rales are almost all of large size.

Large or coarse bubbling rales — gurgling. These sounds are produced in the trachea and large branches, and are heard in three situations, but from their loudness can

...
sometimes be heard at some distance from their source.

They may be heard previous to that of coughing when a
large amount of fluid has accumulated, but, are of
more importance in those cases when from extreme
weakness the patient cannot expectorate.

Medium sized and large rales are heard whenever
fluid is present in the bronchi, but are most often
produced by bronchial catarrh when the secretions
have become fluid. They are also heard in cases of
pulmonary cavities in which there is a collection of
fluid.

The amount of expectoration and number of rales
depend greatly on the quantity of fluid present
in the tissues; if the amount of fluid be large,
the number of rales will be increased, and when
little fluid is present only a few rales can be
heard. In Pneumonia the expectoration will depend on
the expansibility of the lung from secretion of the
respirations, the rales being best when the air cells
are filled with exudation.

The abundance or scantiness of the rales depends
also on the character of the respiration; the number
being always greater if the respiration is deep and
energetic, and scanty when the catarrh conditions
are present.

Position in which they are heard. In listening over
the chest, it does not follow that the sounds heard are produced in that part of the lung over which the stethoscope is placed. Generally speaking, the sounds are best heard, the nearer the stethoscope is placed to their source, but they may be conducted with scarcely diminished intensity to some distance. The râles produced in one lung are rarely if ever heard on the opposite side, and if râles are heard on both sides it is probable that they have been produced in both sides. The loudness or intensity of the râles is affected by the same conditions as other sounds. They are louder when the pasicles are thin, than when they are thick or loaded with fat, and if a good conductor of sound, such as condensed tissue, lie below the surface and the observer when the sound is produced, they are always louder than when the sound passes through cellular tissue. The râles conducted through consolidated tissue often have slight musical resonance and are somewhat higher in pitch than those conducted through air-containing tissue, where they are low, and without musical quality.

The most resonant râles are those heard over cavities. Metallic Râles. These sounds resemble in manner the sounds produced by water dripping from the roof of a cavern into a pool beneath. They only occur in cavities and most frequently in those of large size.
For their production, the walls of the cavity should be firm and smooth and the cavity near the surface communication with a bronchus is not necessary. The sides have a distinct musical value and pitch. All the sounds over the cavity in which they exist have a similar sound, the breathing is amphonic, the pericardiac sound is also amphonic, both having a metallic ring and the voice sounds have the same character. Pericardiac sounds when heard indicate the presence of a cavity but their absence does not exclude the possibility of the existence of a cavity.

**Metallic tinkling.** This sound may be heard in large cavities by the bursting of isolated bubbles, but most frequently it occurs in pneumothorax with pleuritic effusion or in hydropneumothorax. It resembles metallic percussion but the number of sounds is less and they are generally louder and deeper.

**Ronzoni.** When the bronchii are narrowed by contraction of their muscular fibres, by the constriction of fibrous bands round them, by swelling of their mucous membrane or by the adhesion of viscid secretion, the air passing through them frequently produces a somewhat musical note. The sound produced in the larger tubes is deep and of a rough grating character, that, in tubes of less diameter, of a wheezy, sobbing nature. They are heard both with inspiration and expiration and are often loud enough to be distinguished by the patient or
those at a little distance from them. The sound
varies with the size of the tube and the size of the
aperture through which the air passes. Besides the
cavities mentioned they sometimes have a cracking, high-
or roaring character. The sounds are wanting
when the lumen of the tube is entirely closed and
if the muscular tissue to which it leads is infiltrated
and not pervious to air. Most frequently sounds
are indicative of the 1st stage of bronchitis, but they
are present in asthma and various stages of
cataract. They are often altered or obliterated by coughing.

The Cough as an aid to respiration.

As incidentally noticed, the act of coughing by
clearing the tubes, causes marked alteration in the
sounds heard. The number of râles heard may
be diminished, or râles not previously heard may
be recognized. This is due to several circumstances.

By coughing the fluid may be driven together into
a smaller space, the expiration after coughing is deep
and so the fluid is more agitated. In cavities
also the metallic râles may be heard only during
the act of coughing as in the case where no com-
unication with a bronchus exists; or the cough
by clearing out the accumulated secretions from
the number of doctors they have seen and willfully
prevent ailments in order to provoke sympathy.
An incorrect version of a previous medical attendance
view is so often seen that many physicians make
a rule to disregard them unless they see positive
evidence of their correctness.

2) Incorrect or insufficient observation.
This is not infrequent—especially in young practitioners
and is due to want of care in examination generally
but may be owing to want of familiarity with
the physical signs in health and disease, which
can only be attained by careful clinical study.
The most common error is to overlook the
presence of disease, more chronic and less marked,
perhaps, than that for which the physician was
consulted, and which may have remained unknown
to the patient himself. For example a small
aneurism might easily be overlooked by any one
examining a case of Bronchitis.

3) Incorrect deductions.
To lay more stress on one set of symptoms,
and, to neglect the evidence of others, are two
uncommon sources of error, and are generally
due to a too hurried examination of the
facts of the case. By taking time to consider
the cavity will allow amplionic sounds to be produced which before were absent. The act of coughing also by removing an obstructing plug of mucus will cause the breath and voice sound to be heard over the area supplied by that bronchus. In pneumonia for example the breath sound may be absent because the bronchus leading to the affected area is occluded by mucus; an energetic cough will sometimes dislodge the plug and allow the tubular breathing to be heard.

A cough is also useful to determine the conductive sound through the lungs. This is generally estimated by the voice (vocal resonance) but sometimes it is difficult to get patients to speak, especially with children, and the cough sounds, either voluntary or involuntary, may be used instead.

Auscultation of the Voice - Vocal Resonance.

The distinctness with which the sounds produced by vibration are conducted to the ear is important, from the differences that occur in pathological conditions. When the lungs are healthy the articulated words cannot be distinguished when the stethoscope is applied to the chest, but the language note...
is heard as an indefinite humming sound of various intensity, over the different areas of the chest—over the larynx the sound is loud and startling, over the trachea the same sound is heard but diminished in intensity, and over the vesicular substance of the lungs the note is faint—but is more clearly heard than behind and at the upper part of the chest than lower down. The conduction to the ear depends on the same conditions that as vocal resonances due to the hand. It is better heard when the walls are thin, when the voice is deep and loud; and only faintly heard with a high pitched weak voice especially if the resonites are thickened. The vocal resonance heard over the trachea—large bronchi is termed Bronchophony—the articulated words heard when the patient whispers is termed Pectoriophony.

The Voice in disease—Bronchophony, Pectoriophony and Asphyphory.

Under certain circumstances the laryngeal note is heard with almost the same distinctness as when the stethoscope is applied to the larynx. When this occurs as in the production of bronchial breathing one of two
Conditions must be present—either condensation of the lung substance, or a cavity. The sound is conducted along the tubes, through the consolidated tissues and thence to the ear. The two sides of the chest should always be compared, especially if the bronchophony be only heard in a minor degree and it is important to observe whether the increase in the sound corresponds to those areas where naturally the lung-leaf sounds are well heard, or whether it is heard when normally the sounds are only faintly heard so at the back. Bronchophony over a cavity may be due either to good conduction of sound by the dense tissue around it, or to conversion of its walls with the lung-leaf sound. Bronchophony is heard in all forms of consolidation in pneumonia, pleurisy, or tumours of the lungs or when there is a cavity.

Pectoralogy—The articulate words may be heard when the patient whispers, as then the sound of the lung-leaf note is omitted, the whistling words being formed entirely in the mouth. The sound is so distinct that it appears as if it were
spoken directly into the extremity of the stethoscope. It is generally heard over those cavities which contain little exudation and where the bronchus has a free communication; but may also be heard when these conditions are absent, and is heard over consolidated lung tissue.

Auscultation — The "Squeaks":

This peculiar modification of the voice sound appears to be produced by the sound passing through a thin layer of fluid. In cases of bleeding or the exudation which the lung becomes collapsed, and over the unexpanded tissue bronchial breathing is heard with bronchosphygm or vibration, but just at the upper limit of the fluid when the layer is very thin, the voice sounds assume a peculiar bleating character, like the bleating of a goat, or the squeak of “Punch”. The sound disappears when the fluid increases, and may sometimes be heard again as absorption occurs.

Friction Sounds — The sensation perceptible by the hand, is audible to the ear on auscultation. Friction commences as soon as the pleural surfaces become roughened and ceases when exudation is established. The sound heard is a to-and-fro
Pleurisy, sometimes cough and crackling, at
other only of a slight crackling nature easily
confused with larger rales.

The points of difference are the following.
Pleurisy is accompanied by pain in the side when
a deep inspiration is taken
Croup in the presence of a cavity does not cause pain
and pneumonic inspiration is not likely to be mistaken.

Pleurisy then is an evidence of the presence of
friction sounds and the friction sounds are
muffled by coughing; while in the other conditions
friction sounds are always to be heard, and there
and the chest to which might be mistaken for
friction are altered by coughing.

When pleurisy is complicated by croup the rales
may hide the friction sound and it is only by
the pain that we are led to suspect pleurisy by
the rise in temperature which occurs, until the
presence of fluid is dulness on percussion renders
the diagnosis certain.

The friction sound is increased by pressing the
end of the stethoscope into an interface, and can
sometimes be heard thus when otherwise inaudible,
other sounds resembling friction and likely to be
mistaken for it are not intensified by
pressure.
Succession Shaking the Patient

Shaking sounds similar to those heard when a vessel containing fluid and air is shaken, are heard in thorax under similar conditions. So shaking is heard when air or fluid alone is present, but when the pleural cavity contains both, as in pyo-pneumothorax, or in pneumothorax with severe exudation, it is distinctly heard when the patient changes his position or shakes himself. The sound is generally audible without applying the ear to stethoscope to the thorax, but in doubtful cases this procedure should be adopted.

Shaking sounds are also heard over large cavities but not very frequently, the sounds produced by shaking differ little from those produced by violent coughing.

Diagnostic Puncture —

In cases where the existence of fluid is doubtful, or where it is uncertain whether the fluid present is fluid or gas, puncture with a fine needle enables a correct diagnosis to be made. A fine needle attached to an ordinary hypodermic syringe may
be used and the puncture made in an interspace below the level of the fluid. In the seventh space near the angle of the ribs is a very common situation. The puncture should be done with all antiseptic precautions, and if pus be suspected, it is as well to be prepared either to draw off the fluid by aspiration or to make a free opening and drain the cavity.

In pericarditis where pus is suspected, puncture with a needle or fine scissor is useful. The point of insertion of the needle lies in the fifth interspace just above the junction of the sixth rib with its cartilage. Others recommend the puncture to be made between the xiphoid cartilage and the costal margin. It may be sometimes necessary (when the diaphragm is much lowered) to puncture in the sixth space. Care is necessary not to wound the heart or the internal mammary artery.
Physical Examination of the Heart.

Inspection of the Pleurocardial Region

The position of the heart with its relations to the lungs has already been noticed in the anatomical description. The Pleurocardial Region extends roughly from the second space to the level of the sixth rib at its junction with its cartilage, and laterally from about an inch to the right of the right-ternal border to the middle line on the left side, that is about two-and-a-half inches external to the left sternal margin.

On inspection we notice the form and configuration of the Pleurocardial region; the position, extent of the apex beat; the condition of the integuments.

1. The Pleurocardial Region - The presence of the heart in the thorax is not marked in the normal condition, by any change in form, no bulging or contraction, no expansion of the interspaces - the left side is absolutely symmetrical with the right, and the only indication of the presence of the heart is the Apex beat.

Pathological Alterations - Bulging of the Pleurocardia.

This may be caused by changes in the heart or pericardio or in the lungs or other structures.

(1) The change in heart and pericardium are:

(a) Distension of the Pericardial sac by fluid in-
Pericarditis - If the amount of fluid be great the thoracic wall in front of the heart may be bulged forwards the interspaces widened and distended, and if the walls be yielding, as in young or sickly subjects, the alteration will be increased. Bulging is only seen from this cause, if the pericardial sac is greatly distended; a moderate amount of exudation will not cause any displacement.

(b) Increase in the size of the heart - The heart is increased in size by dilatation and by hypertrophy. Bulging of the pericardial regions is more apt to occur as a result of the over action of the heart in the latter, and is rarely of great extent.

(c) Forward displacement of the heart - When the heart is pushed forward by a tumour growing behind it, the pressure may be sufficient to cause the chest wall to bulge, but such an event is rare.

(2) Pericardial bulging from other causes.
(a) Pleurisy with effusion has been known to cause enlargement of the whole or a part of either side of the thorax and will involve the pericardial region, but a small localised pleuritic effusion may cause bulging of the wall in front of the heart.
(b) Indirectly tumours may cause a forward projection of the pericardial region of the thorax, but this is seldom seen.
(c) Subcutaneous abscess, oedema, or tumour.
Swelling over the precordial region of course can cause local bulges - Abscess are painful, generally redness and usually present signs by which they may be easily distinguished. Oedema may be the result of local irritation such as infection of the bone, or it may be part of general decompensation - it cause is rarely difficult to determine.

Tumours may grow from the bones, cartilages or in the fatty tissue - their connections are easily made out and of course no cardiac symptoms are present.

The matter from Emphysema may point at the precordial region and might cause some doubt as to its nature especially if pulsation can be communicated to it from the heart below. The history of the case, extended dulness on percussion, and other signs will generally clear up the nature of the case.

(d) Aneurism - Aneurism of the aorta part of the arch may cause swelling about the level of the 3rd intercostal or lower down. The swelling will pulsate and show the ordinary auscultatory phenomena of aneurism.

(e) The bulging may be congenital or the result of a Rupture or Depressor of the Precordial Region.

Contraction is not caused by any change in the heart itself.

(a) Pericarditis - After the effusion of pericarditis has subsided if there be any adhesions between the two surfaces of the pericardium, a depression may be caused.
all the points of the case and by making repeated examinations in cases of doubt or difficulty, such errors should be avoided.

4) Difficulties from other sources.

The presence of Complications, the absence of distinctive symptoms, obscure or false symptoms such as arise from Hysterie or the administration of drugs, idiocynes, or on the part of the patient, will all tend in some cases to make the diagnosis more or less difficult; but—by a painstaking physical examination and careful consideration of the symptoms present—such difficulties may generally be overcome; but cases occasionally occur which remain doubtful during the greater part of their course and some are only cleared up in the post-mortem room.
which is always most marked in young children, and if it occurs in adults, will be confined to the cartilagenous part of the chest wall.

(b) Pressure from outside - continued use of a characterless cast or some such instrument will cause depression.

(c) Pleuritic contraction.

(d) Congenital malformation.

The Position, extent and character of the Cardiac impulse - The Apex beat.

With each systolic contraction of the ventricles a slight elevation is seen in the 5th intercostal space at a distance of two to two and a half inches from the left sternal border. This pulsation is known as the 'Apex beat' though the apex of the heart very often lies behind the sixth rib; the difference however is so slight that the pulsation indicates with sufficient accuracy the position of the apex. The position of the Apex beat is most frequently in the region stated but varies slightly and may be found as low as the 6th intercostal space or as high as the 4th. In the female, the latter being most frequent in children in whom also the heart often lies further to the left, sometimes as much as a quarter to half an inch beyond the nipple line. As the heart rests on the diaphragm, it falls and rises with the contraction and relaxation of that muscles and therefore the apex beat is lower at the end of inspiration and higher at the close
of expiration. With inspiration sometimes the heart's impulse disappears entirely because the pulsating area is drawn behind a rib or because the lungs expand and cover it. When the patient lies on his back it is not uncommon to find no pulsation, but if we place him on his left side or incline him on his face then the pulse can generally be seen.

Cause of the apical beat - The pulsation at the apex is due to a combination of circumstances and to one cause only. That the beat occurs at the apex and not over the whole heart is due to the fact that the apex of the heart lies close to the thoracic paries and that part of its area occupies the position beneath a yielding intershace. If the heart be exposed during life, the whole surface moves as the contraction occurs, but the base of the heart lies deeply in the chest and the greater part of the surface is covered by the lungs. At each systole the muscular walls of ventricles become thickening and the yielding tissue at the apex is pushed forwards, at the same time as the blood is propelled through the arch of the Aorta, that vessel tends to straighten itself and tattles and partly turns the apex against the chest wall. Both of these facts enter into the production of the pulsation at the apex. The thickening of the walls will account for the diffuse heaving which is seen in some cases of hypertension.
Alteration of the Position of the Apex beat

The position is altered by changes in the situation of the whole heart, the result of alterations in the surrounding tissues, or to changes in the shape of the heart, the result of alterations in the cardiac walls or cavities.

1st. Change in position of the apex beat—From causes outside the heart.

- External or downward displacement depends greatly on the position of the diaphragm.
- The diaphragm is raised and carries the heart with it by enlargements in the abdominal cavity, tumors, ascites, enlargements of the liver, spleen etc., or it may rise as the thoracic wall contracts in case of proper expansion of the lung after pleurisy, empyema, etc.

- The heart itself may be raised when contraction occurs in the lung above it, as in the apices in pleurisy.

Displacement of the apex beat downwards occurs when the diaphragm is thrust down by the accumulation of fluid in the left pleural sac, the heart at the same time being pushed to the right, or the apex beat may be lowered by the diaphragm falling, in consequence of collapse of the abdominal viscera; the growth of a solid tumor above the heart will also displace the organ downwards.

The Diaphragm and heart with it, is displaced downwards by subphrenic tumors.
Case of right-sided heart.

The chest was much deformed, limbs thin and joints enlarged.

A = Heart dulness

B = Liver dulness
By contraction of tissue which will pull it to the affected side or by swelling which will push it to the opposite side, by effusion into the right pleura or by solid growth on the same side the heart will be pushed to the left and the apex beat will be observed to the left of its usual position. Fluid in the left pleura or solid growth will cause similar displacement to the right side.

By contraction of the lung on one side, such as occurs in emphysema or after the absorption of pleuritic effusion, when the lung remains unexpanded and adhesions have formed with the pericardium, the heart is drawn to the affected side, while the expansion of the lung on the opposite side will push it into the same direction.

Congenital Malformation. The whole of the organs may be displaced, the heart lying to the right side the lungs to the left—such a case is related by Dr. Bramwell in his work on the heart. Recently, I saw a case of right-sided heart, a boy aged eight, who had been cyanotic from birth, in whom the heart lay on the right side above the liver. The lungs were fairly healthy and apparently the position of the heart was congenital. (Fig. 34)

Backward or forward displacements are rare. A tumor in front of the heart or a column of emphysema lung will cause it to push, while the latter will be caused by a tumor growing behind the heart, or contraction of the lungs from in front of it.
Displacement of the apex beat - drop changes in the heart itself.

Alterations in the apex beat do not cause any change in the position of the apex beat.

Hypertrophy or dilatation of the left ventricle will cause the pulsation to be seen more to the left and lower down than the normal position. In cases of very great hypertrophy the apex beat may be visible as low as the seventh or even eighth intercostal space and considerably to the left of the middle line.

Enlargements of the right ventricle will also move the apex beat to the left, but never to the same extent as it is with enlargement of the left side, and at the same time pulsation will be visible further to the right of the normal position, and not consequently it is visible in the epigastrium.

Extent of the Cardiac Pulsation

The normal extent of the pulsation does not generally occupy more than one square inch, or an area measuring one inch in the horizontal chiefly the width of the interface in which it occurs in the vertical direction. The extent of the pulsation may
be attended by changes in the heart itself, by changes in its relation to the chest-wall, or by changes in the surrounding parts.

Hypertrophy of the right or left-ventricle will cause an increase in the extent of the impulse, which as a rule is proportionate to the amount of enlargement present. The pulsation may be distinctly visible in two or three spaces, while in extreme degrees of hypertrophy of the left ventricle, the whole of the precordial region may move. The impulse also extends to the left beyond the mammary line, in hypertrophy of the left ventricle, but most markedly in enlargement of the left side, and may appear in the epigastric region when the right cavity is hypertrophied or dilated.

When the heart lies further forwards or is so placed that none of its surface is in contact with the chest-wall, the extent of the visible impulse is apt to be increased without any change in the heart, and is generally due to one of the displacements before mentioned.

Change in the surrounding parts may increase or decrease the extent of the pulsation. Thus the columnar process of emphysema may diminish or abolish altogether the visible impulse, and the
In pericarditis with effusion a diffused fullness is frequently seen over the heart and the intestines are bulged out of the thoracic wall prominent over the heart. After the fluid is absorbed, if adhesions have formed between the two layers of the pericardium, the cardiac systole may be indicated by a contraction of the interface instead of a protusoin.

Character and force of the Apex-beat:

The strength of the cardiac pulsation cannot be fully estimated by inspection and its force is better observed by palpation. It varies even in perfect health between weakness and great strength. Changes in the strength of the heart's beat may be apparent or real, the former as a rule being due to change external to the heart, while the latter are caused by change in the cardiac economy.

Quality of the Apex-beat - Apparent weakness of the impulse is due to similar causes to those on which the visibility of the apex beat is dependent. These are: thickening the chest wall, backward displacement of the heart, overriding
Real weakness arises from weakening of the cardiac muscle as in fatty degeneration, dilatation, hypocarditis, general debility such as occurs in wasting disease, dyspepsia, or after great loss of blood. In all these cases the heart impulsi is weakened, because the muscular fibres either from change in themselves or in their nerves fail to contract properly, and the impulsi or the heart wall is weakened.

The heart’s impulse is also weakened in pericarditis when effusion in any great amount is present, and after fluid has disappeared, if adhesions have formed between the pericardial surfaces, the heart’s action is hampered and the visible impulse lessened in size.

Incessed force of the Apical beat.

Apparent increase is caused by those conditions which favour the conduction of the cardiac impulse. When the interstice is wide or the tissues thin, or where the heart is healthy, the heart will be apparently strong. Also when the lungs are stretched so that the heart is more exposed, or the heart lies nearer the chest wall the apparent strength of the impulsi is increased.

Real increase in the strength of the heart’s beat is due to all changes which strengthen the heart’s action. Thus from over action, after severe bodily exertion, mental excitement, functional disturbances of all of which causes
Even permanent increase of strength is caused by hypertrophy of either side of the heart or of the whole heart. The greatest increase however is caused by hypertrophy of the left ventricle, when not only the force of the apex beat is greatly increased, but the whole precordial area seems to be thrown up at each contraction.

Regularity or Rhythm of the Heart

The regularity of the heart's contractions can be made out by inspection or palpation but are much more continuously estimated by the examination of the pulse. In intermittency of the pulse it is frequently necessary to compare the actual beats of the heart, as sometimes the pulse may intermit owing to the cardiac artery not reaching the artery in the wrist, while the heart is acting regularly, but owing either to a weak contraction or to an insufficient amount of blood being propelled from a poorly filled ventricle, the impulse has not reached the wrist.

Rate of the Cardiac Contractions. This also is always observed by examining the pulse but the slow systematic beats of hypertrophy, or the quick sharp beats of the excited or irritable heart are generally noticed on inspection.

The Precordial Integument

Sears over the precordia are suggestive of ecuphy for a previous pericarditis or endocarditis.
physical examination of the chest is occasionally due to interference with the circulation, but is also caused by respiratory affection, and may be present in conditions of perfect health.

Swelling, redness, or in the pleural cavity region are generally due to affection of the chest wall, that may proceed from irritation, going on beneath, such as the growth of a malignant tumour, the skin may be then seething, over an eminence, and when present—indicates a great amount of tension.

Palpations other than of the Heart—seen on Inspection

Palpation of the Aorta in the thorax is never visible in health, but when dilatation occurs a slight movement of the chest wall may be seen by looking from the side along the surface of the chest—in a good light. The large hollow of some muscular cases are easily detected.

The Palpation of the carotids can be seen in the neck and sometimes may call the attention of the physician to the heart by the character of their movement when quantitation are present.

Ephigastric Palpation

This may be due to dilatation of the Right Ventricle, or to downward displacement of the heart. When the heart is displaced to the right, as by the presence of fluid in the left pleura, the organ first lies almost vertically and the apex beat will be felt in the epigastrium. As the fluid increases the apex is pushed round to the right and at last

Fig. 1

Dorsal region of the spine

(Quain)
The pulsation is seen to right of the sternum and at a higher level than the position of the apex on the left side.

The pulsation of the abdominal aorta may be visible in the epigastrium, being communicated to the surface through an enlargement of the liver, or a solid growth lying over the vessel.

An abdominal aortic aneurysm sometimes pulsates in the epigastrium, and the true pulsation which occasionally occurs in the liver is seen there, but all these causes of pulsation cannot be differentiated without the aid of palpation.

Palpation of the veins at the root of the neck

This may be apparent or real.

Apparent pulsation occurs when the jugular veins are abnormally distended, by obstruction to the flow of blood which may be due to seminal pressure, to lung affection or to cardiac disease; the veins are emptied during inspiration, the pressure within the thorax being negative, and become distended where the intrathoracic pressure is positive in expiration.

A similar wave is seen in some forms of pericarditis.
but the actual distension of the vein takes place during inspiration, and the vein is sucked during expiration. An apparent pulsation is also sometimes communicated to the veins when distended from the cardiac arteries.

True pulsation of the veins occurs when the tricuspid valve is incompetent. At each contraction of the right ventricle a stream of blood is thrown backwards into the veins through the openings in the annulus, the unicuspid valves of which have become incompetent also.

**Palpation of the Precordial Region.**

The points which have been observed during inspection are investigated and confirmed by palpation. The position and extent of any bulges or irregularities of the surface are made out more accurately, and the position, strength and extent of the apex beat and any other pulsations present can be more definitely determined. In addition, any tenderness on pressure is discovered, and the question whether pain is due to intrathoracic or superficial causes can often be settled.

The abnormal sensations felt on palpation are
Cardiac or valvular thrills and friction rales.

Thrills - In the normal heart, the blood in passing through the valvular orifices and cardiac chambers causes no vibration perceptible to touch, over the chest wall, but when the valvular orifices become contracted or the cusps thickened by disease, a distinct tremor is felt when the blood passes through the affected orifice. The sensation communicated to the hand resembles that produced by the pressure of a cat - it is soft and fine and differs greatly from the rough vibration of friction.

Thrills may be produced at any of the valves and by either a direct- or regurgitant-current, but are generally produced by the direct-stream passing through a contracted opening. The most common causes of cardiac thrill are Mitral stenosis, Aortic stenosis, and only very rarely is a thrill caused by disease of the Tricuspid or Pulmonary valves.

A thrill synchronous with the ventricular systole is most commonly caused by Aortic stenoses and is felt best at the base of the heart and over the
Stemum; a mitral systolic thrill is not common but when it does occur is felt best over the apex. A pulmonic thrill would be felt over the position of the valve, that is at the 3 1/2 left costal cartilage close to sternum - it is rarely felt.

A thrill caused by transient vasodilatation is felt along the sternum, and is accompanied by pulsation of the jugular veins. A thrill at this valve is not often felt.

Presystolic thrill. This is the most common thrill felt over the precordium. It is caused by constriction of confluency of the edges of the mitral valve. It is felt with greatest intensity over the junction of the apex, but is generally communicated to a considerable area of the chest wall.

The thrill may be felt during the whole time that blood is passing through the mitral orifice, but is most frequently felt and always with greatest intensity during the auricular systole, which occurs just before the ventricular systole, and therefore the thrill is called presystolic. Stenosis of the mitral valve might possibly cause a presystolic thrill, but the condition is so rare that a
A diastolic thrill may arise in aortic or pulmonic disorders but is rarely felt. Friction may also occur over the precordium. Friction may also occur over the precordial region, and may be due to pericarditis or to pleurisy. Pericardial friction is caused by the rubbing together of the free surfaces of the pericardium. It commences early in the course of the disease but is not felt at its commencement. Friction may continue during the whole course of the case, if the exudation be very limited in amount, but as a rule it follows the course of pleuritic friction, disappearing with the presence of exudation and returning when absorption of the fluid takes place.

Pericardial friction is generally soft and not easily confused with a cardiac thrill, but sometimes the vibration is quite soft and the two vibrations are very much alike. Friction is a to-and-fro vibration and occurs twice in the cardiac cycle, a thrill is felt only once during the cycle.
Friction may be felt over the whole precordium and is frequently most intense at the base, while a thrill is generally confined to a small area, and in the pericarditic thrill, where it is felt over a large area, the point of maximum intensity is at the apex.

To distinguish pericardial friction from pleural friction, it is only necessary to ask the patient to stop breathing. Pleural friction ceases, pericardial friction goes on.

Epi gastric pulsation. The cause of pulsation in the epigastrium have already been noticed on inspection. By palpation it is possible to localize the pulsation more exactly, especially if the patient be raised upward, beneath the ribs. The impulse of the pulsation is felt to come from above in those cases where it proceeds from the heart, when the pulsation arises from causes within the abdomen (e.g., pulsation of the stomach), the impulse is a little later than the ventricular systole, and is directed upward or forwards, rather than downward. Pulsation in the liver can generally be felt diffusely over the whole organ which is enlarged, and there are always other signs pointing to the valvular lesion in the heart, which is the cause of the pulsation, e.g., thrombus or congestion.
Percussion of the Pleural or region.

The points to be made out in percussion are the size, shape and position of the heart; the extent to which the heart is covered by the lungs; the presence or absence of fluid or air in the pericardium; the presence of tumours.

**Normal Cardiac Dullness.**

The relations of the heart to the surrounding organs have been already described, and its position with regard to the chest wall must be briefly criticised. The base of the heart lies chiefly in the chest, covered by the lungs, while the apex and a small margin of the left ventricle, and about two-thirds of the right ventricle are in contact with the chest wall or only slightly covered by lung.

The margin of the left ventricle corresponds to a line drawn obliquely upwards from the apex in the 5th intercostal space, behind the 6th rib, to the 2nd left intercostal, where it joins the left auricle, which continues the border of the heart to the middle of the sternum at the level of a line joining the lower margins of the 2nd rib and the sternal attachment.
Beginning from the apex the right border of the heart runs to the right and slightly upward to the 5th right costal cartilage, which is the lower margin of the right ventricle, from this point the right auricle continues the cardiac border, curving upward and inward to the sternum, where it joins the margin of the left auricle.

With slight differences caused by the physical condition this line corresponds to the limit of cardiac dullness observed on percussion.

In percussion the outline of the heart, several difficulties are met with—1st that the greater part of the area is occupied by lung substance, and therefore the note made out differs according to the strength of the percussion, a resonant note being heard on light percussion and a modified or muffled note in deep percussion. 2nd that over the sternum a more or less resonant note is always heard. 3rd the lower margin of the heart is in contact with the liver and it is impossible to distinguish any difference between the percussion note of the heart and of the liver. The upper and left border can be marked out with a pair of compasses by percussion from the resonant outline of the lung at some distance from the heart and gradually
Diagram showing the superficial and absolute cardiac dulness with reference to the chest wall and the hepatic dulness. Darker shading represents the area of absolute dulness.
approaching the supposed limit, when the note will become imprints. Percussion must be deep, that is, made with sufficient force to allow of the dulness, caused by the head-banging below the lungs, to be heard. The right limit of the lung cannot be made out with such precision, but corresponds to a curved line whose greatest convexity lies about three quarters of an inch to the right of the sternum.

The lower limit corresponds to a line drawn from the apex (the lowest limit of pulsation) to the limit of liver dulness on the right side, the line of course varying with the size and fullness of the diaphragm during respiration. The limit of the heart, made out by percussion, is smaller generally, than the actual size of the heart, the line being often about a quarter of an inch within the actual border.

The upper border of the heart is continuous with the great blood vessels and therefore it is extremely difficult to make out the exact outline with correctness.

35) Area of absolute dulness - superficial cardiac dulness

This corresponds with the area of the heart that covered by the lungs. It can be defined with great exactness, but here the percussion must be light, or
The resonance of the thin layer of air-containing tissue will be lost. The size of the area of dullness is altered during respiration being diminished when the lungs are expanded, and increased when they contract with expiration.

The lower border is the lower margin of the heart, and cannot be determined by percussion.

The right margin of the dull area is represented by the left side of the sternum, though the right lung does not extend beyond the middle of that bone, but owing to the resonance of the percussion note over the sternum, the dullness cannot be made out. The upper and left limit of the area of absolute dullness begins at the sternal articulate of the 5th left costal cartilage, and extends outward and then obliquely downwards, to the lower margin of the heart—just inside the apex beat.

Alterations in the Cardiac Dullness

Slight deviation from the normal outline of dullness are of constant occurrence, and it is not always possible to come to any definite conclusion as to the significance of any variety of these.
Anatomical description of the Thorax

The Thorax consists of a bony and cartilaginous framework, clothed by muscles, fasciae, and skin, which form a closed chamber containing the heart and thoracic portions of the great vessels, the lungs and their conducting air tubes, glands, nerves and lymphatic vessels, and affording passage for the oesophagus, some nerves, & vessels.

The supporting framework of the thorax is made up of the 12 dorsal vertebrae articulated & bound together by ligaments which allow of a limited range of movement in antero-posterior, lateral, and rotatory directions. The vertebral column in the erect position is slightly curved, and in the dorsal or thoracic portion is concave forwards.

Fig. 1 is a lateral view of the spine and shows the normal curve and the facets for articulation of the ribs. The 12 pairs of ribs articulate with the bodies of the vertebrae by the facet of their heads, and with the transverse processes by a small facet on the tubercle of each rib. The ribs are firmly secured to the vertebral column by ligaments. The movement at the centro-capitular articulation is of a rotatory character, while that of the tubercle is altogether sliding, from which it will be seen that the only movements possible are an upward or downward movement of the external extremities of the ribs & rotation of the ribs on themselves.
The area of percussive dulness may be increased or diminished or altered in shape either by alteration in the heart, pericardium, or surrounding tissues.

**Increase in the Area of Cardiac Dulness.**
This is caused by increase in the size of the heart which may be general or local.

General enlargement depends on hypertrophy or dilatation of all the cardiac walls and affects all the cavities. Local enlargement results from hypertrophy or dilatation of the walls of one or more of cardiac chambers. Enlargement may also be due to the deposit of fat on the outer surface of the heart.

Fluid in the Pericardium (Pericarditis with effusion, serum or purulent, hydropericardium, or haemorrhage into the pericardium) will also cause an increase in the dull area.

Dullness from these causes may be obliterated or obscured by changes in the surrounding parts. Thus emphysema, lungs, pneumothorax, air in the pericardium, will interfere with or render impossible the discovery of the increased dullness.

The pericardial dulness, as distinguished from the
Cardiac dulness may be increased by the following conditions outside the heart:

1. Consolidation of the lung bordering on the heart, pneumonia, caseous degeneration, pulmonary abscess,
2. Pleurisy with effusion, empyema,
3. Solid growth in presence in the lungs or mediastinum,
4. Enlargement of the liver,
5. The area of superficial dulness may be increased by the heart remaining normal in size.

This is due to attraction of the lungs as in cirrhosis, contraction of cicatrix in fibrosis, non-expansion of lungs after pleurisy &c., or to displacement forward of the heart itself.

Hypertrophy of the Heart:

Definition: By hypertrophy is meant increase in the muscular elements of the heart either in size or number.

Causes: The cardiac muscle corresponds in its state of nutrition with the condition of the rest of the body; when the tissues are healthy and well nourished, the cardiac muscle (cardiac being present) is firm and healthy, but when the system becomes reduced and the body ill-nourished, the heart becomes weaker and flabby. The size of the heart is increased by bodily exertion and in those whose voluntary muscles are hypertrophied by training the whole heart is increased in size. Hypertrophy is not
a disease, but is the result of a healthy endeavour of the heart to overcome obstruction in the circulation.

All the cavities may be enlarged and their walls hypertrophied, or one or more cavities only may be affected, the relative severity of the hypertrophy of the various cavities being in the following order - (1) left ventricle, 2nd the right ventricle, 3rd the left auricle, and lastly the right auricle.

Hypertrophy is brought about when the cardiac muscle is in a healthy condition, by overwork, or increased stimuli to the heart. Overwork is due to obstruction in any part of the circulatory system, the part of the heart affected being that which lies immediately behind the obstruction. An increased stimulus may be given to the heart by nervous influence or by increasing the flow of blood into any of the cavities.

The chief causes of Hypertrophy are

1st. Changes in the heart
   (a) Valvular obstruction causing increased work
   (b) Valvular incompetence (regurgitation)
   (c) Adhesion of the pericardium

2nd. Changes in the systemic circulation - obstruction to the flow of blood from any cause (killing diseases), increase in the size of any organ (stress in pregnancy), mobilisation of blood.

3rd. Changes in the pulmonary circulation obstructing flow of blood through the lungs (e.g. Pulmonary embolism - contains

4th. Nervous changes - continued overaction, palpitation of the thoracic girdle.
Hypertrophy of the Left Ventricle

The hypertrophy may be simple, that is the muscular tissue is increased, and the walls thickened, while the size of the cavity remains normal, or it may be eccentric, the ventricle being dilated and the walls increased in thickness. The so-called "concentric hypertrophy," where the cavity is decreased in size with greatly hypertrophied walls, is probably due to the heart having stopped during systole and is such a post-mortem change.

Causes - (a) Aortic Stenosis - The blood is prevented from fully leaving the cavity, and remains pressed into the ventricle. The hypertrophy is generally simple with no dilatation.

(b) Aortic Insufficiency - The ventricle is distended and stimulated by the increase in the flow of blood into the cavity, blood being received from the ventricles, origin and backwards from the aorta. The heart is dilated and often enormously hypertrophied, and have been found post-mortem to weigh as much as 1.6 lb.

(c) Mitral Insufficiency - The hypertrophy is eccentric. Increased force is required to carry on the circulation, and owing to the insufficient supply of blood for the action of the heart, dilatation occurs, and an increased nervous impulse is given to the heart, either on account of the comparatively anaemic state of the central area centers or to the condition of the dilat ed organs in the heart.
(d) Pericardial adhesions. The heart is hampered in its movements and increased energy required and thus hypotrophy occurs.

The causes external to the heart, namely affections in the systemic circulation must be simply named.

(a) Bright disease all varieties except the waxy form.
(b) Arteriosclerosis degeneration of the arteries.
(c) Constitution of large vessels.
(d) Pregnancy.
(e) Chlorosis.

(Fig. 35) Percussion dulness in Hypotrophy of the Left Ventricle.

The area of dulness is increased towards the left and the transverse measurement of the hearth is larger than the normal. The greater part of the left border of the hearth lies to the left of the middle line and the outline is more pointed at the apex than in health. The lower margin, as estimated by the position of the apex, is also lower, the extent varying with the amount of hypotrophy present. As the lung is pushed aside by the increase in the size of the heart, it follows that both the superficial and deep areas of percussion are increased. Fig. 36 (See Plate XI)

Hypotrophy of the Right Ventricle.

This is rarely simple, but nearly always associated with some degree of dilatation.

Causes (1) On the Right Side of the Heart.

(a) Pulmonary Atherosclerosis. This is seen as an adult.
Hyper trophy of right ventricle - (after von Dusch)

The dotted line shows alteration in the cardiac outline.

[reproduced from Bramwell, Diseases of Heart]

Fig. 37
Modification of pulmonary pressure due to increased resistance in the pulmonary circuit, is not always associated with
patency of the pulmonic valve, so that in this condition the
amount of hypertrophy is small owing to the escape of
blood through the patent orifice of the pulmonic.

Pulmonary incompetence. Theoretically this may be
united as a cause of hypertrophy, but the lesion is
extremely rare.

6. Endotheliosis -This occurs most frequently
as a result of dilatation due to cardiac failure and is
therefore in such cases associated with hypertrophy -should
the condition occur as the result of primary valvular
disease, hypertrophy would occur just as it does in
the left ventricle the result of primary mitral disease.

(a) Pericardial adhesions will cause hypertrophy of the
right ventricle, for the same reasons as it does hypertrophy
of the left ventricle.

(b) Change on the left side of the heart.

Lesion of the mitral valve by causing some increase
in the pressure on the right ventricle, backwards through
the lungs, will cause hypertrophy.

(3) Change in the lungs.

(a) Cirrhosis - emphysema - chronic bronchitis etc. and
all conditions in which the circulation through the lung is
obstructed will lead to produce hypertrophy of the right-
ventricle by forcing more work on the walls of that
cavity.

(b) Compression of the pulmonary artery by a tumor will produce
the same result as stenosis of the pulmonic orifice.
Hyper trophy of left ventricle showing altered position of apex.  
(after von Dusch)

The dotted line represents the hypertrophied left ventricle.

[adapted from Bremwell on the Heart]
Percussion dulness in Hypertrophy of the Right Ventricle

The dulness is increased in the transverse diameter and slightly also in the vertical. The outline on the left side remains in its normal position, but on the right it extends some distance to the right of the sternum, and from the pulsation in the epigastrium, the lower margin is lower than in health, especially towards its right extremity. Fig. 38.

Hypertrophy often occurs on both sides so that it is not always possible to make a precise diagnosis as to the amount of enlargement present on either side.

Hypertrophy of the Left Atrium

Causes General Atrophia or Anergytation

The hypertrophy is never very great and is best seen in cases of atrophia and only slightly in those of Anergytation.

On percussion an change is found in the outline of the heart, owing to the slight increase in size that takes place, the position of the atrium behind, and its approach to the great vessels.

Hypertrophy of the Right Atrium

This condition is rare and when it does occur cannot be discovered by percussion. It is caused by tricuspid stenosis, a comparatively rare lesion.
Dilatation of the Heart

In dilatation of any of the cavities of the heart to occur, either the blood pressure within the chamber must be abnormally increased, or the resisting part of the wall must be diminished.

With healthy muscular tissue it is impossible for dilatation to occur alone, some amount of hypertrophy is always present. When however the muscular fibres are weakened by disease, or replaced by fatty tissue, or even have been taken unawares, so to speak, by suddenly increased pressure, dilatation occurs without hypertrophy.

1. The pressure in the heart is increased by all those causes which have been noticed as leading to hypertrophy. For dilatation to occur without, or in excess of hypertrophy, the increase of pressure must occur suddenly. Strain, such as is often produced by over exertion will if kept up for any length of time cause the dilatation of the cavity or cavities are which the pressure is thrown.

A slowly increasing pressure on the other hand, will be compensated for by hypertrophy, if the muscular...
tissue is healthy; if, however, the fibers are
degenerated—a slight increase of pressure
even when occurring slowly will cause dilatation.

When the blood pressure is increased throughout
the heart—naturally, the cavity with the thinner
walls gives way, the auricles are dilated sooner
than the ventricles, the cavities on the right side
of the heart before those on the left.

The condition of the wall of the heart, whether
contracted or in diastole, when the increase of
the pressure occurs, is important. Dilatation of
the left ventricle occurs more rapidly in aortic
regurgitation than in aortic stenosis, because in
the former case the overdistention of the heart,
by the double stream from the aorta a through
the mitral valve occurs during the diastole; while
in aortic stenosis, the pressure is increased only
during the systole.

2. Diminished power of resistance.

This is produced by all causes tending to weaken the
muscular fibers of the heart. Thus in simple debility
the heart is weakened, and a slight increase of blood
pressure might cause it to become dilated. Inflammatory
Fig 38. Area of dulness from a case of pericarditis, with effusion and great thickening of pericardium.
Front view of the Thorax showing Sternum, Costal Cartilages, Ribs, and Dorsal Vertebrae. 

from Quain's Anatomy Vol. I P. 24
Changes, myocarditis or endocarditis; degenerative changes, such as fatty degeneration, will all diminish the assisting power of the heart, and even under the normal pressure dilatation may occur, and if the blood pressure has raised dilatation will be more rapid, and in extreme cases rupture of the heart-might occur.

The results of percussion are similar to those produced by auscultation, and by percussion alone, it is impossible to say whether the heart is dilated or hypertrophied, the diagnosis depending on a careful consideration of the symptoms, the other physical signs, strength of cardiac impulses, nutrition of patient.

The dulness caused by Pericarditis with Effusion.

In the early stages of Pericarditis, before the effusion of any fluid into the sac, the cardiac dulness is unaltered, and it is possible for a considerable amount of fluid to be present, without any increase in the area of dulness, especially when the patient lies on his back. When the pericardium is distended with fluid, the outline of dulness on percussion assumes a pyramidal or Yer-Ledshaped form, the blunt apex of the ray, directed upwards, and formed by the portion of pericardium distended over the great vessels, while the base rests on the diaphragm. Fig. 38.
The dull area is expanded both to the right and left of the normal limits, and the pear-shaped form of the dulness is very characteristic. The lungs, even in these cases where they are emphysematous, are pushed aside by the increasing fluid, and the area of absolute dulness is largely increased. In cases where the fluid is not of large amount, the dull area is not so distinctive, and may be confused with a dullness caused by hyperpneic dilatation.

Pain, friction, a diffused cardiac emphysema, rapid pulsation, a dulness extending beyond the apex border, will generally characterize the dulness arising from pericarditis.

Hydro-pericardium, that is, serous effusion into the pericardium, will also cause increased precordial dulness. This effusion is simply part of a general droopy and is accompanied by other effusions in the other serous cavities. Pain is absent; there is no friction and the sign of valvular disease (friction) or Bright's disease are present.

Dulness from other causes (consolidation of lung, pleurisy, solid tumors etc.) is rarely confined to the precordial region, and is accompanied by symptoms and other physical signs, which serve to distinguish them, and the symptoms
and physical signs of cardiac disease are about.

Diminution of the Cardiac Dullness

This may be due to decrease of the heart itself or to conditions in the surrounding tissue obscuring the Cardiac dulness.

1. Atrophy of the heart does not as a rule depend on disease of the heart, but occurs in the course of wasting disease, cancer, phthisis, struma, etc. It may however occur from degenerative change, the result of local disease, such as fibrous degeneration, fatty degeneration, or obstruction, in the coronary arteries. The dulness is diminished in both the vertical and transverse diameters, and if the lungs are voluminous or emphysematous, the dulness may be absent altogether.

2. Gas in the Pericardium - Pneumopericardium.

Air or gas may enter the pericardium from the outside by wounds or by pericarditis, or from some of the air-containing organs, most frequently through a fistulous opening from the lungs. At first the air or gas is present alone, but, as in the case of Pneumothorax, gas is formed as a condition of lungo pneumopericardium takes place. On percussion the note over the air-containing area is tympanitic, and if this be present...
Dullness is heard over the lowest part. If the patient lie on his back, the whole of the pericardium may be tympanitic, but if he lies on one side or sits up, the fluid gravitates to the lowest part and dullness is heard.

Changes in the surrounding air-containing organs may cause diminution of the area of dullness. In pneumothorax, the superficial dullness may be almost or entirely abolished, and the deep dullness with difficulty made out. Pneumomediastinum, distention of the stomach or intestine, will occasionally lessen the cardiac dullness, but these conditions rarely cause any difficulty in the diagnosis.

Auscultation of the Heart

This is the most important method of examining, as by it alone can we determine the condition of the action of the heart, upon the efficiency of which the working of the heart as a muscular pump depends.

During every cycle of cardiac contraction, certain
sounds are produced, having a definite relation to the events which occur at the time of their production; these sounds depend for their production and purity chiefly on the condition of the valves, and when these are not competent, or alterations occur, interfering with their perfect closure, or with the lumen of their orifice, certain definite alterations occur in the cardiac sounds.

The Normal Heart Sounds

The cardiac sounds, their relation to the contraction of the heart, and the cause of their production have been already described in speaking of the structure of the heart.

During each cardiac cycle the following sequence of events occur - the ventricles contract, causing by the vibration of the muscular fibers and by the tension of the segments of the atrioventricular valves, the long first cardiac sound, made up in reality of what may be called the initial first sound and the Tricuspid first sound. This follows a short pause, during which the intra-ventricular and arterial blood pressure is balanced, and this is succeeded by the simultaneous closure of the Aortic and Pulmonary valves, causing the Aortic and Pulmonary second sound which are fused into one, namely the second cardiac sound. The long pause now occurs, during which
Position of the valves of the heart

P = Pulmonary Valve
A = Aortic "
M = Mitral "
T = Tricuspid "
The first pair of ribs is flattened superiorly and inferiorly and the ribs are bent twisted on themselves like the majority of the other ribs. It is so placed that posterior surface looks upwards and forwards, and together with the first dorsal vertebra and the manubrium forms the upper boundary of the thorax. The other ribs increase in length to the seventh and are laterally flattened and at the same time take a more downward direction, always presenting their flattened surfaces externally as internally, allowing which they are twisted on themselves. Below the seventh, the ribs become shorter, the 11th and 12th being quite short and bared floating ribs because they are without cartilages. The anterior extremities of the ribs are firmly united to the costal cartilages, which are practically the continuations of the ribs and pass forwards, upwards, and in the case of the lower ribs upwards to articulate with the fascia on the margins of the sternum or in the 8th, 9th, and 10th pairs with the inferior surface of the cartilage above them. The sternum, situated in the middle line anteriorly, completes the thoracic framework. It presents flattened surfaces anteriorly and posteriorly and is slightly convex forwards. As a whole the thorax is somewhat conical in shape, the walls being convex on their outer surface and the vertical column projects on the interior surface of the posterior wall.
the ventricular diastole and auricular systole takes place. The time occupied, supposing the whole cycle to be represented by 10—the first sound occupies 3/10, the short pause 1/10, the second sound 2/10 and the long pause 3/10;—this is in absolute sound is a good practical division. The first sound is thus seen to be twice as long as the second; it is low in pitch and muffled and distant in character. The second sound is sharp and slightly lower in pitch, and appears to be produced nearer the ear than the first sound. The actual sounds heard are often likened to the pronunciation of the syllables Luft—Drup which is not an exact comparison.

Position of the valves with relation to the chest wall and the points of maximum intensity of the sounds. Fig. 35

The valves are placed close together and even overlap one another so that a stethoscope placed over a certain point of the precordial area will cover a portion of three of them and probably touch the margin of the tricuspid as well. The Pulmonary valve lies close to the sternum behind the 3rd costal cartilage, part of the orifice being behind the sternum. The Aortic valve is a little lower and nearer the middle line than the Pulmonary.

The Tricuspid Valve lies below the aortic, at the level of the upper edge of the fourth costal cartilage. A large portion of the orifice is behind the sternum. The Tricuspid Valve lies in a plane which slants across
the sternum from the 5th left interspace to the costo-

diaphragmatic articulation of 6th rib (cartilaginous part).

If the stethoscope is placed over the position of the

carinal area, all the sounds can be heard, but it is

impossible to differentiate one from the other.

The points where each of the carinal sounds can be

heard with greatest intensity are the following:

1. Initial sounds are best heard at the apex.

2. Tricuspid sounds at the lower end of the sternum

or over the lower cartilages to right or left of sternal

3. Aortic sounds at the second right costal cartilage.

4. Pulmonary sounds at the third left costal cartilage.

Resumen del c. P. 139.

In ascertainment of the heart-sound, it is important
to ascertain at what point in the cardiac cycle the
sound occurs. This is done by timing the sound, so
to speak, by the beats of the heart. If the apex beat
be felt, this should be used as if not the exact
place, as by this we know it can the precise moment
of the ventricular contraction.

Alterations in the Cardiac Sounds

"The sound of the heart" naturally present so much
"diversity of character, and pass from the domain of
"surgical health to that of disease by stages so insensible,
"that it is frequently only by calling to our aid such
"other signs as are furnished by an exhaustive examination.
of the organs of circulation, that it can be determined
whither or not their changes in the sounds are really
due to anatomical lesion of the heart itself. Their
alterations affect the intensity, the quality, and the
timbre of the sounds. Duplication, or division of the
sounds, comes under the same category (Jatnmann [16, P.29])

Increased Intensity of the Cardiac Sounds

The strength of sound may be apparently or actually
increased, the alteration depending on the conduction of
the sound, and the amount of sound produced.
The conduction of the heart sounds is dependent on the
same conditions with regard to the chest-wall and
intervening structures, as are the Bronchial sounds
already described.

Apparent increase in the intensity takes place without
any change in the mechanism of the heart; it is
Caused by (1) their chest-wall, with its development of
muscle and its deposit of fat
(2) Consolidation of the layer of lung over the
heart—e.g., in Pneumonia, or withdrawal of the underlying
lung as in emphysema
3. Amplification and widening of the air
containing cavity such as occurs in evacuation of the lung
in Pneumothorax and Pneumo-pericardium
The intensity is actually increased when the valves (which must be competent and healthy) are more forcibly closed, which occurs when the heart contracts with increased force or when some obstruction exists to the onward flow of blood.

The sounds are increased in intensity during health when the heart contracts more forcibly after exertion, in palpitation, and in exanthematic fever, as well as in some febrile conditions. The intensity of the sounds is increased without any organic changes in the heart.

In these conditions, all the sounds produced in the heart are louder than normal.

Increase in the intensity, the result of changes in the heart or in the circulation, systemic or pulmonary, is generally confined to one sound or the other sounds proceeding from one side of the heart.

The second sounds are more frequently accentuated than the first sound.

The aortic second sound is intensified, whenever the pressure in the aorta is increased, as long as the valve remains competent and the sound is not replaced by a murmur. This occurs when there is obstruction to the flow of blood through the vessels, as in atheroma, in coarctation of the aorta, or neo-motor contraction of the vessels even when temporary. Also in hypertrophy.
when there is a large amount of blood thrown into the aorta. This most often occurs when the hypertrophy is due to changes in the circulation or to the lesser degree of contraction of the aortic valve. In bilateral congestion, especially when of great extent, or in extreme degree of aortic stenosis, the conditions necessary for accentuation of the sound do not exist. In order to determine whether the aortic second sound is intensified or not, the sound should be compared with that heard at the pulmonic valve, remembering of course the possibility that both sounds may be intensified at the same time.

The pulmonic second sound is intensified under similar circumstances as the aortic sound, that is, whenever the blood pressure in the pulmonic artery is increased. This occurs in those diseases of the lungs, when the passage of blood through the pulmonic artery is obstructed by change in the lungs, then in cirrhosis, in chronic inflammation, in chronic bronchitis; this is seen, but the most important cause is obstruction or regurgitation of the pulmonic valve; the blood tends to stagnate in the vessels and the pulmonic valve is closed with increased force. The sound is also intensified by an increase in the amount of blood thrown into the pulmonic artery by an hypertrophied right ventricle.
The upper opening is formed by the 12th dorsal vertebra, the 1st pair of ribs and the mammalian sternum. The lower opening stops from the Xiphisternum downwards and backwards on either side to the extremity of the 12th ribs and then inwards to the spinal column.

Muscles of Respiration — 2. Special Thoracal Muscles. These act on the Thorax alone for the most part and correspond pretty closely to the muscles of ordinary inspiration. They are:

1. Intercostals external and internal
2. Triangularis sterni
3. Rectus costearum
4. Subcostales
5. Diaphragm

The external intercostal muscles, eleven in number on each side, occupy the intercostal spaces running from the lower border of one rib to the upper border of that immediately below, in an oblique direction downwards and forwards. The muscles extend along the ribs from the tubercle to the point of junction between the bone and the cartilage, the space between the cartilages being filled with their fascia.

The internal intercostals have a similar origin and insertion & internal to the outer group of muscles but their direction is from above downwards and backwards.

The triangularis sterni is a thin stratum of muscle running from the ensiform cartilage and from the cartilages of one or two ribs below, upwards and outwards to the junctions between the bones & cartilages of the
Intensification of the Systolic and Diastolic sounds is produced in an excited heart. The ventricle contracts sharply, the sound is heightened and is louder and clearer than the normal first sound. It would be expected that the sounds would be louder when the ventricles are hypertrophied, but this is not the case, probably because the contraction takes place more slowly, causing less vibration of the valve apparatus and chamber tendons and also because the sound is not well conducted through the thickened ventricular walls.

The triphasic sound is more often intensified, than the Systolic, owing to the lesser degree of hypertrophy, and greater amount of dilatation that occur in the right ventricle.

Both sounds may be increased in intensity, when the heart is irritable, and acts excitedly.

### Diminished intensity of the Heart-sounds

The loudness of the heart-sounds is diminished by all those conditions which lessen the conduction of sound. Thus when the chest wall is thick or covered with a great deposit of fat; when the lungs are voluminous and cover the heart completely, or are emphysematous; or when the pericardium is distended with fluid; or the pleural (left) with exudate, the sounds are greatly enfeebled and sometimes inaudible.

The heart-sounds are also rendered inaudible by the
The presence of rales, when very numerous, is the sign! 
It must be remembered that the heart sounds may be 
indistinct over the precordia owing to any of the causes 
mentioned, but will heard in other parts, as over a portion 
of consolidated lung in pneumonia, owing to the conduction 
of sound through the consolidated lung.

The sounds are also rendered feeble by the following 
changes in the heart itself.

1. Less forceful closure of the valves. This occurs when 
the heart action is weak, as in cardiac dilatation or more 
markedly in syncope, when the valves cannot contract 
owing to degenerative changes such as fatty degeneration, 
or from gross dilatation of a cavity.

2. Structural changes in the valve segments. When the 
valve segments are thickened, they can unable to close 
with the same force or suddenness as naturally, and 
the amount of sound produced is lessened and therefore 
its intensity, as carried to the ear, is diminished.

The Aortic sound is rendered feeble by:

1. Diminished pressure in arterial system
2. Thickening of valvular cusps
3. Weakening or degenerative change in the ventricle
4. Mitral regurgitation

The Pulmonary sound is weakened by:

1. Weakening, dilatation, or degeneration in the right ventricle.
2. Tricuspid regurgitation.

The Mitral sound is weakened by:

1. Weak action of the left ventricle - it is muffled in hypertrophy.
Change in the valve segments.

The diastolic sound is weakened by weak action of the right ventricle.

Infirmity of the Heart Sounds

The sounds of the heart—particularly the systolic ventricular sounds, are frequently without accentuation and so markedly flattening in character as those heard in health; they become imprecise, and in extreme instance, lose more or less completely the quality of a sound proper, so much so that one is sometimes in doubt whether to regard them as sounds or murmurs.

Sounds of this doubtful kind often merge into an unmistakable murmur when the heart is excited to more powerful action.

The slightest degree of infirmity of the sounds may have their origin in comparatively unimportant changes in the auricular-ventricular valves, thus a merely trifling diminution in the structural delicacy of the valves, a slight thickening of their substance, perhaps also the want of uniformity of tension and action in the various valvular segments, and other similar but yet thoroughly known conditions, may be sufficient to produce such a result.

Infirmity of the sounds, when not associated with
Metallic Sounds. The heart-sounds acquire a metallic character, through changes in the surrounding structure, and not through any structural or functional alterations in the heart itself. The production of the metallic sound is similar to that of the metallic voice sounds heard in certain conditions of the lung, and is due to resonance of the wall of an air-containing cavity with the cardiac sounds. This variety of sound is heard over a cavity in the lung substance lying close to the heart, in some cases of pneumo-thorax, and especially well developed in pneumo-pericardium.

In some cases the heart-sounds are audible to the patient or to a bystander. This is the case also in pneumonic consolidation of the lungs—"A striking example of auto-audible heart-deafening upon consolidation of the lung came under my observation during the summer of 1891. A patient who for some weeks had been suffering from a limited pleur-o-pneumonia of the left base, was suddenly seized with acute pain in the left side, which was followed by quick pulse, elevation of temperature and rapid consolidation. The day following
Reduplication of the Heart-Sounds

Under certain conditions in health and disease, the sounds which normally are heard fused together into the first or second cardiac sounds, are heard distinctly and distinctly, the two divisions being separated by an appreciable interval.

Doubling or Reduplication of the First-Sound occurs occasionally in health at the end of inspiration.

In disease it is rarely heard, but occurs in functional disturbances, in hypertrophy of either ventricle, in mitral and tricuspid lesions, and in degenerative changes of the heart.

Reduplication of the Second-Sound is more frequently seen than that of the first. In health it occurs at the end of inspiration and at the beginning of expiration.

In disease it is found in mitral stenosis and in obstruction of the pulmonary circulation.

Production of Reduplication.
Cause of Reduplication of the First Sound

Theory 1st. That it is due to non-simultaneous closure of the mitral and tricuspid valve flaps.

Bennett supports this view and believes that these conditions are necessary for the perceptible reduplication of the first sound, viz:—

1) Considerable asynchronism in the contraction of the two ventricles.

2) Diminished duration of one or other or both of the component parts of the reduplicated second.

3) Slow action of the heart.” (Bennett, Page 151)

And explains the asynchronism by supposing the dextro-accelerated action of the ventricles to be due:

1) Differences in the pressure of blood in the two ventricles by reason of which the muscular fibres of one ventricle are stimulated to contract before the muscular fibres of the other.

2) Alterations in the nerve apparatus of one ventricle by reason of which the motor ganglia of one side are rendered more or less irritable than those of the other.

3) Structural alterations of the muscular fibres of one ventricle by reason of which its contraction is more or less quickly affected than that of the other ventricle.” (Bennett, P. 161-2)
2. That it is due to non-synchronous tension of the individual segments of the auricular-ventricular muscles, owing to the absence of perfect uniformity of the contraction of the papillary muscles (Sattmann).

3. That the aduplication is due to splitting up of the first sound into its component parts of the auricular complex and the ventricular sounds. (Hayden)

4. That it is due to a double mitral valve click, the true mechanism of which remains to be discovered.
   (Professor D'Espinse)

5. That the contraction of a dilated, and especially if a hypertrophied left auricle becomes synchronous, and that the first division of the double first sound is the result of the auricular systole (Dr. Johnson).

6. That it is due to a presystolic being closely followed by a normal first sound, the presystolic sound being produced by the sudden floating upwards of the mitral curtain occasioned by the auricular systole.
   (Dr. Sennus)

Aduplication of the Second Sound — Causes

Theoretically this may occur in asynchronous contraction of the ventricles due to the causes already stated, i.e., splitting of the aduplicated first sound; or to asynchronism in the closure of separate cusps of the valve; or to
a rebound of the pulse occurs after a first closing, as is sometimes seen in the values of an ordinary pump. Saltmann suggests that the unduplicated sounds are really the component parts of a murmur (Clinical Diagnosis p. 379.)

The unduplication may be due to longer duration of the systole of one ventricle. The second sound can only occur when the pressure in the ventricle falls below that in the artery, so that if one ventricle begins its direct closure sooner, or in other words, the systole lasts a shorter time than that of the other ventricle, the one valve will close and become tense before the other.

Alteration in the position of maximum intensity of the heart sounds.

1. As the heart changes its position, it follows that the relative position of the valve to the chest wall will be changed also, and therefore the position where the sounds are best heard will be altered. The position of the sounds relative to the heart remains the same, the apex of the aorta, the aortic over the aortic arch.

2. The points of maximum intensity are also changed, by conditions rendering their conduction better - thus in pneumonic consolidation, solid tumors, etc., the sounds may be better heard at the base of the lung, for example, than over the precordia.

3. Auscultation of the Thoracic Aorta. When the heart sounds are loudly heard over a part of the chest, where under
Cardiac Murmurs

Murmurs may be defined as new sounds heard along with the ordinary cardiac sounds or entirely replacing them. They may be produced either within the heart or outside it - the former being termed endocardial, the latter pericardial or extra-cardiac murmurs.

Endocardial murmurs – Production

1. By changes at the valvular orifices causing either
   (a) obstruction to the onward passage of the blood, or
   (b) allowing of its return or regurgitation through the valve.

2. Obstructive changes are the result of contraction of the orifice of the valve by cicatricial tissue, the union of two or more segments at their edges, confluence or thickening of the valve segments, or even the presence of a tongue of lymph adhering to one of the cusps.

3. Changes allowing regurgitation are – destruction of one or more valve segments; thickening of their edges which
prevents the cusps falling together; perforation of one of the valve flaps; degeneration of other changes preventing their synchronous closure; dilatation of the orifice of the valve or of the cavity which the valve protects.

1. Changes in the cavities of the heart—causing vibrations at the valvular orifices (contraction or dilatation) the valvus remaining healthy.

2. Changes in the roots of the great-arteries—annuismus dilatation or pressure from without by solid growth or by dilatation of the annules.


The cause of the murmurs heard lies in the vibrations or wave motion set up in the blood passing through a narrow orifice with vibrating margins, or by the passage of altered blood through an orifice, the structure of which remains healthy, but the walls fall together and narrow the opening.

Some observers ascribe the production of auricular murmurs to the meeting of two blood currents moving in opposite directions, but it seems more probable that the murmur is caused by the blood being forced through a narrow orifice or through an atheromatous condition of vessels orifice is such as to be thrown into vibrations by the blood current.
Second, third, fourth, fifth, and sixth ribs. The levatores costarum have a similar direction to the external intercostals. They arise in number, arising from the transverse processes of the seventh cervical and the eleven upper dorsal vertebrae, are inserted into the ribs, articulating with the vertebrae immediately below that from which each muscle springs, but in those belonging to the lower ribs, some of the muscles pass over two ribs and may be distinguished as levatores costarum longiores.

The intercostal muscles are internal to the external intercostals and have the same direction as the latter group, but their fibres extend over one or more spaces. They are found chiefly about the angles of the lower ribs.

The Diaphragm or midriff (στρογγος to divide) divides the abdominal cavity from the thoracic, at rest it has a dome-like shape with the convexity towards the thorax. It consists of muscular fibres which arch upwards from the circumference of origin to the central tendinous structure. The fibres arise from the upper lumbar vertebrae by two crura, between which the aorta passes into the abdomen; from the ligamentum arteriosum two fibrous arches on either side the spinal column; from the ensiform cartilage to the cartilages of the six lower ribs, the fibres spring by in a series of slips which become united together and pass upwards towards the central tendinous tendon. This tendonous afimoseosis forms the highest part of the dome. The Diaphragm transmits the
The intensity of the murmur depends partly on the strength of the cardiac contractions, that is, the actual intensity, for the sound may be diminished or increased by all those conditions of good and bad conduction which have been mentioned with reference to the intensity of the cardiac sounds. A murmur may be heard when the heart is acting quietly and the patient at rest, but after exertion when the heart is acting strongly. As well marked a murmur may be heard. Doubtless the loudness of the murmur depends on the condition of the valve flaps, their degree of thickening or congestion and on the constriction of the orifice in cases of valvular stenosis, but the degree of loudness has nothing to do with the severity of the lesion, and a soft murmur may be more dangerous than one that can be heard without applying the ear to the chest; and when a murmur which has been loud and harsh alters and becomes soft and blowing, it is generally a sign that the heart is failing and may be regarded as a very grave symptom.

Some of the occurrence of a murmur

All endocardial murmurs correspond in time with one of the events in the cardiac cycle. They may be heard during the ventricular contraction and at their
torned systolic, or immediately before the ventricular systole, that is synchronous with the auricular systole and are then called pre-systolic, or they occur after the completion of the ventricular systole, that is, diastolic. Murmurs may be timed as the heart sounds are timed, by palpating the apex beat or by the carotid impulse which of course is exactly synchronous with the ventricular systole.

The character of the Murmurs. There is great variety in the character of the sounds. Some are blowing, some whistling, others humming, scratching, buzzing, or they may exhibit a combination of these characters. The variety of murmurs present will probably depend on the precise condition of the valvular orifices and the strength of the cardiac contractions but it has no diagnostic value and gives no information as to the amount of blood forcing backwards or forwards through the affected valves. Systolic and Murmurs are louder and clearer than diastolic murmurs which are more prolonged but are not accentuated. A murmur due to stenosis depends greatly on the amount of contraction present but no definite rule can be given.
Sounds are distinguished as organic and inorganic, functional and habitual. Those "dependent on the existence of actual obstruction of the circulation are termed organic, those occurring independently of such obstacles, and in a heart in no way altered in structure, inorganic murmurs" (Saltmann, p. 228).

**Organic Murmurs**

**Systolic Murmurs**. Systolic murmurs are those which occur during the systole of either the right or left ventricle, and may replace an accompanying any of the sounds produced during that event. As there are four orifices present — two arterial (aortic and pulmonary) and two between the auricles and ventricles (mitral and tricuspid) — there are four sites at which a murmur may be produced. One of these murmurs may be produced by the direct flow of the blood, namely those at the arterial orifices, and two by a backward flow of blood from the ventricles to the auricles, these at the mitral or tricuspid openings. Systolic murmurs are thus divided into direct- and indirect,
or regurgitant murmurs.

Direct systolic murmurs owe their production to vibrations sufficient to produce sound, at the aortic or pulmonary orifices, occurring either in the arterial walls or in the valve tissues.

Causes

1. Construction of the aortic or pulmonary orifices, thickening, congealing or thinning of the valve flaps. Aortic stenosis is often seen, while pulmonary stenosis is rare and generally congenital, unless it be due to ulcerative endocarditis.

2. Deposition of lymphoid on the valve segments. Even a minute thread of lymphoid may give rise to a loud murmur, which often possesses a distinctively musical character.

3. Dilatation of the aorta, or pulmonary artery, immediately above the valves. The orifices may be of natural size, but more frequently are contracted. When the opening is of its usual size, it is relatively narrow as compared with the dilated artery beyond.

4. Anemic condition. This is a frequent cause, of inorganic or hemic murmurs, which may be heard at either orifice, but more frequently at the pulmonary opening.
1 Regurgitant Murmurs - These are produced by a backward flow of blood through an incised, frayed, or interrupted valve.

Causes:
1. Calcification, thickening, or contraction of the segments of the valve. Rupture of the valve.
2. Imperfect closure, or non-simultaneous closure of the valve segments.
3. Dilatation of the valve orifice, the segments being normal.

Initial regurgitation is of frequent occurrence and is often the result of primary disease. Tricuspid regurgitation is more frequently due to changes in the right ventricle, produced by backflow pressure from the lungs, the result of obstruction in the lungs themselves (constriction) or to dilatation of the mitral valve (stenosis or regurgitation).

Diasstolic Murmurs

These murmurs can only occur at the aortic or pulmonic opening. They may replace or accompany the 2nd cardiac sound, and may extend into the long pause. A diasstolic murmur is almost always the diagnosis of Aortic Regurgitation.
as the pulmonary lesion necessary for its production is very rarely met with.

The murmur is produced by the backflow passage of the blood through a valve rendered incompetent by disease, or rupture of the valve flaps. The blood may escape from the heart during the whole or part of diastole, and therefore the murmur is frequently long, and extends into the long pause.

Diastolic murmurs are never functional or hemi-

Presystolic murmurs. These murmurs are

heard during the diastolic pause (ventricular diastole)

and are sometimes described as diastolic murmurs.

As they occur immediately before, and end with

the beginning of the ventricular systole, it is

better to apply some distinctive name, such

as ‘pre-systolic’ or, as Prof. Guardner suggests,

‘auriculo-systolic’.

Causa. Stenosis of the mitral or tricuspid

orifice. The letter is exceedingly rare, so that a

presystolic murmur for all practical purposes may

be regarded as pathognomonic of mitral stenosis.
The valve orifice is altered by contraction of the segment, thickening of the chordee tendineae, deposits of lymph, calcareous deposits or on the cusps. Though the blood enters the ventricle, even through a stenotic orifice, during the whole of its diastole, it is only when the force of the stream is increased by the contraction of the auricle that a murmur is produced; thus the murmur immediately precedes and ends with the ventricular systole. This is the usual explanation of this murmur. By Dr. Pierre Audinet, it states: "It may exist in case of pure aortic regurgitation without any mitral lesion." (Clinical Medicine, P. 174)

A murmur following the second sound and ending before the ventricular systole, is described as occurring in some cases of mitral stenosis, and is termed a post-diastolic murmur.

Besides the systolic murmurs already noticed, Prof. Austin Flint described a "mitral systolic murmurs" which is the most frequent ventricular murmurs. This is heard with its maximum intensity at the situation of the apex beat and over the base of the heart. It is not transmitted far as at all, to the left of the heart. This murmur occurs in endocarditis. It may be caused by a tendinous cord stretching.
It may be produced by the pressure of the apex of the heart against the adjacent pulmonary tissue, the murmurs then being caused by the expulsion of air from the air vesicles of the lungs. It may be due to atheroma within the semilunar, the function of the valve being unaffected. It is not therefore in all cases a murmur of importance in its pathological or diagnostic signification. The author has found this murmur twenty to thirty years ago and subsequently, in persons who at the present time are free from any symptom of cardiac disease. (Scott's Clinical Medicine, 1773)

Murmurs may entirely take the place of the normal heart sounds, or the sounds may be audible along with and accompanying the murmur. If, for example, we have a mitral systolic murmur, and the 1st sound of the heart remains audible in the mitral area, distant from the tricuspid sound, it is fair to infer that the mitral valves are still capable of partially closing the mitral orifice, but if the mitral first sound be replaced entirely by the murmur, the probability is that the valves no longer act, and that the mitral orifice is without any function. To determine whether both sound and murmur are present, the cardiac area is partially covered by the stethoscope, a removal of little distance from it, the sound is heard and must audible the murmur has distinctly.
Fig 40: Showing point of maximum intensity and direction of propagation of a mitral diastolic murmur. 

Fig 41: Show point of maximum intensity and direction of propagation of a mitral presystolic murmur.
Combined Murmurs. Several murmurs may be audible over the pericardium, dependent upon lesion of one or more of the valve orifices. It is not uncommon to find a double murmur (systolic and diastolic) at the same valve, the levin which caused contraction and originated a systolic murmur, only allowing the competence of the valve, and regurgitation occurs, causing a diastolic murmur. The most frequent double murmurs are a double orifice, a double mitral (premature and systolic) or the murmurs may originate at different orifices, such as an aneurismal stenosis followed by tricuspid regurgitation, the murmur being a premature mitral and a systolic tricuspid.

Points of Maximum Intensity, and Propagation of Murmurs.

Systolic Murmurs. Systolic or tricuspid murmurs are best heard at the apex of the heart. Occasionally, when the auricular appendage becomes dilated or hypertrophied and lies close to the chest wall, the murmur is loudly heard at the 2nd left intercostal space, close to the sternum. The murmur is propagated outward to the left axilla and may often be heard at the inferior angle of the left scapulae. Fig. 40

A premature or tricuspid murmur can be heard

Premature or tricuspid murmurs.
Fig. 42 shows point of maximum intensity and direction of propagation of an aortic systolic murmur.

Fig. 43 shows point of maximum intensity and direction of propagation of an aortic diastolic murmur. + = Apex beat.

Fig. 44 shows point of maximum intensity and direction of propagation of a pulmonary systolic murmur.
Costa, thoracic duct, and generally, the Vena azygos which passes between the Curva, the oesophagus passes through a foramen formed by the decussating fibres of the Curva, the vena cava perforates the central tendon; there are also small prominences for the sympathetic, slight bohemian nerves on both sides for the Vena azygos minor on the left.

The intercostal nerves supply all these muscles except the Diaphragm, which is supplied by the phrenic nerves from the fourth or fifth cervical nerves, and by the sympathetic by fibres from the plexuses round the phrenic arteries.

The other muscles acting on the Thorax are:

- Scaleni
- I. Anticus + I. Posticus
- Serratus posterior inferior
- I. Posticus
- Serratus Magnus
- Quadratus Lumborum
- Erector Spinae
- Especially the sacro-lumbar division
- Pectorales
- Major + Minor
- Latissimus Dorsi
- Trapezius
- Subclavies
- Sterno-Mastoid with Muscles of Neck arising from Sternum
- Triangularis Sterno
- Abdominal Muscles

Three muscles act on the ribs, cartilages or sternum and bound down by fascia, the greater number of them cover the thorax. External to them there is in most subjects a layer of fat which contributes to the smooth rounded appearance of the thorax, the whole being covered by the integument.

Besides, the muscles named in the above list, the
with greatest intensity at the apex, and the murmur is very soon lost as we leave that area. The murmur varies, being frequently very soft at its commencement in the ventricular diastole, and loud and sonorous as it reaches its close, that is with the auricular systole. Fig. 41

Aortic Diastolic Murmurs.

Aortic diastolic murmurs have their point of greatest intensity at the second right costal cartilage close to the sternum. They are carried upward by the blood current and can be heard in the carotid arteries or even at a greater distance. Fig. 42

Aortic diastolic murmurs. These murmurs are usually heard most loudly at the aortic cartilage, and are propagated downwards along the sternum and also towards the apex. Sometimes attain their greatest intensity at the xiphoid cartilage. Fig. 43

Pulmonary Murmurs both systolic and diastolic are best heard at the 2nd left costal cartilage, at its sternal articulation. Systolic murmurs are only propagated slightly upwards. Diastolic pulmonary murmurs are too rare to say definitely in what direction they would be propagated. Fig 44

Tricuspid Murmurs. Systolic auscultation tricuspid
Fig 45. Point of maximum intensity and direction of propagation of tricuspid systolic murmurs.
Grahammas are generally best heard at the lower end of the sternum, sometimes slightly intensified towards one side, right or left, probably depending on the position of the right ventricle. They are not propagated extensively but may generally be heard over the greater part of the sternum.

Diastolic, triumfial murmurs are rarely heard but would probably be heard towards the apex.

If several murmurs be present, the tone of each murmur must be compared, the points where they are best heard accurately defined, and the duration of their propagation carefully considered. Fig 45

**Inorganic, Haemic, or Functional Murmurs**

These murmurs occur independently of any organic cardiac lesion. They are always systolic in time and are never diastolic. They are recognised by the following characters:

1. By their softness, fulness, and short duration, they are of a gentle blowing quality or softly articulate, never harsh, ceasing on halting, etc.
2. By their rhythm, they are, as already noted, never diastolic but invariably systolic, and generally attended by a more or less marked systolic hard-sound.
3. They occur most frequently at the pulmonary orifice, next most often at the aortic orifice, but very seldom
at the aortic or tricuspid valve. The systolic murmur is most usually limited to the pulmonary orifice, sometimes it is heard over both it and the mitral valve, occasionally over the latter alone, and very rarely over both auriculo-ventricular valves, and both aortic orifices.

They are very commonly, in chlorotic subjects, combined with auscultation in the aortic arch.

They are not permanent, but become fainter as the general health improves, and ultimately disappear altogether. (Fellheim loc. cit. 17286)

Anaemic or functional murmurs are found in those cases where from any cause the blood is diminished in quantity or quality. Thus, after severe haemorrhage, after profuse albuminous discharge, in fever and other diseases where great wasting has occurred, in chlorosis, or progressive pernicious anaemia, murmurs occur which if the condition of the patient improve will disappear as his health recovers.

The explanation of their production has given rise to much dispute and cannot yet be regarded as settled. The following is a brief statement of the
Various theories. In the later stages of anaemia, espulsive
the anemic form, putty degeneration and dilatation of
the cardiac cavities occur, so that regurgitation takes
place in some of the valves; about these anaemias there
is no difference of opinion. The murmurs which occur
in the earlier stages of simple anaemia are explained
by the following three theories—

1. That the murmurs are pulmonary. The murmurs
are said to be caused by “the sudden propulsion of a
large blood mass of abnormal (chanaemic) composition
into the vessel which in some cases at least, dilated”

2. That the murmurs are due to arterial regurgitation,
and that it is conducted to the anterior wall of the
chest through the dilated appendix of the left auricle.”
(Dr. George Bellomy’s theory)

3. That the murmurs are produced in the pulmonary
arteries as the result of a constriction of that vessel,
the constriction being caused by the pressure of the dilated
left auricle. (Dr. Rumels’ theory) Dr. Rumels further believes
that the murmurs heard in the second, third, and
fourth left intermediaries in the later stage of each
case, is due to tricuspid regurgitation.” (Brownell C. Ch. 87)

It is impossible that all theories are more or less correct, and
that different murmurs owe their production to different causes.
Some being due to simple blood changes, others to some special relation between the position of the valve leaflets, their degree of tension, and the force of the blood current, et cætera, unexplained.

Pericardial Murmurs - Friction Murmurs.

The murmurs caused by pericardial friction have been studied and its relation to the heart thus pointed out. That which to the hand is communicated as friction to the ear is conducted as a friction murmur.

The murmur is caused by the rubbing together of the two surfaces of the pericardial sac, performed by the deposit of lymph during inflammation. With each contraction and expansion of the heart the two surfaces rub together and a double murmur is heard over the precordium. The sound as a rule is rough, rasping, or a light-rubbing not synchronous with any cardiac event, but occurring throughout the whole or at any point in the cardiac cycle. The murmur disappears as effusion takes place, but a large quantity of fluid may be present and still allow of some friction sound. Occasionally when the patient lies in one position (on his back for example) a murmur may be audible, but if he change his position
and sit up or turn on one side, so that the fluid is displaced the fricton murmure may become distinctly audible. As a rule the fricton is increased by pressure, but this is not always the case. Sometimes it is difficult to distinguish a pericardial fricton from one of endocardial origin, and this is especially the case when the fricton sound is very soft and feeble. The history of the case, the other symptoms present, the locality of murmure, and its want of propagating its to-and-fro character, and want of correspondence with the cardiac sounds will generally prove to distinguish the one from the other.

Pericardial – Pleural – fricton. Limited pleurisy affecting the layer of pleura reflected over the pericardium will give rise to a fricton murmure closely resembling pericardial fricton. As the heart moves the pleural surfaces are rubbed together in the same rhythmical manner which is seen in pericarditis.

Pericardial – Pleural – fricton is distinguished from pericardial fricton by the following points.

1) The former is heard best to one side of the heart, namely the side on which the pleurisy lies, while true pericardial fricton is best heard in the middle of the pericardial region.
(2) Pericardial fluid—pleural friction is altered by respiration. It is increased with inspiration and occasionally ordinary pleural friction may be heard.

(3) There should be no symptoms of pericarditis but this is often the case with ordinary pericardial friction, where no other symptom may occur.

Significance of the Cardiac Sounds and Murmurs

When the sounds are normal both during rest and after exertion, we may infer that the valves are capable of performing their functions— we cannot affirm that the valves are perfectly healthy.

1. Murmurs

(a) A systolic murmur heard with greatest intensity at the apex, and propagated outwards towards the axilla, the heart—probably hypertrophied—on the left side, and the second pulmonary sound intensified, is significant of Mitral Lesion.

(b) A systolic murmur heard at the aortic center and in the arteries of the neck. The left auricle hypertrophied, with a small radial pulse, is diagnostic of Aortic Stenosis.

(c) A systolic murmur heard at the lower part of the sternum not markedly propagated—  pulsation in the jugular veins, and probably a Mitral Murmur also present.
is due to tricuspid insufficiency.

(a) A systolic murmur heard at the left cartilage, the right ventricle dilated or hypertrophied is caused by pulmonary stenosis.

(b) A Diastolic murmur heard at the aortic cartilage or in the middle of the sternum and propagated downward towards the Kliefund cartilage and to the apex into the sternum and dilatation of the left ventricle, and a collapsing murmur is significant of Aortic incompetence.

(c) A diastolic murmur at the pulmonic orifice has been heard but is extremely rare.

(d) A presystolic murmur heard with greatest distinctness at the apex of the heart, and heard over a very limited area, with a presystolic beat, accentuation or reduplication of the second sound (that at the pulmonic orifice is accentuated), hypertrophy and dilatation of the right ventricle, is diagnostic of Pulmonary Stenosis.

(e) Tricuspid stenosis is too rare to require any notice.

(f) Systolic murmur not always heard, most definite at the base of the heart, and not markedly propagated, with a bicuspid orifice, and other signs of or cardiac is functional.
following act indirectly on the thorax, or give support to the thoracic muscles viz. — The Rhomboids, the subscapularis, teres minor & supraspinatus, the muscles of the spine & such. "In fact, every muscle which by its contraction can either elevate the ribs or contribute to the fixed support of muscles which do elevate the ribs, such as the Trapezius, Latissimus dorsi, Scapularis, and Rhomboids by fixing the scapula, may in the inspiratory efforts which accompany dyspnoea, be brought into play".

And again — "As expiration becomes more and more forced, every muscle in the body which can either by contracting depress the ribs, or press on the abdominal viscera, or afford fixed support to muscles, having those actions, is called into play" (Fothergill's Phys. p. 305-306).

The Thorax as a whole varies in shape in different individuals. In health the surface should be gently rounded with no marked prominences or depressions, and should be bilaterally symmetrical both during quiescence and during respiratory movements.

Thoracic contents — The Lungs & air passages.

The Lungs are placed one on each side of the Thorax. The right lung is larger than the left and is divided into three lobes, while the left lung has only two lobes, divided as follows: left lung — upper & lower lobe. They are closely covered by the pleura which also lines the inner surface of the cavity & divides it into two chambers by its oblique position, the mediastinum.

Each lung is an irregular pyramid with its base resting on the diaphragm and the blunt apex reaching...
Physical Examination of the Aorta and great Vessels

The course of the aorta in the thorax has been described, and it is easily understood that under normal circumstances the presence of that vessel in the thorax is not indicated by any physical signs. Occasionally the pulsation of the aorta arch can be felt in health when the heart is acting excitably, by pressing deeply into the infra-sternal notch, but this is by no means frequent.

When, however, the artery becomes dilated, or when a large aneurismal swelling occurs in the course of the vessel, and especially in that part which lies near the anterior surface, namely the ascending portion of the arch distal pulsation may be made out—both by inspection and palpation.

The pulsation of a large superficial aneurism is easily discovered, but the slight movement—occasioned by a small or deep seated swelling requires great care and is apt to be overlooked. On inspection and palpation of the preceding the
Pulsation due to aneurism has been noted, and therefore, the site of the pulsation as found in aneurisms of the different parts of the aorta in the thorax require to be named.

Aneurinal swelling of the ascending aorta causes a cystotic pulsation in the region of the second right intercostal space, close to the sternum. This pulsation is deep seated and may sometimes only be detected by pressing the anterior and posterior surfaces of the thorax together during expiration. The expansile pulsation, when the tumour is large, are easily recognized, and there is little or no difficulty in determining their significance.

When the transverse portion of the arch is affected the pulsation can be felt in the supra- sternal notch. The patient's head should be bent forwards and the fingers pressed deeply down behind the sternum.

Aneurisms of the descending thoracic aorta, unless they be of large size cannot usually be recognised either by inspection or palpation. Occasionally in the dorsal aspect of the thorax at the left side of
the skin crepitation may be felt if the patient be very thin and the muscles poorly developed.

Pulsation in the epigastrum is occasionally due to thoracic enlargement of the aorta, but this is not common.

Percussion of the thoracic aorta. It is only when the vessel becomes enlarged that any appreciable dulness can be heard on percussion. In aneurysm of the ascending aorta, well-marked dulness may be made out over the site of the tumour. If the tumour be large, and the lung be pushed aside, absolute dulness may be heard, its extent depending on the size of the aneurysm.

Percussion must never be made with any degree of force, in case of causing rupture of the aneurysmal sac.

Auscultation of the thoracic aorta.

The auscultatory phenomena heard over the aorta are:

1. Sounds or murmurs conducted from the heart.
2. Murmurs generated in the vessel due to ankylosis of the coats.
3. Murmurs due to aneurysm.
4. Murmurs due to compression of the mediastinum.
The cardiac sounds and murmurs which have been described may be conducted along the aorta for some distance. The intensity of the sounds and murmurs is diminished and distant, though the sound of the murmur due to stenosis may be heard with great distinctness along the course of the vessel.

Murmurs due to conglobation of the internal coat occur mainly at the roots of the aortic and rarely are heard except in conjunction with the ordinary murmur of aortic stenosis, or in aneurism.

3. Aneurismal Murmurs - When the aneurismal swelling is small, and is chiefly lateral, no abnormal sounds may be heard, except possibly the accentuation of the aortic second sound. When however the tumour approaches, or is in contact with the chest wall, the sounds of the heart are often heard with great distinctness, a phenomenon which though of small importance in itself, is, when accompanied by accentuation of the aortic second sound, very suspicious of the presence of an aneurism. When the cardiac sounds are audible posteriorly to the left of the spinal column, in all probability an aneurism is present, unless the sounds are conducted through a pneumonic lung, a sone other good conductor of sound.
In some cases a distinct murmur is generated in the vessel leading to the aneurism, and is audible as a systolic blowing murmur, which occasionally is accompanied, especially when aortic regurgitation is present, by a distinct diastolic murmur.

In 1882 J. B. Bumens and G. Pearson describe a 'whiff' synchronous with the cardiac systole, heard with a binaural stethoscope, the check piece being placed in the mouth, during gentle expiration.

He says—"Briefly, the oral whiff, which I may call the sign I am now referring to, can be detected in the following manner in cases of aortic aneurism. The patient is directed, while lying on his back, to breathe as quietly as possible through the widely opened mouth, the oral of the binaural stethoscope is then introduced into the mouth to receive the expired air. Would, then, the sign be present—the expiration will appear to be interrupted at each beat of the heart by a whiff, which, in some cases is very loud, whilst, in others, it is only detected at the end of expiration, an indication that it is but feebly marked. In certain cases, especially if the aneurism be large, a diastolic whiff can be heard as well as a systolic. In cases in which the sign is well marked, it can be plainly heard in the trachea during quiet expiration, or
when the patient is holding his breath with the mouth open and the tongue depressed, so as to allow the gaging glass to communicate freely with the bronch cavity. In very well marked cases, the whiff is audible in the trachea with the mouth closed, but it at once disappears when the nostrils are compressed by the fingers. In seeking for the sign, it is most important to avoid cardiac excitement; hence it should only be sought for, after the patient has lain in the recumbent position for a short while, and after the ocular for inserting such a formidable looking instrument as the laryngeal stethoscope into the mouth have been fully explained. It is well indeed, to school the patient accurately before commencing the examination, for nervous, intermittent inspiration on one hand, and possible or actual breathing on the other, will defeat the object of the examination. *

In many cases, aneurismal murmurs are only audible in the trachea. I have occasionally been able to diagnose an aneurism by detecting a systolic vascular murmur in the trachea at the top of the sternum, as well as at the base of the heart, in the cancellous costal area, furnishing, at the same time, absolutely nothing abnormal beyond a somewhat muffled first sound, followed by a loud high-pitched second sound and sometimes not even that. These vascular murmurs confined to the trachea are tolerably frequent in cases of dilated aorta, and small saccular aneurisms; in one of the cases in which the tracheal whiff was absent, this tracheal murmur was the sign which led me to a diagnosis in absence of the basal breath.
It is a fact worth remembering that all systolic Austin murmurs are well heard in the trachea; but, when they are much louder here than at the base of the heart, they generally mean an aneurism, either fusiform or saccular. The two sounds in the trachea — the vascular bruit and the air whistle — can easily be distinguished, for the latter disappears when the patient's mouth and nasal passages are closed, whilst the former are best heard under these circumstances" (Dr. Drummond — Brit. Med. Journal 1872 Vol III P773).

4) Systolic murmurs due to pressure on the Aorta. Pressure which lessens the lumen of the vessel will cause a murmur at the point of compression. The aorta may be compressed by a solid tumour, by osseous outgrowth, by a carniplzid aneurysm, and a systolic murmur originating. The murmur will be a little later than the cardiac systole, and will be propagated in the direction of the blood flow. They are rarely heard and are explained only by the absence of other lesions and the discovery of the cause.

Examination of distant arteries.

The radial pulse in diseases of the heart.

Examination of the pulse as made

1st. By simple inspection
2nd. By the fingers (palpation)
3rd. By the chest (percussion)
The superficial position of the radial artery in the wrist, resting as it does on a hard boney surface which makes its compressibility easy to be ascertained, and the convenience of its situation, render the radial the most suitable for observation of the arterial pulse. As a rule it is indifferent which wrist is examined, but certain circumstances, such as malformation of one wrist injury to the artery, unusual distention, and various pathological conditions, may make it necessary to examine both radials, or even to choose some of the other arteries for examination.

The points to be noticed in examining the pulse are:

- The frequency, the regularity or rhythm; the volume,
- the strength, compressibility or tension; Clarity or
  smoothness; Discrimination and any special features of the condition
  of the arterial coats.

(a) Frequency - The pulse varies of most fevers, as well as some of the curariform and other conditions in which an increased frequency is found. There has been already considered. The normal frequency of the pulse varies in different individuals, and even in the same person variations occur within very wide limits. In infants the pulse rate is generally about 120-130 per minute, in children of 7 years it is from 80-90 or even higher.
it decreases still further as time goes on, and at 80 years averages from 65-75. Similar idiosyncrasies are seen in some individuals a pulse of 80 or 100 being frequently seen in perfect health, with no known or functional ailment to cause any increase in the cardiac rate.

Under normal conditions each systole of the heart is marked by an elevation of the aorta at the wrist, so that the frequency of the pulse denotes the number of cardiac contractions. This is not always the case, as it sometimes happens that the heart may beat regularly, but distinct intermissions are observed at the wrist. When this is the case it may be necessary to examine the pulsations of the carotids or when the circulation is very weak to auscultate the heart and count the beats.

Increased frequency - During health the rate of the pulse is often temporarily increased by slight mental disturbances - the visit of the physician may produce a great elevation above the normal, and even a meal will sometimes be marked by an increased pulse rate.
The rate of the heart's action, with which the frequency of the pulse corresponds, is governed by various influences.

Resistance to the outward current of blood in the arteries, or, in other words, increase of pressure in the arterial system, whether produced by compression of large vessels, such as the femoral and brachial, or by obstruction in the arterioles and capillaries, tends to slow the action of the heart, and render the pulse less frequent; and conversely, diminished resistance or lowered tension accelerates the heart-and pulse rate. But more direct and powerful than these varieties of the arterial pressure, and entirely overcoming this tendency, are nervous influences, of which the central are the pneumogastric and sympathetic nerves. (Beaumont. Brit. Med. Journal - March 1807, p. 657)

In diseases of the heart, the pulse is increased in frequency in all acute inflammatory affections, in endocarditis, myocardiitis, and in pericardial inflammation, and in some of the chronic vascular cases. During rest the frequency is very little above the normal, but rises quietly on exertion and the palpitation is often painfully evident to the patient. In cases of irritable heart, whether arising from debility or from overstrain, a persistent increased pulse rate; in the latter case the frequency is ascribed to straining of encrusted heart fibres or irritation of the ganglia.

Functional palpitation has been already noticed as a
painful and troublesome symptom, but the most extraordinary increase in the pulse rate occurs in cardiac neurones, a remarkable case of which has been reported by Dr. Winner, in which the pulse rate often numbered 200-250 and even 304 or 308 per minute. In these cases no cardiac disease is discoverable and the explanation of the rapid heart's action has not been cleared up. The increased pulse rate in epileptic or manic fever, in some forms of meningitis, and in hysteria has already been mentioned.

Decreased frequency. In some individuals a slow pulse appears to be the normal condition, and a persistent slow pulse of 60-1235 per minute is sometimes seen and must be regarded as an idiosyncrasy. It is important that such a condition should be known to the physician for a pulse rate of 60 per minute in such a case would indicate a serious dise.

In heart lesions, aortic stenosis is slow characterized by a normal or slow pulse rate and this is due to the difficulty the ventricle has in emptying itself.

In fatty degeneration of the heart, in irritation of the vagus and in some nervous lesions a slow pulse is observed.

In jaundice and some hepatic disease also a slow pulse rate is frequently seen.

Rhythm. When the heart and system generally are healthy
the rate of the heart and pulse are regular, one beat succeeding another with regularity and each separated from
the beat preceding by a uniform interval.
Disturbances of the rhythm are frequent and occur in
tem who enjoy the best of health.
In disease many forms of irregularity have been
described some of them occurring in regular series, others
being altogether devoid of regularity.
Of the first group the Pulsus bigeminus in which the
beats occur regularly in pairs separated by a larger
interval, Pulsus trigeminus when a series of three beats
separated also by a well marked pause are observed,
Pulsus alternans where a strong beat alternates with
a weaker beat; and the absolute pulsus in which the
weak beat is entirely lost; are the chief forms.
The precise causation of these irregularities is not
fully explained. The Pulsus bigeminus and the absolute
pulsus are seen in mitral stenosis, and the use of
digoxin is not infrequently followed in such cases,
by a dropful beat. The conditions appear to run
into one another and it is seldom that pathological irregularities continue for any length of time.
Extreme irregularities in some cases of irritable heart,
dilatation of one or more cavities, or in debility.
In old age the pulse is frequently irregular without
The 

The putative paradoxues also occurs when there is obstruction to the external passage of air into the lungs, especially in conjunction with allergic bronchitis. The cure is frequently only diminished, not entirely, usually during inspiration.
The influence of the inspiration is sometimes very marked in exciting irregular cardiac action. It is due to the difference of pressure within the thorax during expiration and inspiration. Expiration increases the intrathoracic pressure and thereby increases the pulse tension and slows the heart's action, during inspiration the conditions are reversed and the pulse rate decreased.
The Pulse paradoxical is characterized by the absence of the pulse wave during inspiration. It occurs in cases of Mediastinal inflammation, and in fibrous pericarditis, in which bands of adhesions have formed around the aorta, leading it to the chest wall. During inspiration these bands are tightened and the flow of blood through the vessel prevented. Then expiration takes place the constriction is relaxed and the circulation goes on as before.

By the excessive use of tobacco, tea, etc., by hysterical influences, and various excesses, extreme irregularity of the heart may be originated.

Intermission

"Intermission, occasional or habitual, of the pulse is compatible with health and vigour up to extreme old age, and, in the absence of symptoms, may be practically disregarded." (Brodhurt L. C., Page 704)

Feobservin an intermittent pulse is find after several
regular beats, one is omitted. This may be due either to the failure of the heart to contract, owing to some nervous failure, or to the ventricle being so poorly filled during diastole, that the muscle was either not stimulated to contraction, or the amount of blood thrown into the ventricle, was not sufficient to raise the arterial tension so as to reach the wrist. A feeble contraction of the ventricle may give rise to intermission of the pulse at the wrist. The most important cardiac causes of intermission are atrophy or degeneration of the walls, mitral disease or cardiac failure, the result of organic changes in the heart.

Most of the singularities of the pulse can be recognized by the finger, but in most the sphygmographic tracing is the best method of estimating them.

Volume of the Pulse. The volume of the pulse, smallness or largeness, depends on the size of the vessel, the strength of the heart's action and the amount of blood discharged during each systole, and the state of the blood pressure.

A large full pulse is seen when the heart's action is strong, and a large quantity of blood is thrown into the aorta. In fever the pulse is generally full and often bounding; in aortic regurgitation the pulse is large during the ventricular systole but falls rapidly
As soon as the pressure ceases, in hypertrophy the fulness of the pulse depends on the cause. In the less degree of stenosis a full large pulse is seen, but when the constriction is great and especially when the mitral valve has given way, a very small pulse may be observed. In the pulse paradoxus a very small pulse alternates with one of normal size.

A small pulse. This occurs in failure of the heart in syphilitic and acute delirium. In valvular disease a small pulse is seen wherever the physical condition permits, prevents a large quantity of blood passing into the aorta. In mitral disease both in stenosis, where little blood enters the ventricle, and in syphilitic where a great amount passes back into the auricle, only a small amount enters the arteries. In aortic stenosis the blood does not flow into the aorta with sufficient rapidity to raise the blood pressure, nor to distend the arteries fully, and a small pulse is the result.

Inequality in the two radial pulses is often of the greatest diagnostic importance. A normally large pulse at the one wrist, with one scarcely perceptible at the other, may be caused by pressure on the arteries on the side where the small pulse exists. This may be due to a tumour, inflammatory enlargements, or constriction by adhesions, but the most important cause...
is the pressure of an aneurism which closely resembles the systolic variation of blood pressure and leads into an almost continuous stream to the arterial beyond:

**Pulse tension.** The tension of the arterial pulse can be estimated with the greatest accuracy by the fingers. Three fingers should be placed over the artery, with the finger highest up, the wrist, that is, nearest the heart, pressure is made directly over the vessel with gradually increasing pressure until the pulse is extinguished and no beat can be felt by the fingers below. While the flow is stopped, the coats of the vessel should be examined by the lower fingers and any thickening noticed.

Bradford recommends that the vessel be rolled under the fingers, when an artery with high tension will stand out like a tendon, and it will be found possible to trace the vessel a little distance up the arm. The tension of the pulse can also be estimated by the pressure of the phrenograph spring, but so much depends on the nicety of the adjustment of the lead and the resistance of the tissues so that the results of this estimate are always open to doubt.
The tension of the pulse depends on the state of contraction or relaxation of the arterioles and capillaries. When the blood can flow freely through the capillaries, the tension of the blood in the arteries is low; when there is some interference to the flow, as for example by contraction of the arterioles by cold or some other cause, the tension of the pulse at our wrists increases.

A pulse of low tension is characterized by "the complete subsidence of all blood pressure between the beats." The pulsations are small and can be effected with a very slight pressure. The tension falls rapidly in hypothermia and in various nervous conditions; also when the arterioles are dilated as by immersion in a hot bath; and in cases of high temperature after the rigor has subsided, the pulse tension is generally low. In disease of the heart, weak action will be accompanied by a pulse of low tension, and faulty disposition may sometimes be diagnosed by the condition of the pulse.

The high tension pulse. Its distinguishing character is that the artery is full between the beats. So full is it that it can be rolled under the finger like a tendon.
And followed like a solid cord some distance up the arm, and, when the tension is well marked, no pulsation may be felt—when this is being done, unless decided presence is made by the fingers. But in frequency, especially when the skin is thin, the artery can be seen to form a distinct projection, but no pulsation is visible in it, unless it is thrown into a curve, when this will be seen to be accentuated at each beat. The artery is usually small from contraction of its muscular coats, unless it has been dilated by muscular distension, when it may have much beyond the average diameter... it fills the finger powerfully; it persists for an appreciable time, and then gradually subsides with little or no diastolic echo. It is the "long pulse," the "Pulse tardius." (Broadhurst-Green, Lecture, Brit. Med. J. April 2, 1878, p. 711.)

In cardiac disease a pulse of high tension is most found unless depending on some other affection, such as Bright's disease, where we have seen there is hyper trophy of the left ventricle. A pulse of high tension is found to arise from the following causes—1. Heredity—a pulse of high tension existing in members of the same family. 2. Kidney disease of all kinds except such as is attended with suffocation. 3. Gout and allied conditions—functional liver changes. 4. Lead poisoning with or without renal
Celerity or Slightness of the Pulse

When examined by the finger, the expansion and retraction of the artery appear in the normal pulse to be nearly equal, the retraction only slightly preceding the expansion in time. The exactness or otherwise of the sphygmographic tracing gives the true relation of the duration of the two events.

By a quiet pulse is meant one which rises sharply with a bound as if it were, and subsides at once under the finger. The pulse of acute regurgitation is typically a quiet pulse. It is named from its action the "water hammer pulse," or "Corrigan's pulse" after its first describer. The pulse is generally regular, visible on inspection of the wrist, often flickering and collapsing suddenly, especially when the arm is raised. Its character are well shown by the sphygmograph.

A slow pulse "pulsa tarda" is we have seen a pulse of high tension. It occurs in the condition mentioned above and when the arteries lose their expansible character as in atheroma.

Diagnosis - This variety of pulse can only be appreciated in its extreme degree by the finger, but
by the phonograph. The best appearance of diastolic is shown on the tracing. By diastolic is meant—the appearance of an extra pulse wave in the arteries, due apparently to recoil and synchronous with the closure of the aortic valves. The pulse wave appears as if doubled and this can be detected when well marked by the finger. In the normal physiognomophic tracing, the aortic or diastolic notch is only feebly marked, and in high tension may be absent. It is absent in tracings from aortic insufficiency, or nearly so. When the diastolic wave is greatly exaggerated the pulse is called diastolic. The varieties of diastolic pulse are called (1) Diastolic (2) fully diastolic, and (3) hyperdiastolic, according to the development of the aortic or diastolic wave.

The conditions favorable to the development of diastolic are:

1. A low condition of arterial tension
2. Freedom of outflow from the arterial system, i.e., through the capillaries
3. A sudden sharp ventricular systole
4. Elasticity of the arterial walls.

Clinically the pulse is diastolic in cases in which the nerve tone (arterial system) is feeble, but the
The chief condition with which diastasis is associated is fever - a continued temperature of 102°-104° being often accompanied by a diastatic pulse.

Hyper diastasis is only seen as a rule in cases of great exhaustion (Bonnell C.P., Pp. 256-257 cited).

The Phleugnomograph -

This is an instrument intended graphically to record the movements of expansion and retraction which occur in the pulse during the cardiac cycle. In general practice it is rarely used owing partly to the time occupied in obtaining a tracing and to the bulk and business of the apparatus. Should it be found inconvenient and untrustworthy (which it probably is not the case) or some other portable and easily applied instrument be devised, many of the difficulties would be overcome.

The phleugnomograph for diagnostic purposes however may be done without, as most of the pulse characters can be detected by examination with the fingers. "It is rarely necessary for diagnosis, and scarcely ever to be trusted in prognosis" (Broadbent L.C. 1860).

In hospital work, for teaching purposes and for research, the phleugnomograph is invaluable, but it is scarcely likely that it will ever come into general use.
The essential parts in the construction of the sphygmograph are a pad to be applied over the vessel, a spring or other contrivance to apply pressure, and a lever, or some contrivance, whereby the arterial movements are magnified on a card moved past the writing instrument by means of clockwork. The instrument was first introduced by Vicoroli in 1854. This was followed by Fanny's sphygmograph which was modified by Bahrommed and then from then on to be most reliable. A few years ago a portable sphygmograph was brought out by Dr. Badgeron who promises great advantages from its use.

The tracing produced by the sphygmograph consists of the following parts - 1st: the epitroch representing the expansion of the artery -

2nd: the apex representing the state of tension during full expansion

3rd: The down stroke representing the contraction of the vessel and any subsidiary waves occurring in the pulse at that period.

In a normal tracing the epitroch is vertical or nearly so, showing that the artery is distended suddenly, the length depending on the force of the ventricular contraction and the elasticity of the arterial coat as well as the pressure applied by the instrument. The apex in normal tracings and in most cases of
Diurese is provided, showing that the pressure of the
urine is to fall in the vessel after its distension.
It lies of descent-steps gradually down until the
line has been reached. It is interrupted by one, two or
even more subsidiary waves. The diuretic wave
is present in most tracings and is especially marked
in pulses of low tension. It is said to be due to a
wave caused by the closing of the arterial valves.
Another wave frequently seen, is situated usually above
the diuretic wave. This is named the tidal wave and
is said to represent the true passage of the blood
through the artery.

It is only necessary for me here to indicate the
pathological varieties of tracings that are of
diagnostic value.

Irregularities and intermissions are as a rule
well brought out, in a phlegmographic tracing;
thus the pulsus biegeminus, trigeminus, altus, and
their characters illustrated and the irregularities of
their rhythm shown, by a carefully taken tracing.

The intermission of the heart on the occurrence of
a weak beat, which might be overlooked on examination
with the eye, can be detected at a glance by even,
by observing the phlegmographic lever when acting.
Fig. 46

Dicrotic Pulse (after Mahommed)

AB = Baseline. C = aortic notch

Fully Dicrotic Pulse (after Mahommed)

AB = Baseline. C = aortic notch

Hyper-dicrotic Pulse (after Mahommed)

AB = Baseline. C = aortic notch

(from Bramwell & C. / 253-258)
The singular pulse of mitral disease, the Lexus paradoxus, and even the inequalities dependent on expiration, are all shown by the sphygmograph, and the tracings, taken at rest, during excitement or after the exhibition of drugs, can be compared. In heart disease, the pulse character of active aegression, with its quick upstroke and sharp aorta, and the very small development of the diastolic wave, are in many cases diagnostic of the lesion present.

In aortic stenosis, the slow elevating upstroke, an apex generally rounded and the long down stroke are very significant.

In mitral lesion, supposing the aortic valves to be healthy, the pulse tracing are characterized by irregularities and differences in volume and tension and are rarely of much value in diagnosis.

The high tension of aortic disease, with the consequent columns of water, the high upstroke and square or rounded apex.

The characters of the diastolic, fully diastolic, and supraventricular pulse are all well shown and are a rule more fully estimated, by the sphygmograph than by the finger. The variations are shown in Fig. 46.

The difference in the tracing of the two radicals, in cases of acute syncope affecting the arteries of one side, are well illustrated by the sphygmograph.
The Cardiograph. This instrument, which illustrates the cardiac impulses of the thoracic wall is too little known and even in hospital work so little used that it unnecessary to give any description of the instrument or of tracings produced by it here.

Recently Dr B. Bramwell and Dr Hilton Murray have invented a method by which the exact time of the recurrence of Cardiac Murmurs can be recorded. This is done by producing a cardiographic tracing on a revolving drum. The observer listens (the eye being cloud) with a binural stethoscope to the cardiac murmur and signals by pressing a tambour which in turn moves a lever arranged to as to mark on the same structure the cardiograph. By this mean it was found possible exactly to determine the time of the recurrence of a murmur, with reference to the events of the cardiac cycle.

Examination of the Veins.

Distension of the veins at the root of the neck occurs in cardiac disease, in obstructive respiratory affection, palsy of the right side of the heart, in periarterial inflammation, and in cases of glaucoma.
about an inch above the level of the 2nd rib. The outer surface is convex & is applied closely to the thoracic pleura, while the inner surface is more or less concave and reaches forward to the middle line above & lower down comes into relation with the serous layer diffused over the pericardium. The anterior border is sharp then and at its upper part is separated from that on the opposite side by the mediastinum. The posterior border rests in the hollow between the spine & the ribs & reaches as low as the 11th vertebra; the lower or basal margin is received into the angle between the diaphragm & the costae but does not extend so low as the insertion of the diaphragm.

The lungs communicate with the external cavity by means of the bronchi, arachi 2 trachea, through larynx, mouth 2 nasals.

1. Trachea.- It is placed in the median plane of the body and extends from the lower border of the cricoid cartilage of the larynx on a level with the 5th cervical vertebra, to oppose the 3rd dorsal vertebra.

The trachea is a hollow tube consisting of an elastic framework of cartilages sixteen to twenty in number in the form of incomplete rings presenting a Festival of rather more than two thirds of a circle. They are held together by a strong fibrous membrane, in which the cartilages are embedded. This membrane is continued across from one side to the other of the cartilaginous ring and completes the tube behind, in this part of the membrane is a layer of muscular muscular fibres which
or solid tumour pressing on the veins, than have all been incidentally referred to in what has gone before.

Pulsion in the veins of the neck has also been noticed as occurring in turbulent regurgitation, and the apparent pulsation arising from change in the extra-thoracic pressure, adherent pericardium, etc.
and therefore do not require further description.

Auscultation of the veins frequently discovers a humming Ausmurmur in the veins, which may be heard over the veins at the root of the neck, over the eyeball or torcular Herophili, and in other situations. The Ausmurmur may be heard in health, especially if pressure be made with the stethoscope. It is best heard in cases of anaemia, and in well marked cases is rarely absent. The Ausmurmur is a continuous hum resembling that heard in a still or produced by some luteus. It is known as the bruit de Table or humming top murmur. Its production has been assigned to the altered condition of the blood, or to the falling together of the walls of the badly filled veins. The latter explanation could not hold good in the Ausmurmur heard over the torcular
when the veins cannot collapse, the cause probably lies in the condition of the blood.

In conclusion I append a list of the principal diseases which affect the thoracic organs.

Diseases of the Trachea and Bronchi

Bronchitis

(a) acute (b) chronic (c) catarrhal (d) Plastic

Diphtheria
Cancer
Perforation of Cartilage
Sequestration of Cartilage
Dilatation of Cartilage
Pneumonic Neoplasm
Malignant Neoplasm
Tuberculosis
Syphilis
Dilatation
Contractions
Parasitic disease
Malformations

Diseases of the Lung

Pulmonary Congestion
Haemoptysis (a) Haemoptysis (b) Pulmonary Apoplexy
Edema
Pneumonia
Varicities
(a) Lobular Symmetry Catarrhal
(b) Lobar Crepita
Diseases of the Lung (continued)

Abscess
Emphysema
Pythia
Gangrene
Canicosis - Syn. Tuberculous
Chronic Interstitial Inflammation
Brown Induration
Black Induration
Syn. Tumour Induration
Acute pneumonic Phthisis
Chronic pneumonic Phthisis
Encircling of branches of the Pulmonary Artery
Non-malignant New growth
Malignant New growth
Tubercle
Syphilis
Emphysema (a) Vascular
(b) Imgatubular
A pneumoniae
Achietatis

Diseases of the Pleura

Hydrothorax
Pleurisy Varieties
(a) Acute (b) Chronic
Emphysema
Adhesions, including thickening and calcification
Non-malignant growth
Malignant New growth

Sarcopenia
Embolism (Infarct)
Parasitii disease
Malignant
Injuries
Skilstone - Multiple phtisis
Syphilis phtisis
Other affections due to inhalation of mechanical, chemical, or otherwise poisonous, irritants.
Circulatory System

Diseases of the Heart and its Membranes

Diseases of the Membranes

Pericardium

Inflammation

1. Peri- and Endo-carditis
2. Pericarditis
   Varieties: Suppurative, Pyemic
3. Endocarditis

Adherent Pericardium

Purulent Pericardium

Valvular Disease

Anatomical distribution

1. Aortic
2. Pulmonary
3. Mitral
4. Tricuspid

Varieties

c. Vegetations
b. Fibroid thickening and contraction
c. Obliteration
da. Atresia (chronic inflammation with fatty and calcareous degeneration)
ec. Atresia of valves
f. Laceration
g. Simple dilatation of orifice
h. Malformation

(Diseases of heart and membrane continued)

Tumour
Malignant New Growth
Benign New Growth

Injuries
Syphilitic disease
Parasitic disease

Infections

Blots in the Heart: (a) Thrombus (b) Embolus

Diseases of the Muscular Substance of the Heart

Hypertrophy (a) of left-side
(b) of right-side

Atrophy
Inflammation Syn. Pericarditis
Abscess

Degeneration (a) fatty (b) fibrous (c) pigmented

Diseases of the coronary arteries: (a) atheroma
Excessive growth of fat-
Malignant New Growth - Non-Malignant New Growth

Tumours - Syphilitic disease

Dilatation (a) of left-side (b) of right-side

Parasitic disease - Malformations - Injuries
Endocarditis Glandular Syn. Gravis Disease - Rosendorf's disease
(Cyanosis - Angina pectoris - Syncope - Palpitation and irregularity of the heart - Syncope)

Diseases of the Blood-Vessels

Hypertrophy (a) of muscular coat (b) of fibrous coats.

Arteritis - Periarteritis - Endarteritis
Degeneration Atherosoma (fatty and ulcerous) Syn. Arteriosclerosis

(1) Primary calcification (c) Lardacoma of arterio-sclerotic

fibrinosis
pass transversely across the trachea and a few longitudinal fibres are also seen. A quantity of elastic tissue is found in the submucous layer lining the trachea, which allows of a certain amount of stretching. Mucous glands are numerous on the outer surface of the fibres layer. The mucous membrane lining the trachea is continuous with that lining the bronchi; it is quite thick in health and consists of a quantity of lymphoid tissue, the adventitia of which forms a well-marked basement membrane. The epithelium consists of more than one layer of cells, the most superficial being columnar and ciliated; the cilia serving to expel mucus or from the trachea, their motion being towards the larynx. The trachea is supplied by arteries from the inferior thyroid, and with nerves from the sympathetic, and the recurrent branch of the pneumogastric; it has a rich network of lymphatics. Opposite the body of the third dorsal vertebra the trachea bifurcates and forms the two bronchi. In from the bronchi resemble the trachea, having a similar arrangement of incomplete cartilaginous rings in front, and are membranous behind, and the mucous membrane is in direct continuation with that of the trachea, while the glands, muscular fibres, or are the same. The right bronchus is larger in men and appears to be the more direct continuation of the trachea. They enter the lungs and immediately divide into two branches which again subdivide again and again until they terminate in the air cells or the surface of the lungs.
Intracranial disease - Effusion. Disease

Dilation, narrowing, and obliteration

Aneurysm: (a) Fissuring (b) Saccular (c) Diffuse ( cavity bounded by the surrounding tissues )

(a) Dissecting (b) Pseudaneurysm - As thin but usually if ever occurs in the thorax.

Rupture of Artery: (1) of all coats (2) from disease of artery

(6) Traumatic external to artery

2 of inner coat only

Obstruction or occlusion by clot - (a) Thrombus (b) Embolism

Aneurysm - Aneurysm by Anastomosis

Malformations - Injuries

Disease of the Vessels

Phlebitis - Varix - Obstruction

Obliteration - Thrombus (Phlebitis) Parasitic disease

Injuries - Intercurrent air

Arteriosclerosis - Aneurysm

Varicose Aneurysm: (a) Traumatic (b) Spontaneous

Anomalous Varix - Aneurysm 

Several of the diseases named can rarely occur in the thorax or its organs - The list is taken from the


Line
divides still further and terminates in the air cells or pulmonary vesicles. These vesicles, with the branches of vessels and nerves to interstitial tissue make up the substance of the lung.

The bronchioles contain the same elements as the bronchi and trachea, but are cylindrical in form and the cartilage are disposed in irregular plates and imperfect rings over the whole surface of the tube, and as the tube decreases in size the cartilaginous plates become more and more rare and are almost absent in the terminal bronchioles. The fibrous coat extends to the smallest division of the bronchial tube, and elastic fibres and muscular bundles are also found. The mucous membrane is similar in character to that found in the larger bronchi, trachea, and the epithelium is ciliated. On entering the terminal cluster of air cells or infundibula the bronchioles lose their cylindrical character and become bent with minute recesses or pulmonary vesicles which become more numerous until the infundibulum is reached. The structural elements of the tube become changed, the muscular layer disappears, the elastic fibres spread out into a net of network over the infundibulum, and the epithelium loses the cilia and gives place to a layer of cubical epithelium. The air cells consist of fibrous and connective tissue strengthened by elastic fibres, and according to some authorities by muscular fibres also. The cells are lined with tubular epithelium of the cells of which are smaller and more angular at the junction of two air cells vesicles as shown in Fig. 3.

Blood Vessels. The pulmonary artery carries the dark impure blood from the heart to the lungs; it is a short vessel arising from the right ventricle and ends at its
The bronchi are accompanied by the divisions of the pulmonary artery, the pulmonary veins, the bronchial arteries and veins, lymphatic vessels & glands, all connected together by areolar tissue and enclosed in a sheath formed by the reflection of the pleura, the whole forming what are known as the "roots of the lungs."

The Lungs - The substance of the lungs is spongy in texture and, after expansion at birth, floats in water unless altered by disease, compression, or collapse when owing to the increase in the specific gravity it sinks.

When handled the lung substance causes a peculiar sensation of crispitation, and when pressed the escape of the contained air causes a cracking noise.

In healthy lungs is pink in colour in the newborn child but in the adult is mottled of a reddish slate hue. The external surface is smooth & shining owing to the pleural covering. On section the colour is mottled with the colour varying greatly even in health, and the cut surface exudes a pretty fluid consisting of serous, mucous & air.

When inflated out of the body the lungs expand easily but contract when the air is released to about a third of the size owing to their highly elastic structure. The lungs are covered by the pleura which has the structure of the ordinary serous membranes, and immediately below this by a thin layer of subserous areolar tissue in which is found a close network of lymphatics, which are continuous with the lymphatics of the intercostal septa of the lungs and open by stomata into the pleural sack.

As already stated the bronchi divide & subdivide within the lung substance until they attain very small dimensions, when they enter distinct pulmonary lobules within which each tube...
Fig. 5.

Section of Normal Lung
Shewing group of alveoli and character of epithelium
Stained with Argent. Nit. X about 300 diam.
division under the aortic arch into right and left
pulmonary arteries. The latter arteries enter the lungs
at the Roots and immediately divide and subdivide, their
branches accompanying the divisions of the bronchi, without
anastomoses, until they end in the capillary network
round the air vessels. The network of capillaries
is spread over the whole air surface of the lungs and
his immediacy below the epithelium and is formed
wherever the terminal bronchiae are ducted into alveoli.
The meshes of the network are very fine, being scarcely
wider than the vessels themselves. Round each alveoli
is an arteriolar circle which communicates freely
with the corresponding circle of bronchial vessels.
The pulmonary veins arise from the capillary network
over the alveoli, and for the most part follow the
course of the bronchiae, but in some places pass alone
through the lung substance. The veins coalesce into
large vessels and pour their blood, by two openings on
either side into the left auricle. The veins are united
values to anastomose freely.

The substance of the lung is supplied with blood by
the bronchial arteries. These vessels, one to three in number
on each side, are branches of the aorta or of an intercostal
artery and ramify in the lymph glands, on the coats of large
blood vessels, on the air tubes, and give off into the fine
capillary plexus within the bronchial tubes, which becomes continu
in the smaller tubes with the plexus supplied by the pulmonary
vessels; other branches from pleurae and in the interlobular
tissue; others spread out over the pleurae. When they form pleurorr
anacapillary network. Part of the blood is returned from
the lung by the pulmonary veins. The bronchial veins unite
at the root of the lung, opening on the right side into the
Mechanism of Respiration

The lungs are placed in a semi-distended state in the air-tight thorax, the cavity of which they, together with the heart, great blood vessels and other organs completely fill. By the contraction of certain muscles, the cavity of the thorax is enlarged; in consequence, the pressure of the air within the lungs becomes less than that of the air outside the body, and this difference of pressure causes a rush of air through the trachea into the lungs until an equilibrium of pressure is established between the air inside and that outside the lungs. This constitutes inspiration. Upon the relaxation of the inspiratory muscles (the muscles whose contraction has brought about the thoracic expansion), the elasticity of the chest walls and lung, aided perhaps to some extent by the contraction of certain muscles, causes the chest to return to its original size; in consequence of this the pressure within the lungs now becomes greater than that outside, and thus air rushes out of the trachea until equilibrium is once more established. This constitutes expiration; the expiratory and inspiratory act together forming a Respiration (1861).

The space within the thorax is increased by the elevation of the ribs and consequent forward movement of the sternum or by the contraction of the diaphragm. If the a rib with its cartilage be considered as an arc of a circle it will be seen that during rest or during the pause before inspiration that the greatest convexity is directed downwards and upwards; during the inspiratory movement this convexity changes its direction and at the close of inspiration looks more directly outwards. At the same time the external extremities rotate in an upward direction so that the
The thorax is pushed forward and upwards. The ribs have a less oblique direction than before. Thus the capacity of the thorax is increased both in the antero-posterior and transverse diameters.

During normal inspiration the ribs are raised by the contraction of the intercostal muscles, both external and internal. These act on all the ribs, but as the first pair is less movable than those below their action is to draw the lower ribs upwards. The internal intercostal draw the ribs upwards and tend to throw their sternal extremities forwards, while the intercostal muscles with the subcostal contribute largely to the rotatory motion of the ribs. The scaleni muscles probably act during forced inspiration by raising the first two ribs, or by arching them foward. While the diaphragm contracts the vertical diameter of the thorax is increased by the descent of its floor. The abdominal viscera are displaced and the abdominal wall thrown forwards.

During forced inspiration the scaleni muscles are strongly contracted, the serratus pectoralis superior by its contraction raises the ribs, the false ribs become fixed giving additional support to the diaphragm. The muscles passing from the chest to the shoulder come into play; the shoulders and arms are fixed and the pectoral muscles, serratus magnus, latissimus dorsi are thrown into strong contraction, and as before stated all the muscles which can increase the thoracic capacity are given support to muscles which have such action are brought into play.

Normal inspiration is mainly due to the elastic reaction of the ribs, costal cartilages, and of the lungs themselves. The triangular sterni by pulling down the costal cartilages and the elasticity and contraction of the abdominal muscles will aid in the expiratory act.

In laboured expiration the abdominal muscles are the chief factors aided perhaps by the serratus posteriour.
Fig. 6.

Innominate Artery dividing into Left Carotid and Left Subclavian.

Innominate Veins.

Vena Cava Superior.

Aortic Arch.

Left Atrium.

Right Atrium.

Left Ventricle.

Right Ventricle.

Vena Cava Inferior.

Descending Thoracic Aorta.

Outline of Heart and Great Vessels. Semi Diagrammatic.
Facial and Laryngeal Respiration — In normal respiration, the air enters the lungs through the nasal passages, where it becomes warmed by passing over the highly vascular membrane lining the nose. During inspiration, the nostrils are slightly expanded by the action of the dilator nasi and the elasticity of the cartilage causes their contraction during inspiration. When the breathing becomes laboured, these movements are much more evident. On the passage of the air through the larynx there is generally seen a certain amount of expansion and contraction of the glottis, but during forced inspiration the glottis is widely opened by the action of the posterior crico-arytenoid muscles aided probably by all the muscles which by their action can relax the vocal cords and fix the larynx. During forced inspiration the cords either fall loosely together or by the action of certain muscles are approximated or partially tense when inspiration occurs. “Whether there exists a rhythmic contraction and expansion of the trachea and bronchial passages effected by means of plain muscular tissue of those organs and synchronous with the respiratory movements of the chest is uncertain” (Lewis loc. cit. P. 306).

The Circulatory Organs — Heart & Great Vessels Fig. 6

The Heart lies in the front of the thorax, slightly to the left of the middle line. It is enclosed in a membraneous covering or sack — the pericardium, which entirely surrounds the heart and extends for a short distance over the aorta and great vessels at the base of the heart. The pericardium consists of two layers an external fibrous coat, which has the structure of ordinary fibrous membrane, and an internal serous layer which lines the internal surface of the pericardial sack and is reflected over the external surface of the heart.
The seems conic-inward the vessel enters and leaving
the heart for a considerable distance with the exception of
the aorta cave inferior on which the reflection is very
limited. The pericardial sac is conical in shape, the
base resting on the diaphragm, and when distended with
fluid presents anteriorly a broad triangular surface.

The heart is a hollow organ of muscular tissue, and
is divided into two distinct parts which may be called
right- and left-hearts, these divisions are again divided
into a receiving chamber—the auricle, and a discharging
chamber—the ventricle.

In shape the heart is somewhat conical and is often
directed to the closed fist, the apex is directed downward
and to the left, while the basal portion looks upwards
and backwards. The median division is somewhat obtuse
so that the right-auricle and ventricle occupy the greater
part of the anterior surface and only a small portion
of the left ventricle can be seen anteriorly when the heart
is exposed in situ. The right-auricle occupies the right
anterior portion of the base of the heart, the auricular
appendix being at the upper angle to the front. The
cavity of the auricle may be described as irregularly cubical
and at its posterior angles are seen the openings of the
superior and inferior venae cavae. The posterior wall
is the septum between the auricles and near its lower
border lie the remains of the aortic opening, which in the
foetal state is patent. At the margin of the opening of the
inferior cave is the Eustachian valve a thin fold of membrane
lying in the fossa to direct the blood in the left auricle.
The auricular ventricular opening occupies the greater part
of the anterior-inferior wall is large enough to admit three
fingers within the orifice and is protected by valves. Another
opening in the right auricle are those for the coronary veins.
Of the lesser cardiac veins, and the prominence of the appendices venae of which are closed, but which others are the openings of small veins. The interior surface is smooth, with the exception of the walls of the appendices which are ridged vertically with prominent muscular bands called musculi ventriculi owing to their arrangement like the teeth of a comb. The venous openings are unguarded by true valves.

The right ventricle occupies the greater part of the anterior surface of the heart. The posterior wall is formed by the interventricular partition which bulges into the cavity of right ventricle, while the superior wall is occupied by the auricular opening and by the pulmonic orifice. The inner surface of the walls of the ventricle are elevated into ridges by muscular bundles (columnae carnea) which are more prominent or less so in certain parts forming two distinct projections from the ventricular wall, anterior and one posterior, named musculi papillares which give attachment to tendinous fibres the chordae tendineae, through which they act as the segments of the tricuspid valve, tending to keep the segments tined during the ventricular contraction.

The auricular-ventricular valve consists of three segments formed mainly by a reflection of the endocardial lining. The valve closes during the contraction of the ventricle and thus prevents any backward flow of blood into the auricle.

The Pulmonary orifice is guarded by three semilunar cusps and resembles the aortic Valve-like arrangement.

The left ventricle is similar in structure to the right. It occupies the left posterior part of the base of the heart, the appendices being the only part visible in front. The openings in the auricle are those for the pulmonary veins, two on each side of the posterior wall, unprotected by definite valves, and
The auricular ventricular opening in the lower and fore part of the floor. A depression corresponding with that in the right auricle represents the obliterated orifice of osseous oval.

The left ventricle forms the left posterior and lower or atrial part of the heart. Anteriorly it is visible along the left border of the right ventricle and forms the apex of the heart. The cavity is oval in section and the walls are thinner and stronger than those of the right ventricle. The columnae carneae are smaller and closer, and the musculi papillares are larger than those on the right side, giving attachment through the chordae tendineae to the cusps of the aortic valve. The orifces of the aorta and the auricular-ventricular opening are placed close together in the ventricle, the aortic opening being towards the front, while the auricular opening lies posteriorly and somewhat to the left. The auricular orifice is guarded by a valve similar to the tricuspid in structure but having only two distinct cuspis. The cuspis are thin fibrous flaps covered by a layer of endocardium and attached at their free ventricular edges to the chordae tendineae, while united to the musculi pectinati, the contractions of the latter holding the valvular segment in position during the systole of the ventricle.

The aortic orifice is circular, and is defended by three semilunar flaps attached by their circular margins to the sides of the arterial opening, having a slightly curved border which projects towards the lumen of the vessel. The three segments are structured...
Fig. 6.
Diagrammatic representation of the course of the circulation (Modified from Dalton)

Arteries marked by cross shading
Veins dark

From Byron Bramwell’s Diseases of Heart, P.4.
by a tendinous band running along their free margin which is slightly thickened in the middle and forms a small nodule called the Corpus Arantii. The Aortic valve differs from the Pulmonary in being slightly larger, the cusps stronger and more tendinous, and the capacity of the sinuses of Valsalva greater. In the Aorta the cusps are arranged, one anteriorly and two posteriorly, the coronary arteries arising on from the anterior sinus, the other from the left-posterior sinus. In the Pulmonary valve the cusps are placed two anteriorly and one posteriorly and the orifices of the arteries are absent.

The circulation through the Heart and Lungs. (Fig. 6.) The venous blood from the systemic circulation is received into the right auricle during its diastole which is synchronous with the "punt" in the cardiac sounds, during part of which time "the blood flows in an unbroken stream from the vena cava into the [right] ventricle." (Darte loc. cit. 1750). The auricle when filled contracts sharply, driving the blood through the tricuspid orifice into ventricle, then into a state of diastole. The contraction of the right ventricle immediately follows, the backward flow into the auricle is prevented by the tricuspid valve and the blood forced through the Pulmonary orifices arteries to the lungs. The Pulmonary valves immediately close at the conclusion of the ventricles contraction or systole, preventing any regurgitant flow into the ventricles. By repeated cardiac contractions and by the contraction of the arteries, the blood is forced on through the fine capillaries into the veins whence it is poured into
the left auricle, which in turn contracts, driving the blood through the mitral orifice into the left ventricle. The systole of the left ventricle is similar to that of the right but is more powerful and therefore greater strain is thrown on the aortic valve than on the tricuspid. As its conclusion the valve closes to prevent regurgitation.

In health the systole of the left auricle is synchronous with the contraction of the right of the two ventricles also contract synchronously.

During the cardiac cycle the movement of the heart are evident - on inspection of the precordium, in the production of the apex beat - at a point an inch and a half below the left nipple, generally in the 5th intercostal, sometimes in a diffuse heating in other intercostal or in pulsation in the subcostal. The apex beat is produced by the contraction of the left ventricle. During the diastole the apex remains in contact with the chest wall (except perhaps in certain positions of the body as lying on the back, it may fall away) and the sudden hardening which occurs during contraction conveys an impulse to the chest wall which may be seen or felt with the hand.

Production of the Heart Sounds - Two sounds are heard during each normal cardiac evolution - one long and dull, the first sound occurring during the greater part of the ventricular systole, the other short and clear following immediately after the conclusion of the systole and separated by a short interval from the 1st sound. The production of the first sound has given rise to much discussion - the muscular contraction
of the ventricles, the sudden tension or stretching of the valvular segments, the vibrations of the cardiac tendineous cords, and the impact of the heart against the chest wall, have all been as its cause. Probably the sound is due entirely to vibration caused by the sudden tension of the segments of cardiac belonging to the mitral and tricuspid valves.

The second sound is also entirely valvular. When the ventricular contraction ceases, the backward pressure in the arteries closes the valves with a sharp snap and the vibrations caused by the sudden tension is conveyed to the ear as the short second sound.

In reality four sounds are produced by the closure and tension of each valve but the two first sounds and the two seconds occur together so that only one short or one second sound reaches the ear.

Vessels Supply of the Heart: The heart is supplied with nerves from the sympathetic and pneumogastric trunks. The nerves from the sympathetic, three in number, arise in the neck, one from each of the cervical ganglia, and descend into the thorax in more or less close relation with the vessels of the neck, and communicating with the branches of the pneumogastric. In the thorax there is a communication with the recurrent laryngeal branch of the vagus, and branches are given off to the aorta, the nerves ending in the cardiac plexus.

Cardiac branches from the pneumogastric arise both in the neck and in the thorax. In the neck they communicate with the sympathetic nerves and lie in immediate relation to the sheaths of the carotid or innominate arteries and terminate in the sub cardiac plexus either separately or blended.
with the sympathetic branches. The thoracic branches of the vagus (cardiac branch) lie at the side or in front of the trachea, those on the left side arising from the recurrent branch, and the nerves on both sides terminate in the cardiac plexus.

The cardiac plexus is divided artificially into a superficial division lying on each side of the arch of the aorta and which receives the superficial cardiac branch of the sympathetic and the lower cervical branch of the vagus, and a deep division (which may be subdivided into a right and left division) lying behind the arch of the aorta and therefore in close relation with the trachea. All the cardiac nerves except those mentioned as terminating in the superficial plexus end in this division. From the cardiac plexus they proceed to the heart forming one or a dense fibrous network of nerves which is particularly dense in the atrial grooves, where it receives the names of the right and left coronary plexuses.

Nerves in the Thorax. The sympathetic
The ganglionic cord of the sympathetic lies over the heads of the ribs, and beneath the pleura, being continuous with the cervical sympathetic in the neck and the lumbar sympathetic in the abdomen. The ganglia usually correspond with the number of ribs but that for the first rib is rarely distinct. From the six upper ganglia, communicating branches are given to the upper intercostal nerves, and from the lower six to the corresponding lower intercostal and the splanchic nerves aside. The great splanchic nerves arise in the thorax from the 7th, 8th, and 9th ganglia, the lesser nerves from the 10th and 11th ganglia.
and pierce the crus of the diaphragm on either side to join the solar and renal plexuses. The least branch arises from the 12th ganglion and goes to the renal plexus.

The Pneumogastric or Vagus enters the Thorax, on the right side, between the subclavian artery and the right innominate vein. It runs along the side of the trachea to the tracheal bifurcation, to form the pulmonary plexus on the back of the right bronchus, from which plexus the nerve supplying to the lung is chiefly derived.

The Pneumogastric also supplies the oesophagus forming with branches from the nerve on the left side the plexus gulae; it then passes through the diaphragm to reach the back of the stomach. The left Pneumogastric as it enters the thorax lies between the left carotid and left subclavian arteries, passing behind the innominate vein. It crosses in front of the arch of the aorta, giving off the recurrent branches, which winds around the arch.

Branches are given off to the left lung, to the oesophageal plexus gulae, and from the recurrent laryngeal, the cardiac branches. The nerve pierces the diaphragm and is distributed on the front of the stomach.

The Phrenic Nerves from the fourth and fifth cervical nerves descend through the thorax to the diaphragm. Both nerves lie on the roots of the lungs, that on the left side crossing the arch of the aorta, internal to the Vagus, and then pass between the pericardium and the diaphragm to the diaphragm. They are accompanied by the common Phrenic artery, a branch of the internal mammary.
The intercostal nerves are distributed to each intercostal space, and accompany (except in the 1st space) the intercostal arteries and veins, running along the lower border of each rib. The 1st intercostal nerve joins the brachial plexus and only gives a small branch to the 1st intercostal space.

The great thoracic aorta.

The aorta springs from the base of the left ventricle and is first directed slightly forwards over the right ventricle, the pulmonary artery lying in front and left; the superior vena cava lies to the right and behind the root of the lung. The vessel ascends as high as the level of the second dorsal vertebra and then arches over the left hypochondriac and right pulmonary artery to reach the left side of the vertebral column. The left pneumogastric, left phrenic, and the subclavian, cardiac and diaphragmatic nerves lie in front; behind the trachea, oesophagus and thymus duct, the right pneumogastric and left recurrent laryngeal nerves, oesophagus, & thoracic duct. Above the left innominate vein” (Hastie Anatomy Page 385). This part of the vessel gives off the innominate artery to the left side of the aortic arch, the common carotid and left subclavian to the left side. It next descends on the left side of the vertebral column, to which it is bound by pleura, till at the level of the 5th dorsal vertebra it passes into the thoracic aorta. This portion lies first to the left and afterwards in front of the spinal vertebral bodies crossing the aorta and azygos minor. The root of the right lung passes in front and lower down the oesophagus passes obliquely from left to right. The thoracic duct, and azygos major lie to the left side. The branches of the aorta beside
then mentioned are, the two coronary just above the aortic valve, and from the thoracic portion, the pericardiac, brachial cephalic, and mediastinal branches arise, also the intercostals.

The aorta passes between the crura of the diaphragm into the abdomen.

The Pulmonary vessels have already been noticed in the description of the lung.

The Vena Cava superior is formed by the junction of the right- and left-omtinate veins. The latter vein receives the blood from the head and inferior extremities and lies in front of the corresponding arteries but the left-omtinate vein crosses above the arch of the aorta in front of the trachea and left carotid to join the vein of the opposite side. The vena cava receives the vena azygos major and opens into the left auricle. The Vena azygos major passes through the aortic opening in the diaphragm, ascends to the right of the vertebra receiving the vena azygos minor and sometimes the inferior intercostal vein and opens into the superior cava. The Vena azygos minor receives the lower intercostals on the left side and crosses the vertebral column beneath the aorta to join the azygos major vein.

The Infeirior Vena Cava conveys the whole of the blood from the abdomen and furnishes the diaphragm and opens into the right auricle.

Sympathetics. The thoracic duct lies between the aorta and Vena azygos major. It arises from aucteactum cephal, piercing the diaphragm to the right of the aorta and lies on the azygos column until the level of the 6th dorsal vertebra, when it passes obliquely over to the left beneath the arch of the aorta and ascends in the neck as far as the 6th cervical vertebra and then
cursus downward to enter the left internal jugular vein, close to its junction with the subclavian vein. The bronchial lymphatic glands lie round the bronchi close to the bifurcation of the trachea and communicate with the lymphatics of the lungs. Other glands are found around the oesophagus, in the intercostal spaces, and in the posterior mediastinal space.

The oesophagus enters the thorax behind the trachea having the apices of the lungs on either side. It descends in the chest-passing behind the arch of the aorta and lower down crosses in front of it—when the diaphragm is prised.

As has been seen, the lungs occupying the greater part of the space on each side of the thorax, the space between them is divided into the anterior, middle, and posterior mediastinum. The Anterior Mediastinum is the small space bounded by the sternum in front, the pericardium behind, and the pleurae on either side, and is placed to the left of the median line. It contains (1) the thymus gland; (2) the origins of the sternum, hyoid and thyroid muscles; the remains of the thymus gland (a ductless gland largely developed in the foetus); (4) the left internal mammary vessels; some cellular tissue and a few lymphatics.

The Middle Mediastinum is the space between the two lungs and contains therein: (1) the heart and large vessels (2) the pericardium (3) the roots of the lungs (4) the phrenic nerves. The Posterior Mediastinum is behind the pericardium... bounded by the pleurae on each side, the vertebrae behind and the pericardium, in front, and contains (1) the thoracic aorta, (2) the trachea,
Left Side
3. Tiliae Mammary Arter
2. Innominate Vein
9. Phrenic Nerve
10. Pneumogastric Nerve
11. Recurrent Laryngeal Nerve
12. Cardiac Nerve
13. Left Cardiac
14. Left Subclavian
15. Thoracic Duct
16. Sympathetic
17. Superior Intercostal Art.
18. First Vertebral Art.
19. Apex of Lung and Pleura

Fig. 8

Indian Line
1. Sterno-Hyoid Muscles
2. Sterno-Thyroid Muscle
3. Remains of Thymus Gland
4. Trachea
5. Oesophagus
6. Long Colli Muscles

Fig. 9

1. Aorta
2. Anterior Mediastinum
3. Anterior Mammary Arter
4. Triangle of Sterno-Muscle
5. Dorsa
6. Right-Anterior
7. Right-Posterior
8. Vena Cava Inferior
9. Pulmonary Artery
10. Right-phrenic Nerve between Pleura and Pericardium
11. Left-phrenic nerve anterior to right and eight-vertebrae behind.
12. Thoracic Artery per- off intercostal artes
13. Sympathetic Cord of Spinal
14. Vesicular and
15. Peritoneal layer of Art.
16. Pericardium
17. Thoracic Duct in in Posterior Mediastinum.
Examination of the Patient

When seeing a patient for the first time, there are certain particulars which require to be noted and which in the form of case-taking are set down as preliminary information. Some of the questions will in many cases be found to have no practical bearing on the case but it is necessary to go into them in order that nothing may be wanting to make the case complete.

Name — The name of the patient is generally useful only as a means of reference but may sometimes be interesting as showing how members of the same family, however remotely connected, are affected by similar diseases.

Address — The full postal address should be carefully noted in order that the patient may be traced after leaving hospital, or his friends communicated with if necessary.

Residence — This is often of importance as bearing on the
causation, or the continuance of the disease and seems to be of especial value in diseases of the respiratory system. Bronchitis is common in all countries with the exception of those which have a very dry climate. Upper Egypt, for example, shows a remarkable immunity from bronchitis and catarrh (Kirsch; Handbook of Geographical Pathology Bd. Soc. Pag. 5). In warm countries Kirsch points out that the natives are more subject to catarrh than are foreigners. Pneumonia is subject to the same conditions as bronchitis, districts where water is plentiful, drainage deficient, and a low temperature common are favourable for its development, and when the population is crowded it is apt to become epidemic, especially if the sanitary condition of the dwellings is defective. With regard to the production of phthisis pure dry air is unfavourable to its development and to its continuance, but at the same time many countries show no exceptional amount of phthisis. Thus Denmark is not well suited in rainfall but no excess of phthisis. Holland has a great amount of moisture in the soil but there is no excess of phthisis. Phthisis is rare amongst those dwelling in high altitudes which Kirsch ascribes to continuous residence in a damp and atmosphere which will enormously increase the development and expansion of the lungs.
Locality has very little influence on disease of the circulatory organs, indeed with exception of those places where rheumatism is common, the cause of disease is traceable rather to the habits and employment of the people than to the conditions of residence. A peculiar form of Pericarditis is described as occurring in certain parts of Russia, rarely elsewhere but the scurbutic Pericarditis is owing to the prevalence of scurvy in those districts - the disease becoming more rare as the scarcity decreases.

**Age**

Diseases of the thoracic viscera occur for the most part at all ages but at certain periods of life they are more frequent than at others.

The life of an individual may be divided into three periods. First - the period of growth (a) Infancy to 3 years of age; (b) childhood; (c) early manhood.

Second - Active manhood.

Third - (a) period of decline (b) old age.

During infancy the mortality from bronchitis especially of the capillary variety is large. Broncho-pneumonia is common and tuberculous also occurs. Pneumonia is rare and inflammation of the lung substance is less frequent than at other periods. In the circulatory system congenital malformations are almost the only...
Diagram showing curves of mortality from all causes and from Phthisis.

A A General mortality (after Aquelet)

B B Proportional Mortality from Phthisis.
affecting that call for notice but when discovered now are almost always fatal.

(6) During childhood we have almost the same class of diseases of the chest as in infancy, tuberculosis of the lungs becomes more frequent, and valvular and other forms of heart disease, the sequelae of croupus or measles are not infrequently seen.

12 to 20 years age.

(7) In youth, diseases of the pleura, heart, pericardium are frequently met with, but anaemia, chlorosis, and phthisis are most characteristic of this period.

II. Period of active manhood. Diseases of employment now begin to be common, such as atsmosarcs lung, rupture of valves, diseases of the vessel, aneurism. Habits and modes of living have considerable influence at this period—alcoholism, excesses on phthisis is common.

III. Period of decline. The vital powers are failing. Disease tends to become chronic; chronic bronchitis, pneumonia, and emphysema are common. Lesions in the lungs; dilatation of the heart and general debility from interference with the circulation or respiration are often seen.

(6) Old age is marked by general decay—ostomelacia, atheromaticous vessels, bronchitis is often fatal.

The age at which phthisis is especially common is from 21 to 27 years—but the disease occurs at all ages from early childhood to old age, as is shown in the diagram.
aaa. General mortality, after Quetelet. It has been constructed for both sexes, but the dotted line ad show the modification for women.

bbb. Male mortality from Phthisis.

ccc. Female mortality from Phthisis.

Dr. A. James, Edin. Med. Journal March 1886.
Medical Journal (Nos 1885, p.347) Dr. Tyler  
(Pages 239-240) 

1. Dr. Frieseney's statement: whilst in infancy 
the membranes of the brain, the larynx, the skin, 
the intestines, etc., are chiefly liable to disease, 
the affections of these organs become less frequent 
at the times of puberty, and in their stead attacks 
of bronchial haemorrhage, as well as of acute and 
chronic inflammations of the lung, increase in 
frequency.” (Lecture of Pathology, Medical School, 1885, P.239-240)

Sex: Apart from other considerations, sex appears 
to exercise little influence in the production of 
thoracic disease. Ankylosis and cardiac disease are 
more common in men, owing to the greater strains 
to which they are exposed, and measles and coal 
poison phthisis are due entirely to their employment.
Women during pregnancy are liable to cardiac dilatation 
and derangement of the circulation, and phthisis 
ocasionally is developed as a result of rapidly 
occurring pregnancies.

Employment: As a general rule, it may be said that 
the occupation of any work is better than illness—then 
the economy of the body is better carried on when 
the lungs, muscles, nerves, etc., have the stimulus of
use and exertion. This is true if the surroundings of the worker are perfect and the work proportionate to the physical strength; but if the air is bad or insufficient or loaded with irritating particles — if the individuals employed are poorly fed, badly clothed and are exposed to damp or extremities of heat and cold — or if the work to be done takes a strain on weak or diseased organs then the work becomes injurious and the health suffers. Amongst the working classes these conditions are too often present and labourers, porters, cab-drivers, are frequently suffers from diseases brought on by exposure; millworkers, dressmakers, milliners who often are obliged to work in close, badly ventilated rooms are prone to become anaemic, and to suffer from cataracts of the respiratory passages. On the other hand those whose occupation keeps them in the open air, such as shepherds, farmworkers, generally enjoy robust health. Certain employments again are directly injurious, and of these stonecutters, foundrymen, coal miners, lead or copper workers are familiar examples. These men owing to the quantities of dust and irritating matters they inhale are frequent sufferers from phthisis and catarhal affections.
Strain such as is experienced among navies, dock-labourers &c is a frequent cause of valvular disease and aneurism, especially if the arteries are weakened by atheroma or the system by intemperate habits.

Married or single - The condition of married life seems to exercise very little influence on the thoracic organs - disease being equally prevalent in both conditions. One point of interest is the probability of the infection of the wife if the husband is consumptive, and vice versa. Doubtless infection does occur and is most frequent between husband and wife, a fact which might influence the diagnosis in a suspicious case.

The date of admission to hospital or the date when the patient was first seen should be added, and in hospital cases note the No. of the Ward or bed.

II. Complaints

The most common complaints made by Patient suffering from either pulmonary or cardiac disease are, pain, cough, with or without expectoration, shortness of breath especially on exertion and palpitation. If these may be added the more objective phenomena, emaciation, lividity,
edema—general or local, local congestions, enlargement of veins. The complaints vary according to the organ affected and only serve as a guide for the physical examination.

**History**

As of present attack. After hearing what a patient complains of, we ask as a rule—“How long have you been ill?” The answer to this question determines at once whether the disease is acute or chronic. Acute disease is characterized by a sudden onset and a rapid course, ending in recovery or death, or it passes into a chronic state. Chronic disease, on the other hand, begin slowly (unless they are the result of an acute disease) and continue for months, sometimes years, usually with periods of improvement and of exacerbation and end sometimes in complete recovery, more often in partial recovery or death. It is necessary to exercise great care with regard to acute exacerbations of a chronic disease, for example, acute pleurisy is the result of exacerbation of a previously diseased lung is a very different thing to deal with from a simple pleurisy with no such cause.

The mode of commencement—the character of the symptom with the other of development—often give a very good
picture of the disease. Thus a cough, followed by fever, cough, uneasy feeling in the side, with
easy expectoration will almost certainly indicate
acute pneumonia, while fever with or without a
premature rise, followed by acute pain in the side
or breathing points at once, to Pneumonia.

The course of chronic disease is more difficult to
make out—owing to the confusion of the patient's
mind with regard to dates, and to the slow mode
of progression. In valvular disease of the heart—for
instance, it is often impossible to determine
the course of the disease, as the effect of the valves
may have gone on for months even years without
causing any symptoms.

Previous Treatment. This should always be ascertained
so that the alteration which may have taken place
in the phenomena of the case, as the result of treatment
may be taken into account. The uneasy tightness
in bronchitis will be much allayed by placing the
patient in a suitable temperature and giving proper
remedies; and the signs of dilated heart may be
altogether obliterated by appropriate treatment.
The treatment is occasionally a guide as to the condition
of the patient when last under observation and is
useful sometimes when the medical attendant cannot.
be communicated with

Cause - The causes or conditions predisposing to thoracic disease are various. They may be divided into five groups:

1. Direct injury to the organs. Wounds, such as by stab, gun shot, wounds, injury by broken ribs may by laceration of the organs or by introduction of septic material into the tissues set up various inflammatory or septic diseases such as pleurisy, pericarditis, etc.

2. Irritation (a) Direct (b) Indirect.

(a) Direct irritation in the case of the lungs is chiefly by inhalation of gasses or particles of matter into the alveoli or smaller tubes and in the case of the heart by the circulation through the viscera of blood contaminated by septic or other material.

(b) Indirect irritation is most commonly occurs by exposure of the body to extremes of heat or cold. The pathological changes which follow are probably brought about by nerve-motor changes. In some cases disease is due to a lowering in the tone either of the system generally or of one particular organ which tends the development of certain bacilli possible. The spread of disease from other organs, contamination of the tissues may spread to the bronchi, superficial inflammation extend to deeper structures,
be commencement with.

Pericardial inflammation set up usually
tubercular disease be conveyed to the lungs from
some other organ, - cancer in a distant part develop
in the thorax &

15. Heredity or predisposition.

Health History. - The previous condition
of the patient's health is important, not so much
in bringing out the circumstances which have
led up to this present illness, but rather in
helping us to determine the progress of recovery
of the patient, the course of previous diseases,
and the sequelae which may have been left.
Patient questioning is necessary in order to obtain
accurate account of the various ailments from
which any patient may have suffered and it is
of the greatest advantage to get the particulars
from the previous medical attendant.

The question how far previous attacks of illness
render the patient vulnerable is one which it is
difficult to decide. Bronchitis seems to have a
distinct tendency to return and that frequently.
at a particular period in the year. After recurring
bronchitic attacks, weaken the lung substance, which
may become emphysematous, inflammation especially
of a catarhal nature is more liable to ensue, and
this in turn may culminate in phthisis.

One attack of pneumonia, though it resembles
the infectious fevers in some points, does not confer
immunity, nor does it appear to render another
attack more probable. It is of importance to
find out—whether the patient has suffered from
syphilis, from any of the infectious fevers, from
phthisis, and to enquire into the severity
and course of the attack, and the condition of
the health subsequently. It is convenient at
this stage to make oneself acquainted with the
habits and mode of life of the patient. It is agreed
that a well-regulated life is a healthy one, and that
the contrary proposition is generally true. A man
leading an irregular, unsteady life, keeping late
hours, frequenting hot-illuminated drinking saloons
will find his health suffer both bodily and mentally and
disease in him will be more severe and more probably end-
trarily than in a man whose tissues are kept in good
condition by a well-regulated mode of living.
The general surroundings and social condition of any individual exercise a considerable influence over the production of disease and to a greater extent influence the course and duration of any malady. The poor and the working classes generally run greater risks as regards their health than those in a superior station partly owing to the amount of exposure they are obliged to endure, and partly to insufficient food and clothing. Disease amongst the poor also is more liable to be fatal owing to the time that generally elapses before advice is sought—and to the lack of nursing and general hygienic remedies which are within the reach of those in better circumstances.

It is of interest to note how any special conditions with regard to the patient’s employment, such as an insanitary workroom, its situation with regard to the main sewer or main water, the length of hours, any unusual material used in his work.

In cases where loss of flesh is complained of, the weight of the patient should be ascertained and if possible compared with the weight previously.

Family History — To prove or disprove the heredity of disease is extremely difficult. From many patients it is impossible to obtain any information as to the health even of near relatives, partly owing to carelessness.
or ignorance, and partly in some cases because the medical attendant has given to definite names to the disease. All patients should be asked as to the disease from which their relatives have suffered. The health of brothers, sisters, parents and even grand-parents should be investigated, and if the patient has a family the health of the children should be inquired into, not merely whether any of them have suffered from that disease, but as to what diseases they may have specially suffered from. It would be of great interest if a note of health were appended to each name in the family tree. Absolute badness is very rare but the tendency to suffer from certain diseases such as Rheumatism or Phthisis is not uncommonly derived from one or other of the parents or in some instances the liability appears to skip a generation and to descend from the grandparents.

General Condition at time of examination.

While the preliminary facts and previous history are being elicited, the physician is both consciously and unconsciously forming an opinion as to the nature of the case; excluding this or that condition, narrowing the enquiry, limiting the disease to this or that system or organ; and in some cases coming to a positive conclusion as to the exact nature of the morbid process. His conclusions are
based upon the impression which the whole appearance, conduct and bearing of the patient—i.e. the words the
physiognomy of the case—make upon his mind, and
this impression necessarily guides the oral examination and
suggests questions both as to the previous history and the
"present complaint." (Byron Bramwell, Medical Diagnosis, P.42)

The general aspect of the patient is often very suggestive
of the severity of the disease. If, for example, on seeing
a patient he comes forward in an easy manner without
any appearance of pain, dejection, no difficulty in
breathing, or flushing or color of the face, it is fair to
conclude there is nothing very serious the matter.
To find a patient in bed or the other hand shows
generally that the case is considered serious at least
by the patient or his friends. In these cases when
there is much interference with the aspiration the
attitude is often striking. The patient is often unable
to lie down and requires to be propped up with
pillows and assumes such a position in which
he can use the accessory muscles of aspiration
with the greatest effect. In some heart cases he
refuses to go to bed and will pass the day and night
too in a chair or on the side of his bed the head or
body bent forward, his hands grasping his knees,
other times he will find greatest ease.
leaning over the back of a chair — the position being chosen in which there is greatest ease or in which there is the greatest power of inflating the lungs. In Pneumonia and other diseases of the lung substance the position is generally dorsal differing from pneumonia when it is generally lateral the patient being on the affected side.

(b) Countenance. Professor Flint describes eleven varieties of "Facies" which may be enumerated.

1. Facies of Anaemia
2. Erythotic Facies
3. Facies of Renal disease
4. Malarial Facies
5. Facies of Carcino-
6. " " Typhoid
7. " " Peritonitis
8. " " Pneumonia and Acute
9. " " Exophthalmic Gravel
10. " " Cholera
11. Hippocratic Facies
1st. The Signs of Anaemia.

Blanching or pallor of the surface of the body, of the skin and mucous membranes may be present to a considerable degree without any severe symptoms being manifested, in fact a certain degree of pallor is quite consistent with good general health and appears in some individuals to be the normal condition. In its more marked degree however it is symptomatic of many more or less grave conditions. It may arise 2) from haemorrhage. When a quantity of blood is withdrawn from the circulation either suddenly from the rupture of some large vessel, or gradually from persistent oozing from some injured surface, the blood formation is not sufficiently rapid to replace the loss, the capillaries are insufficiently filled and the surface becomes pale. Allied to this cause is (b) the loss of albumen from the blood as in albumenuria (from renal disease), in effusion into the pleura or pericardium, and in general anaemia, or, the quantity of blood is decreased owing to the loss of blood forming material. The quantity of blood may also be diminished indirectly owing to insufficient supply or malabsorption of food so as to obstruct diseases of the alimentary canal. The above causes may produce pallor owing to the quality of the blood being decreased, the quantity remaining the same normal.
Fig 12. Microscopic Appearance of Normal Blood. (x 250)
(decl. ad Nat)
Fig. 13. Blood Corpuscles from a case of Progressive Pernicious Anaemia. (X 250) (del. ad Nat.)
(4) Anemia due to a deficiency in the number of red corpuscles, and probably to a less amount than normal of hemoglobin being present in each corpuscle. (See Figs. 12 and 13)

Independent of the amount or quality of the blood pallor is present when the arteries and capillaries are empty or only imperfectly filled with blood. This may arise from failure or weak action of the heart, as in syncope or shock, or from contraction of the arterioles which may be brought about by various emotional changes such as fright, anger, etc. or more locally by application of cold or other stimulants of the vasomotor nerves. The appearance of the patient varies with the degree of anemia. In some cases there is little change from the normal but—often marked cases the whole surface is pearly white or slightly yellow in colour, with sometimes a greenish tinge. The mucous membranes lose their rose colour and become pale, often almost as pale as the skin. The nutrition is generally maintained, and when affected the loss of flesh is not in any degree proportionate to the degree of anemia. In severe chlorosis uncomplicated by any other condition, there may be no emaciation present or only a very slight degree.

The Cyanotic Facies.

Cyanosis or blueness of the skin may exist in all degrees, from a slight bluish tinge to an indigo blue or
bluish black. In the face it is observed chiefly where the
surface is naturally red, as in the lips, cheeks, eyelids, and
cars and gradually extends over the whole face especially
the dependent parts. On the body, the extremities, wherever
the skin is thinner and more transparent, the fingers
and toes, especially the nails, the elbows and knees are the
earliest parts affected. In extreme degrees the blue
adrenia is observed all over the surface but is
always most marked in those parts which are more
vascular and the skin delicate and transparent.

Causes Cyanosis occurs in all cases when from any
cause the blood is imperfectly oxygenated. The cause may
lie in the lungs or some part of the respiratory tract
or in the circulatory system. The supply of oxygen
may be deficient as in asphyxiated air, or it may be
unable to reach the surface of the air cells as in obstruction
of the Larynx, trachea, or bronchi by a foreign body or from
disease (edema glottidis, diphtheria, bronchitis) or the breathing
surface of the lung may be diminished as in collapse
of lung, in pneumonia or phthisis, flukeying with effusion
or the capillaries of the lung may be obliteratad or diminished as
by cirrhosis or emphysema. The divinity is not always in
proportion to the extent of lung involved, the more severe
degree being observed in the loss of lung oxygenating
surface has occurred suddenly as in pneumothorax the
result of accident. Apart from Special individual differences
The explanation of the fact that the slowly advancing diminution of the respiratory surface in chronic disease is associated with but little lividity evidently is that the healthy lung gradually expands and in that way comes to supply, to a certain extent, the place of the partially disabled lung. That robust, full-blooded persons, suffering from embarrassment of the respiration, should present a higher degree of cyanosis than those who are anemic is to be expected, as the more plethora an individual is the more completely are his vessels and among them those of the lungo-filled and it is well known that oxidation of the blood goes on more slowly when the vessels are distended than when they are partially empty. In PHthisi, in the other hand, as the association and decrease in the quantity of blood in circulation keeps pace with the diminution of the respiratory surface, the cyanosis is always slight. Cyanosis becomes extreme when as in the emphysema which accompanies chronic bronchitis, both conditions which tend to produce it are present—obstruction of the air passages and diminution of the functionally "active lung substance." (Suttmane—Handbook of Physical Diagnosis Page 137. Syd. Sigh)

The capacity of the thorax acts as a consequence the breathing space may be diminished by abdominal tumors or other swellings forcing up the diaphragm and prevent its proper action. Cyanosis in such cases is a prominent symptom.

Valvular disease of the heart is also a common
cause of cyanosis. It occurs in all cases where the 
heart's work has become overloaded as in mental 
degeneration and contraction of that organ, when there is 
insufficient heart power to overcome the obstruction. 
In fatty degeneration of the heart, cyanosis is common 
as it is in all conditions where the heart is weakened. 
A disease is unable to drive the blood through the 
llangs. In the disease or condition known as 
congenital cyanosis, the cyanosis is often extreme. Here there 
is imperfect closure of the foramen ovale, the ductus 
arteriosus may remain open and there is frequently 
estension of the pulmonary artery. The lesion may be 
so severe that the child dies immediately or soon after 
birth; or life may be prolonged with the presence of 
constant cardiac symptoms, or the lesion may be so 
slight that symptoms are wanting and only appear 
when from some cause there is a failure of compensation. 
Pressure on the veins will also induce cyanosis which 
may be only partial but will be more general if the 
vein obstructed be one of the main channels leading to the heart. These local congestions are most important 
as indicating the seat of tumours or other swellings which 
are not visible or within reach of palpation. 
Facies of Renal disease: "In some cases of acute 
albuminuria, and of chronic parenchymatous nephritis 
the face is white, shining, and bright, the perspiration of the face 
from edema with notable pallor, renders the advent highly 
diagnostic" (Flint: Clin. Med. 1874). This only requires notice
in order to point out the importance of distinguishing this form of dyspnoea from that which occurs in cardiac disease, where the dyspnoea is generally first observed in the put and the pallor is not so marked a symptom.

"Malarial Facies" - Pallor of the face, sallowness, and slight puffiness, if renal disease be excluded, point to malarial disease.

"Facies of Carcinoma" - Notable anaemia, a waxy, or straw coloured complexion, and more or less emaciation, in combination, under the aspect marked in some cases of malignant disease. In a patient over forty years of age, this aspect has a considerable diagnostic import although it is by no means always present when malignant disease exists.

"The Typhoid Facies" - In the middle and later periods of typhoid fever the countenance is often dull, listless, expressionless. This facies may be present in the typhoid state which is incident to diseases other than typhoid fever, e.g., pneumonia. Co-existing with a dusky tone of the skin and congestive redness of the conjunctiva it distinguishes typhus, as contrasted with typhoid fever. (Fland: Clinical Medicine p.24) The Typhoid state is characterized by the dry, leathery, "typhoid" tongue, the presence of cords on the teeth, sleeplessness, delirium, tendency to coma, and subcutaneous tenderness.
The Facies of Acute Peritonitis. — The upper lip retracted so as to expose the front teeth, gives an aspect which characterizes, in a certain proportion of cases, acute peritonitis. It is often wanting, but when present is strongly diagnostic.

The Facies of Acute Pneumonia and Septic Fever. —

Circumscribed redness of one or both cheeks, with abruptly defined borders, is diagnostic of pneumonia.

If it be observed in a case of chronic pulmonary disease it denotes the so-called septic fever, and is a sign of phthisis (Flint loc. cit.). Circumscribed redness of the cheeks is seen in angioneurotic edema and in some hysterical anemic patients, but in these there is no fever, and the edges of the lips, dilated alae of the nose which are so often seen in pneumonia are wanting.

The Facies of Exophthalmic Goitre. — Projecting the eyeballs, giving to the face a remarkably strong and sometimes fierce expression, conjoined with enlargement of the thyroid bodies and frequency of the pulse, is distinctive of the affection known as exophthalmic goitre, Graves disease, and Basedow's disease.

The Choleraic Facies. — In the collapsed stage of cholera, the face is contracted, sometimes wrinkled; the cheeks are hollow, the eyes sunken, the skin livid, and the expression denotes indifference. This combination of traits
is quite distinctive. They are, however, to a certain extent combined in a state of collapse which occurs in some cases of pernicious intermittent fever, and in other pathological conditions.

The Hippocratic Facies. — This facies denotes the moribund state. The skin is pale, with a leaden or bluish hue; the eyes are seconden, the eyelids separated and the cornea loses its transparency; the nose is pinched, and the ears are contracted; the temples are hollow, and the lower jaw droops. Hippocrates described "this facies in graphic terms and the name Hippocratic has ever since been used to designate it." — Thal 1825.

The Nutrition of the Patient

Healthy Nutrition may be said to exist when the waste products of all bodies are equivalent to the food consumed and to the work done. In the child the food is in excess of the waste, and the same condition exists in those who are gaining in weight or putting on flesh, as after recovery from acute diseases or from a state of emaciation. In those whose nutrition is healthy the skin is elastic, fitting smoothly to the surface without being wrinkled or abnormally stretched. The muscles are firm and when in action are hard and tense. The color is clear and bright; the eyes bright; there is always a fair amount of fat present, but the healthy amount varies, according to the activity, mode of life
and diet of the individual.

Emaciation - Extreme degrees of emaciation are easily recognized. The causes of emaciation may be divided into two groups 1st those in which the supply of food, or the amount assimilated is deficient and 2nd when the tissues waste is in excess of the normal.

(25) The actual supply of food may be deficient, from the inability of the patient to procure food, or from voluntary fasting, but these conditions being easily treated by an increased supply are not of the same importance as the following. The patient may not be able to partake of food owing to painful condition of the mouth or fauces, from obstruction of the gullet, structure of the oesophagus, any of which condition if persistent will cause emaciation, the degree varying with the amount of food which reaches the stomach. Food taken into the stomach may be expelled undigested, either owing to its irritating character or to some irritable condition of the mucous membrane such as catarrh or ulcer. The walls of the stomach being healthy, the obstruction may exist at the pylorus preventing the food from passing into the intestines and being absorbed.

Obstruction and obstruction of the intestines in any part of the tract will also similarly cause emaciation if the absorption of food be prevented, though if the character of the food be so regulated that only those varieties of foods be given which can be absorbed and digested in the part of the alimentary tract which remains healthy, the nutrition is maintained and little loss of flesh occurs.
Emaciation occurs in all cases of fever. In all the typical wasting diseases fever is more or less present, and as a general rule it may be said, while the temperature is high, wasting and loss of weight continue, and when the temperature falls the patient's weight remains constant or the parts of the flesh.

Diseases of the circulation being almost free from fever, except those in which there is inflammation or suppuration present, are unattended by emaciation. In acute and subacute tuberculosis of the lungs there is rapid wasting, chiefly owing to the very high fever which accompanies it; it is most-probable also that the wasting which is such a constant and prominent symptom of that form of pneumonia, which leads to phthisis pulmonaria, is due next to the nocturnal sweats to the pelvic disturbance, as notwithstanding his almost-insatiable appetite, the phthisical patient rapidly loses flesh, but whenever the fever abates and the progress of the disease is thus temporarily arrested, he at once gains in weight.

Emaciation, apart from its prognostic signification is of some importance from a diagnostic point of view. None of all the chronic diseases of the lungs, caseous pneumonitis is the only one in which it is observed; the other chronic lung affections, however, being chronic from year to year, may run their course without being marked by any trace of wasting, though they may give rise to description of the horsemanship and to the formation of cavities; and offer therefore the same physical signs as are found in caseous pneumonitis; such
patients indeed, if only their digestive organs be in good condition, may present every indication of being perfectly well nourished." (Guttmann, loc. cit. p. 21)

Wasting of muscular tissue from loss of function is seen in all these cases when from any cause the patient is deprived of the partial or entire use of his limbs, thus in these confined to bed for a broken leg, the muscles waste, but this is a perfectly different thing from what is understood by emaciation and does not require further notice. The same may be said of atrophy from loss of trophic influence seen in cases of injury or disease of the spinal cord.

Fever. The two principal indications of fever are 1st. the temperature and 2nd. the pulse, the skin, tongue, general reaction being to a certain extent subsidiary.

The Temperature. Method of ascertaining the Temperature.

Roughly an appreciation of the temperature of the body may be made by the hand of the observer, but there are so many circumstances that modify the information so obtained that it should never be trusted to, but the evidence of the Thermometer taken. Thermometers are of various forms but the following are those chiefly in use.

1. The Clinical Thermometer. Any thermometer which has a maximum index may be used provided it can be applied easily to the surface, or even if an index be wanting any thermometer with an unprotected bulb may be used if the stem be long enough to read the scale without removing the instrument. The instrument which is
Fig. 14

Clinical Thermometer
Nat. Size.

Fig. 15

The Thermograph - from woodcut in Brit. Med. Journ. The register card should be black with white circles.
First in use at present consists of a very thin glass bulb to which is attached a stem whose bore is of capillary finished - the object of this arrangement being, that each division marking degrees is sufficiently large to be divided into tenths, which are large enough to be easily appreciated. The thin bulb renders the heating of the mercury rapid. The index scale is engraved on bent into the stem. (Fig. 14)

2nd The surface thermometer. In this the bulb is either simply flattened or is a tube of thin glass arranged in a flat coil so as to give an extended surface for application to the skin. The side is covered with cork or some iron-conductor of heat, the other being applied to the surface, the stem and index are on the same principle as the ordinary clinical thermometre.

3rd The continuous registering Thermometer or the Thermograph. Fig. 15

This instrument was introduced in 1881 by Mr. Bowditch. It is thus described: - “The construction of the instrument is as simple as it is ingenious; included in a copper cantharide case is a metallic vessel, rigid and unyielding, about 3 inches in diameter and about 1/2 in. in depth. In connection with this is a curved hollow tube or siphon, much smaller in size but similar to that used in the Bourdon strain-gauge. One end of this tube is fixed to the vessel, with the chamber of which it communicates, the other extremity is closed, and is in connection with a simple lever movement, increasing a joint movement some three or four times. The whole is filled with liquid and hermetically sealed; any
Increase of temperature causes the contained liquid to expand, the vessel being unyielding, the expansive force influencing the tube only (which is rendered elastic by its form) in such a manner as to cause the end in connection with the lever to recede from its position of rest, and the lever is thus moved upon the recording surface. The recording surface consists of a disk of card board, set-in motion by a waxed worm occupying the center of the instrument. The disk makes one revolution in 24 hours and is divided by concentric circles into degrees of temperature, and by 24 radiating lines into spaces representing hours. * * * "The flat under surface is applied to the body, the other portions being protected by a suitable and commodious case. It is usually applied to the abdomen, being held in position by a broad band of non-conducting material. (Brit. Med. Journal Vol. 2, 1881, Page 903.) Another Thermograph has been invented by Dr. Wellington Adams of Colorado Springs but its construction involving the use of an electric battery renders its use more troublesome than that previously described. Another form of Thermograph has come into general use and the question of its utility as a diagnostic method is still in abeyance.

45. The Kitteli Thermometer. This is an instrument of the size of a small watch, which has been recently introduced. In appearance, so far, to be trustworthy and is less destructible than the glass instruments. It owes its invention to Schrönich. Fig. 15A.

The scale in general use in this country and America is the Fahrenheit—on the continent the centigrade scale.
is most often used, but that of Reamnnz is in use in some places.

The Normal Temperature. The temperature taken in the axilla varies from 98.4°F (36.9°C) to 99.5°F (37.5°C) in the adult; in the infant it is slightly higher and in old age slightly lower. The diurnal variations are stated by Jurgenssen to be from 1.5° to 3.5°. The lowest reading occurs from 4:30 to 7:30 A.M. the maximum from 4:00 to 9:00 P.M. The temperature rises between 7:30 A.M. and 9:00 P.M. and then falls till 7:30 A.M., the variation following pretty closely the activity of the respiration and circulation. The limits of the rise and fall are from 91.4°F (33.0°C) to which there is rarely a lower observation, to 109°F or even 112°, 113° or higher (42-45°C).

Instead of taking the temperature—situation—

The thermometer is generally placed in the axilla in the adult; but in children it is often found more convenient to place it in the groin, in the axilla or scrotum. Sometimes in the adult these situations have some advantage; the instrument may be placed in the mouth. The axilla or groin are the only situations in which the metallic thermometer can be conveniently applied.

It is important that the bulb of the instrument should be in close contact with the skin; thus in the axilla it is placed under the fold of the pectoralis and the arm brought close to the side, the forearm lying across the chest. If placed in the groin it is best to cross one leg over the
Hypothermia with convulsions in an infant aged 10 months.
March 1895 - Case of Bronchitis and Pneumonia.

Fig. 16

Chart showing the course of the temperature, pulse, and respiration in a case of acute tuberculosis.

Fig. 17
other that the skin is close to the bulb of the thermometer. In the mouth keep the bulb away from the teeth, placing it between the tongue and the gums or between the gums and teeth cheek. In the rectum or vagina it is only necessary to see that the bulb is entirely inserted for which purpose a little oil may be applied.

The surface thermometer is applied to the surface to be examined and secured in position by some non-conducting bandage.

The thermograph is most conveniently applied to the abdomen but may be used in other situations if found more convenient.

Temperature charts—In taking a series of observations it is advisable that the temperature should be taken at nearly as possible at the same time and under the same circumstances each day. In ordinary cases a morning and evening temperature may be sufficient, but in severe cases it is advisable to observe the temperature at more frequent intervals, for instance every three or two hours or every hour or still more frequently. For ease of comparison the height of the thermometer should be marked on a chart such as that shown in fig 16. which shows at a glance, the temperature, and the time at which each observation was made. A single chart may be constructed to record the temperature, pulse, and respiration and then show the relation of the one to the other. See fig. 17.
Low Temperature. In disease a subnormal temperature is rare but it is seen under the following conditions:

1st. After prolonged exposure to cold. It is not uncommon to see the temperature descend below the normal after the use of the cold bath in the treatment of pyrexia.

2nd. After repeated haemorrhages such as occur in typhoid fever and sometimes after long continued haemoptyses. A temporary fall of temperature is seen after slight bleeding but recovery soon takes place and unless the bleeding is carried to a dangerous extent the temperature is not permanently reduced.

3rd. In cases of inanition and exhaustion, such as occur after long continued vomiting, in diarrhoea etc.

4th. From the use of certain drugs or under the influence of certain poisons. Thus Aconite, Antimony, Chloral and most of the iron- poisons produce a fall in the temperature.

5th. When the oxygenation of the blood is incomplete as in emphysaema, asthma and some cardiac affections.

6th. In the depression of fever the fall is in some cases below the normal.

7th. In the ‘algid stage’ of Cholera the temperature falls sometimes as low as 92° F.

Increase of Temperature. This is one of the essential phenomena of fever. If there is a morbid increase in the temperature, either one of the essential fevers exists or the fever is symptomatic of some local affection, and in such a case is excluded by a normal temperature provided that the influence of drugs, haemorrhages or cold are excluded. The thermometer is the only guide.
to the height of the year, though a quick pulse is the usual accompaniment to a high temperature, yet this is not always the case and a quick pulse may be present without any great rise in the temperature.

The degree of fever can variously be described. A rise of half to one and a half degrees, but not exceeding 101°F is considered a slight fever, and called a sub-pleural temperature. Moderately high fever has a temperature of from 101°F to 103°F. From 103°F to 106°F is considered a high fever. A temperature above this is generally called hyperpyrexic. As a rule there is a morning fall and evening rise of temperature, corresponding to the rise and fall which occurs at the same time in health. Generally it may be stated that, as the temperature of the body depends on the maintenance of a proper balance between the amount of heat generated in the body and the amount given off to the surrounding medium, any interference which causes a decrease in the amount of heat given off, or an increase in the production will cause a rise of temperature.

The temperature rises 1° on exposure to heat - it is 1/2° higher in residents in India (Laudon Bruntin Trenchant, 1838). Prolonged exposure in a medium where the regulating action of the skin cannot come into play, as in hot water or hot moist air, is better than the temperature of the body. 2nd. When the vital processes are increased as in the various specific fevers, or due to nervous influence or in inflammation. 3rd. In some hysterical cases where also the high temperature
due to the influence of the bowel system. The temperature often rise to an enormous height. M. J. Ziesle records a temperature of 122°F in the Lancet in 1875 and Ross records a case where the temperature varied from 98° to above 116°F (Diseases of Human Syph. p. 84). Very high temperatures such as these, should always be looked upon with suspicion.

For some nervous lesions, a local rise of temperature has been observed, apparently due to the increased vascularity of the part.

Types of Fever: (a) Continued, (b) Intermittent, (c) Septic.

(a) Continued Fever. The temperature from the beginning of the attack to its close is above the normal. This is seen in the specific fevers where only a single introduction of the poison takes place, and in simple inflammatory fevers where there is no development of the suppuration or septic variety.

(b) Intermittent Fever. In this variety there is a rapid elevation of temperature followed after a certain period by an intermission during which the temperature may reach the normal, to be followed after a longer or shorter interval by another rise of temperature and intermission. The fever poison seems to undergo repeated new multiplication, and does not exhaust the soil as does the poison of continued fever.

(c) Septic Fever. This cannot be described as a distinct type but rather as a variety of a continued fever. The term septic is applied to these varieties of fever which attend malignant
Disease, tuberculosis, chronic syphilis, and chronic disease of bones, where there is a continuous proliferation of tissue elements of a low type and the production of purulent discharge. The chief characters of diphtheria are its long continuance, vicious development, loss of flesh, and a temperature showing an evening rise with a morning intermission which rarely if ever reaches the normal in the first stage, but which later may become subnormal.

The phenomena of fever—
An attack of fever is usually announced by a feeling of malaise followed by a more or less distinct rigor in the adult, or in infants by a convulsion. The rigor however may be absent and the malaise only slight. The temperature begins to rise and goes on more or less rapidly, until it reaches its acme which may vary from 101° to 105°F. At this point it remains, it may be for several days, with only slight variations and then within twelve, twenty-four, or forty-eight hours falls to the normal. This is called resolution by crisis. Resolution may however take place by lysis. The return to the normal is gradual and the morning remission and evening exacerbation are more marked, having a difference of one to three degrees.

The symptoms accompanying this course of temperature are the following. The primary symptoms are an ill-defined feeling of being “out of sorts,” sometimes headache
Lanugo, and depression soon or less marked, and a disinclination to be disturbed. The limbs feel heavy and the patient feels unable to raise his head from the pillow. During the rigor he feels cold, the features are quivered, the lips and nails blue, the teeth chatter and the skin is dry and harsh (cutis marmorata). This may be so slight as only to amount to a feeling of uneasiness or slight malaise. The temperature at this time if taken in the mouth or rectum will be found often considerably above the normal through the surface thermometer may not rise to the natural height. As the axillary temperature rises the face becomes flushed, the skin warm, dry and often leaning or purplish. Perspiration is increased in the emaciated fever, sometimes in typhoid and relapsing fever. The tongue becomes furrowed, dry, and often cracked; the colour ranging from the bright red tongue of scalding to the brown or black tongue of typhoid. Sores in the gums and teeth are frequently seen.

The Pulse. The heart is generally proportionate to the size of the temperature but in some of the typhoid type it may be below the normal. As the temperature rises the pulse becomes full and bounding and the patient often has the sensation of throbbing in the temples or elsewhere. Towards the end of the attack, the pulse may become fluttering and sometimes diastolic.

The urine in spite of the increased consumption of fluids
and the absence of perspiration is concentrated, and the quantity of urea and uric acid excreted is increased. Albumen is sometimes present and blood may be observed. The chlorides are scanty or absent. Delirium and various central disturbances are often present. Respiration is increased in frequency and is shallow especially when fever disease is present. The appetite for solid food is impaired and nausea is not uncommon, but the desire for fluid is increased and thirst is generally a marked symptom. The bowels are generally constipated but diarrhea is not uncommon especially if there is any acute inflammation of the intestines. Association is always present but is not marked unless the fever is very high or remains high for a considerable time.

In fall of depression - The temperature falls rapidly and steadily in depression by crisis, more slowly and irregularly in depression by lysis. It is important to distinguish the fall of recovery from the fall of approaching death. In the latter (the presomnita fall) the pulse remains high, and irregular and flatter, while in depression the pulse and temperature fall together. The tongue becomes moist, delirium disappears, and there is frequently an outburst of perspiration and a green discharge of urine. But sometimes the depression when rapid is followed by a period of great depression and weakness.
The frequent administration of food, and a course or low
rate exhibition of stimulants. A slight disturbance at
this time either of the bodily or mental functions, for
example, unsuitable food, too much talking, excitement
will cause a rise of temperature and a temporary return
of the febrile symptoms.
The Pulse in fever. The normal frequency of the
pulse is from 60 to 80 beats per minute. In fever
the rate is increased up to 100 or 150 beats per minute.
The increased frequency corresponds to some extent
with the temperature. A slight fever has a pulse rate
of about 100 per minute; 100 to 120 is seen in a moderate
fever, and with a very high fever the rate may be
140, 160, 180 or even 200 beats per minute.
Character. During the height of the fever the pulse
is full, hard and bounding. The aphygmographic tracing
shows a high upstroke and sudden fall. In the cold
stage (rigor) it is hard and small, while in the sweating
stage (fall) it is full, large, and soft.
Independently of fever a rapid pulse is seen in cases
of Hypothyroidism, in irritation of the sympathetic,
and in cases of the vagus (destroying the inhibitory action)
by a tumor and in some cases of heart disease — the
temperature remaining normal.
A high temperature with a relatively slow pulse is seen in
some basal affections of the brain. It is evident therefore
that the examination of the pulse alone is not sufficient.
to diagnose a condition of fever.
During this phase, the pulse falls rapidly corresponding to the fall of the temperature. The fall by
lypia takes place gradually, sometimes continually, but
more often with ups and downs similar to the changes
in the temperature.

Fever in Acute Disease. In acute inflammations
the fever follows the course of a continuous fever being
with the onset of the inflammation and falling as
the inflammation subsides. In chronic infections,
especially in phthisis, empyema, carcinoma of the
lungs, the type is hectic.

In some cases the patient, more especially when the
heat issue is impending, passes into the typhoid
state, or called from its resemblance to what occurs
in the late stages of typhoid fever. It occurs in
cases when the continuance of the fever is prolonged, and
is seen in pneumonic, pleurisy, pericarditis, with varying
frequency.

The Typhoid Condition. The patient became prostrate, he
lies in his bed, with eyes closed, features drawn and
gratuit, and a dull stupid aspect; unconscious or nearly
conscious of everything that is going on about him. He,
clumsy, moist, and sometimes, bathed in sweat, which
often yields a fetid odor, and is for the most part, especially
in the extremities, or exposed situations, cold. His lips are
dark black and bloodily pimpled, his teeth loaded with blood
his tongue dry, brown, or black, and often contracted in all its
dimensions.
The desire for food is usually slight, and probably no material thirst.
but he has a difficulty (partly due to the condition of his mouth)
in swallowing and utterance. His bowels are sometimes constipated,
but often relaxed, and the evacuations are apt to be offensive.
His respirations are shallow, but for the most part not much
accelerated—ranging probably between twenty and thirty in the
minute. They may however be much more frequent, and are
liable to variation. The pulse is rapid and feeble, and, toward
the end, imperceptible at the wrist, and irregular. It may
vary at first from 100 to 120, but often attains a frequency
of 140 or more, and at the same time becomes extremely
irregular in character. The sound of the heart is liable
to become inaudible. Shortly before death, the superficial
capillaries often dilate, the blood accumulates and stagnates
within them, the surface acquires a ruddy aspect, and a proper
flow of perspiration takes place. Blood is apt to form
upon the expanse and other parts exposed to pressure. The
condition of the urine presents considerable variety—sometimes
it is scanty, high colored and loaded with urates, sometimes it
is abundant, pale, and limpid, and of low specific gravity. Muscular
stiffness is shown in the tendency which the patient has to lie
upon his back, and to curl towards the bottom of the bed.
His senses are blunted; often he is deaf; he takes little notice
—even if his eyes be open—of surrounding objects; he rarely conveys
a pain or uneasiness, or acknowledges its presence, and is
insensible to conditions which at other times would have caused
much personal discomfort; his intelligence is impaired, especially
his memory; his mind is full of delusions, and he is more
or less constantly muttering— he is in a condition of—
low-constituting delirium” or typhomania, he can probably however, be recalled to himself momentarily if addressed loudly, and will then half open his eyes, endeavour to do what he is told and even give an intelligent response, but he soon lapses into the state from which he was awakened; he picks at the bed-clothes; his limbs are tumultuous when he endeavour to use them, and his muscular fibres are in constant vibratile movement giving rise to the condition known as subsaults tendinitis; he passes his evacuations incessantly, or allows the urine to accumulate in his bladder. With the advance of the typhoid symptoms, the mind becomes more and more obtuse, and the patient gradually passes into stupor, and thence into profound coma. The temperature presents great variety, dependent in a considerable degree on the nature of the disease upon which the typhoid symptoms depend; sometimes as in Brigg's disease it is a good deal below the normal standard, sometimes as in the hyperpyrexia of acute rheumatism, it attains the elevation of 110° or more. The typhoid condition is always one of great privation, and in a large proportion of cases terminates in death”

(Thom and Practice of Medicine. Kriitian Ap. 36. 100)

Examination of the Subcutaneous Tissues — Dropsy.

“Dropsy is invariably caused by the transudation of the serum of the blood through the veins” — “The causes of the increased transudation of fluid are two — laceration of the veins or an abnormality in the condition of the blood which gives rise to changes in the wall of the vessels and...”
Passive oedema is a symptom of certain conditions of the circulation. It occurs whenever the return of venous blood to the heart is impeded as by pressure on the jugular vein, or when the splanchnic flow of blood is interrupted as in aortic regurgitation. If the obstruction be on the left side of the heart, as in mitral stenosis or regurgitation, the oedema occurs first with the lungs and only after the right heart has become incompetent does general oedema ensue. Local passive oedema may occur owing to pressure or constriction of the vessels as in embolism of the lungs, the cirrhosis of the liver. Oedema of a still more local nature is caused by the blocking of a vein by embolism or by its obstruction by pressure from within.

Hydraulic oedema is symptomatic of a variety of conditions. It may occur in simple debility after exhausting disease or from simple malnutrition. The most important condition however are the acute or chronic varieties of nephritis, the hydropemia being due to the diminution of the water excreted by the kidneys and in some cases by the skin also.

The chief features of oedema are the swelling, the appearance of the skin and the effect of pressure. The swelling is
always most marked where the tissue is loose as in the subcutaneous region, the buttocks, or the face. The swelling is rounded and even, and definitely limited but more widely distributed than swellings from other causes. The skin loses its natural colour, is pale, and when the swelling is well marked becomes tense and shining. When pressure is made the tissue feels doughy and non-elastic, and continuous pressure gives rise to a more or less distinct flattening, the depression remaining for a considerable time.

Drayer in Thoracic Disease.

The occurrence of drayer in cardiac disease has been noticed, as well as that due to emphysema. In its slightest degree it is noticed in chronic bronchitis, phthisic, cirrhosis especially when there is much debility. In thin emaciated, cancerous, will give rise to drayer.

In connection with cardiac drayer or any general drayer it should be noted that there is always more or less extension into the lower cavities giving rise to hydrothorax cardiacum, hydro-thorax.

Subcutaneous Emphysema. — The swelling of emphysema resembles drayer in appearance, but is different in its distribution, drayer occurs in the more dependent parts, while emphysema occurs in the parts nearest the end of the supply of air. It is caused by the entrance of air into the subcutaneous tissues. This may follow the rupture of any of the air-containing viscera when the rupture

...
communicates with the subcutaneous tissue. Thus, capture of the trachea or oesophagus or of the pulmonary oesophagus may be followed by emphysema, but in the latter case, unless adhesion with the thoracic wall are present, the emphysema is followed by pneumothorax. When capture of the air cells takes place from simple overdistension, as by coughing, the air may be forced into the interlobular septa and through the small sinuses into the root of the neck.

Emphysema of the subcutaneous tissue is also caused by traumatic injury as by a fractured rib, when the swelling may be local or general as in the remarkable case recorded by Prof. Stewen (System of Surgery, Pt 1113-1127).

The character of the swelling is different from that of edema. The skin has not the same shining appearance, and the swelling feels less dense and more elastic and on pressure produces a peculiar crackling sensation. When the accumulation of air is marked, air enters alone or mixed with serum escapes when the skin is punctured.

In thoracic disease, subcutaneous emphysema occurs after injuries to the pleuritic, in capture of the oesophagus by perforating ulcer or in elevation of the trachea, in pleuritis of the lungs, and in capture of the air cells of the lungs.

The Swelling of Myxoeedema — The appearance resembles edema in some degree, but the gradual appearance of the swelling, the hardness of the skin, the hardness of the subcutaneous tissue, the expression of the face, the oedematous pluck, the articulation, with the other mental features of the disease serve to distinguish this from the swellings.
Symptoms

The heart and lungs are so closely connected in their nervous supply, as well as by the mechanical arrangements of the circulation that it is not surprising that many of the symptoms which indicate disturbance of the heart should be the same or closely resemble those which occur in disease of the respiratory organs, and vice versa.

Pain. Pain the result of traumatic injury, tearing of the thoracic wall, fractured ribs, wounds of the heart or any special notice, except to point out that a strict examination should be made in order to ascertain as far as possible whether the organs below the seat of the injury have suffered or not and whether pleurisy or pericarditis may not be present, the result of the injury or of some other cause. Pleurisy (muscular pleurism) and intercostal neuralgia occasion a great amount of pain which is more or less affected by the movements of respiration and often cause the patient great alarm. The absence of other symptoms and the physical examination will readily make the nature of the case clear. Pericarditis may go through all its stages without pain, but in the early stages especially if the cough be at all severe there is a sense of congestion and tension often amounting to actual pain in the atelectatic region. The most important cause of intra-thoracic pain however is pleurisy and pericarditis. The pain in both cases is caused by the rubbing together of the inflamed surfaces of the serous membranes lining the pleura or pericardium, - the pain in both occurs at the beginning of the inflammation, disappears when effusion occurs and may return when absorption takes place.
The pain is often severe, sharp, burning, and lancinating. The duration and extent of the pain will usually serve to distinguish the one from the other, but a limited pleurisy in contact with the pericardium will often simulate pericarditis especially in cases of adherent pericardium. The pain in pleurisy and pericarditis is increased by pressure, but in pleurisy the pain as a rule ceases when the breathing is stopped while it continues unaffected in pericarditis, and of course the physical examination will clear up the nature of the case.

Pain is sometimes present in pneumonia, pleurisy, abscess of lung or heart in most cases pleurisy generally of limited extent is present, and the disease of the lung may go on through all its stages without pain.

Cardiac affection with exudation of pericarditis and angina pectoris are as a rule unattended by any pain, but a feeling of distress or heaviness in the precordial region is present in some cases, especially myocarditis but this is by no means constant. Angina pectoris causes a dull boring pain the result of pressure, and for the same reason solid intrathoracic tumours may give rise to pain, while the sharp darting pain of cancer is felt when that disease occurs within the thorax.

Cough - A cough is an expulsive respiratory effort, sometimes entirely reflex being stimulated by irritation of some of the sensory nerves distributed to the pharynx, trachea, bronchi &c. or by irritation of some other reflex arc such as the aneurysm, or it may be purely voluntary and under control of the will, or as is most common it is partly voluntary and partly reflex.
Cough is a common symptom in affection of the trachea, bronchi, bronchioles, and lung substance, in some cardiac lesions; in aneurysm and other extrathoracic tumours it forms an important symptom.

Varieties of cough:—1. A cough is termed dry, when no expectoration is present and where from the sound of the cough, no evidence of the presence of fluid is observed. In the first stage of cataract (pharyngeal, laryngeal or bronchial) the cough is dry and becomes moist when inflammation takes place. A dry hacking cough is often suspected to indicate incipient phthisis; but not infrequently this is found to be simply nervous and quite unconnected with any disease of the respiratory tract and to be due to hysteria. The so-called "stomach" cough is generally dry and of nervous origin.

2. Sputum or bloody cough. This term is applied when secretion begins to accumulate in the bronchi and to be expelled through the larynx. A cough is typically loose when the secretion is abundant and fluid, and is expelled without any great effort.

3. Suppressed cough. This can scarcely be called a variety of cough, but is rather a symptom of pain, thus in pleurisy or after an injury to the thorax (e.g., broken ribs) the patient avoids movement of the thorax as far as possible and therefore suppresses the inclination to cough, and when coughing becomes empiric the act is short and with as little movement as possible and often accompanied by an exclamation of pain.
Spasmodic cough. This is a purely reflex act, and continues for a longer or shorter time, before it can be checked or ceases naturally. The best example occurs in whooping cough, but occasionally in bronchitis when the mucus is very sticky and adherent—a cough which began voluntarily will develop into a spasmodic and reflex cough.

(5) Sycronic cough, is short and dry and frequently is the result of habit or dulness. It is common in apoplexy and is accompanied by any evidence of respiratory disease.

(6) Subacute cough, or chronic cough. This arises in cases of extreme weakness; it has a hollow sound and is quite unproductive. It does not actually indicate appendage dissolution, as its name might imply, but merely an extreme degree of weakness.

The sound of the cough (quality and intensity) depends on the condition of the larynx, the strength of the patient and the condition of the pharynx and tonsils. If the larynx is healthy the cough is clear and ringing, but may be muffled or obtain a peculiar nasal sound when the pharynx of tonsils are enlarged. (The cough of pharyngitis and tonsillitis is generally of a hacking nature). Should the larynx and branch cords be inflamed, even though it is of a slight amount the cough becomes hoarse and the voice of the patient is affected in a similar manner.

Examination of the Throat—

Expectoration is present to a greater or less extent in some of the stages of all diseases of the respiratory organs.
and its appearance is often so characteristic as to afford data for an absolute diagnosis. The presence of sputum is not to be looked upon as an indication of intrathoracic disease, as the secretions from the nose and pharynx which are usually expelled by a short-hacking cough may be drawn through the larynx and expelled by coughing. The absence of expectoration does not exclude respiratory disease, but in the presence of coughing it indicates the presence of tenacious sputum in the bronchi, and when strength is failing and the disease evidently is extending, it is an symptom of the greatest gravity often indicating approaching dissolution.

The constituents of the sputa are chiefly: mucus, pus, blood, serum, epithelium (chiefly squamous), lung tissue, tubercles, nodules and chalky excretions, fibrinous coats of the trachea or bronchi, crypts, fatty acids or of blood pigment, cholesterol and tyrosin, fungi of several varieties, bacilli and micrococci, tannin, blood cells, fragments of food, foreign bodies etc.

It is usual to assign special names to the varieties of the sputa, indicating the element which is present in greatest amount. Thus, mucus expectoration consists almost entirely of mucus and is simply an increase in the normal secretion of the bronchi; purulent of pus which occasionally is pure from the bursting of an abscess into the trachea or bronchi, but mucus is nearly always present—
and in the mucous-purulent variety, the two constituents are in nearly equal proportions. Sputum is sometimes present in large amount (edema of the lungs) and the sputum is then termed serous, but it is more usual for certain of the other elements to be present and mixed intimately with the serous discharge and we get the mucous-serous or sero-purulent forms of sputum.

Blood may from the greater part or the whole of the expectoration after the rupture of a large vessel in the lungs, or it may only tinge or streak the expectorated matter, or may be so intimately mixed as to give a rusty or brick-red colour to the sputum.

Fibrinous sputa are the result of fibrinous exudation into the bronchi or trachea as in diphtheria or in the fibrinous form of bronchitis; occasionally they are produced by the decolorisation of blood clot taking place in the lungs. The other forms of expectoration such as the "prune juice", the "currant jelly" or the gangrenous may be included as varieties of one of the above forms.

Charcoal and scalded eye appearance of the sputum.

Gaseous sputum is frequent to some extent in all pulmonary diseases where expectoration occurs, but it is in the first stages of bronchitis that it is specially significant. The sputum may be clear and foamy but is more usually of a greyish, greenish or almonnd-black
Colour from the inhalation of smoke, dust, soot or other colouring matter. It is adhesive and sticky and when a portion is separated it is drawn out in strings; some air is always present and gives a somewhat gritty affair, and the expectoration will float when placed in water. The consistency varies; at first, especially if the bronchial irritation is very severe, the expectoration is adhesive so that it is only expelled with difficulty, but later when the number of white corpuscles increases, the expectoration becomes less viscid and gradually acquires a mucopurulent appearance.

Mucopurulent expectoration is generally of a greyish-white or yellow colour. It is more fluid than pure mucus and contains less air and therefore has less tendency to float in water, but has a tendency to separate into layers the purulent part forming a deposit at the bottom, on which rests a layer of mucus often in comminuted masses, with floating corpuscles at the top. The expectoration may run together in a vessel, into a mass; at other times each distinct mass expectorated remains separate. Hence the term "comminuted" is applied to this variety of expectoration, from the rounded and flattened character of the little masses. This appearance is often seen in Phthisis, as is also the separation into layers of the
Expectation but expectorate can be considered to be pathognomonic of that disease as they occur in ordinary subacute cases of Bronchitis.

Purulent expectoration—Sometimes in Bronchitis especially in the more chronic forms the sputum contains so much pus that it is termed purulent. A large amount of serous howes is always present as can be seen by the stringy nature of the sputum, but pure pus is sometimes expectorated after the bursting of an abscess into the trachea or bronchi. Such an abscess may lie in the lung substance, in the mediastinum, in the liver, spleen or elsewhere. In Empyema, the matter may be discharged through the bronchi, a sinus being formed in communication. Purulent expectoration has the same character and appearance as pus from other sources. It is generally of a creamy consistency, thick as water and when free from ounces cannot be drawn out into stringy. When the pus is discharged from a suppurring cavity in the lungs, it is frequently yellow and the smell of the expectoration as well as the patient’s breath is very offensive.

Expectoration of blood—Hemoptysis—It is always necessary to examine the throat—
Rose, to ascertain whether the expectorated blood does not come from these regions. Actually there is no great difficulty in determining this point, but it is more difficult sometimes to be certain whether the patient has not vomited the blood especially if the blood be not seen. Vomited blood is dark in colour not mixed with air and has a slightly sour smell, but it must be remembered that vomited blood may come originally from the lungs and has just passed into the stomach. As a rule after the expectoration of a quantity of blood, the sputum remains coloured for a little time after, and blood pigment may be demonstrated in the sputum some time after the haemoptysis has ceased.

A small amount of blood is sometimes seen in the beginning of Bronchitis, but rarely as strokes in the sputum and rarely lasts long. Before any of the physical signs of Phthisis show themselves, haemoptysis is often seen, and is a most important symptom, but by Riemeyer is regarded as the cause of many disease. Doubtless a great number of cases of Phthisis are met with where haemoptysis has occurred followed by the lung symptoms, but it is difficult to determine the extent to which the lung symptoms are their causative to the presence of blood in the alveoli.
When cavities are being formed in the lungs, the vessels so they are exposed are very apt to be the seat of haemorrhage, which may be only of small amount, but is frequently extensive and sufficient to cause the immediate death of the patient. The blood in such cases is generally bright and florid and is only slightly mixed with mucus, pus, or lung detritus. In other cases, the haemorrhage takes place more slowly, and the blood is expectorated mixed with the secretion and detritus from the cavity, or the blood may remain in the cavity and become dark from deoxygenation, or undergo various changes the result of decomposition or other chemical processes.

When the lungs become engorged with blood the Occult of Mitral disease, small haemorrhages are not uncommon. Cough is frequent owing to the edematous condition of the lungs, and the expectoration before the haemorphysis, is watery and of considerable quantity. It is in Mitral disease, or as a complication of Bright's disease, that pulmonary abscess is most prone to occur. The haemorrhage takes place partly into air cells partly into intralobar tissues. Some of the blood is expectorated and may be bright in colour but more often dark and venous, the rest of the extravacated blood remains in the tissues, where it may be absorbed leaving only a patch of pigmented or breakdown and suffused, or death may ensue before any change can take place and if post-mortem shows a more or less localized.
Fig. 18. Fibrinous casts from Bronchi
(Bristow Medicine P 340)
Serosa exsudation occurs in regions of the lungs due to obstruction of the central valvulae, and in congestion of the lungs, and occasionally is secreted by the bronchial tubes. The expectoration is thin and watery with some viscosity dependent on the amount of mucus present, or it may be turbid and semifluid from the presence of pus corpuscles. In the former case the expectoration is termed mucous, in the latter purulent.

Fibrinous expectoration - This consists of fragments of false membrane from the trachea, or bronchi, more rarely of casts of the bronchi extending to their finer divisions (Fig 18). The sputum should be placed in water when the casts unroll and their tree-like character becomes evident. They are always the result of fibrinous bronchitis and occur very frequently in the early stages of pneumonia of adults, which is generally accompanied by a fibrinous inflammation of the finest tubes. They appear in the sputum from the beginning to the acute of the stage of desquamation, that is usually from about the third to about the seventh day of the disease, but are absent in the first stage, as exudation has not yet taken place, and in the third stage, the plastic exudation having then become fluid and in great part absorbed. 

* * *

* in about 10-20 per cent of cases they are absent when the patient is weak. Expectoration is scanty, and the patient weak and exhausted and unable to cough with any degree of force.
Lobular casts of the bronchi are most
membranous and most perfectly formed in cases of chronic
bronchitis, acute as well as chronic. (Suttman p. 180-181)

Fonseaeus exsudation. — In gangrene of the lungs
and in bronchitis acute the exsudation has occurred.
The exsudation is of a very offensive character. The exsudation
is of a dirty yellowish colour, but in sometines stained
dark claret colour the result of haemorrhage. The
lung detritus, milled and lobics, and if the exsudation has
remained long enough in the lung, fatty crystals are the
chief constituents. Few or no elastic fibres are discerned
in which points this exsudation differs from the pituitous
exsudum where there is also great destruction of tissues.
The odor is very offensive and the patient’s breath
has a putrid odour even before expectoration has occurred.

Microscopic Examination. — The exsudum may be
examined without special preparation with a magnifying
power of from 200 to 300 diameters but for the demonstration
of lung tissue it require to undergo special treatment
in order to bring out the elastic fibres clearly and elastic
processes, staining reagents and high powers of the microscope
are necessary to discover the bacilli or micrococci which
have been identified in the exsudation.

The Microscopic characters of Boccos and pus do not
again any notice here.

Pituitous exsudum should be collected for about 24 hours.
Fig. 19 Elastic fibres from Pathological Spumum

Fig. 20 Bacterium Pneumoniae Cruspus from Neural cavity of a mouse. A.B. Thread Forms C.D.E. Short Rod Forms. G. Diplococci, H. cocci. I. Streptococci. From Cruickshank's Bacteriology P.226

Fig. 21 Bacillus Tuberculosis. Stained by Carlin's Method X 1500

(Cruickshank's Page 272)
mixed with a solution of caustic soda or liquor potassii and boiled till the mucous which is present has lost its tenacious character, then if allowed to settle in a conical glass and a specimen taken from the bottom of the vessel and examined with a multiplying power of about 300 diameters there is no difficulty in demonstrating the curled fibers of elastic tissue, as shown in Fig. 19.

To demonstrate the bacteria of pneumonia:  

(a) Stain by method of Gram and after stain with eosin.  

(Gran's method is to stain for 3 minutes with aniline gentian violet solution, and decolorize with absolute alcohol, when the eosin may be added.)

(b) Treat with acetic acid, then stain with gentian violet or hematoxylin. Eosin is distilled water, or dry and preserve in Canada balsam.

(c) Float them on weak solutions of the aniline dyes for twenty-four hours; differentiation of coccius and capsules is thus obtained.

(d) Stain with aniline acid; the contour of the capsule is brought out.  (Creilshanke's Bacteriology, p. 227)

The Bacterium Pneumonicum Enfleurus is shown at Fig. 20.

The Bacillus of Tuberculosis - Tubercle Bacillus - "Rod, 2-3 µµ, and occasionally up to 6. Very thin, and rounded at the ends. They are straight or curved, and frequently banded (Fig. 21) and occur singly, in pairs or in bundles."

"The Bacilli appear to be the direct cause of tuberculosis, and the presence of the bacillus in the sputum..."
Fig 22. *Bacillus Tuberculosis*.

From a coverslip preparation of this from a tubercular cavity of the human lung. Ethiolic Method (Fuchsin and Methylum Blaze).

Lyco 0.1 Oc. 4.

Crawshaw and Mack 17492011
of patients is regarded as a distinctive sign of the existence of this disease. The detection of the bacillus has, consequently, become a test which is daily applied by physicians in forming clinical diagnoses.” (Bacteriobolos loc. cit. 1271)

To demonstrate the bacilli in the sputum, cover-glass preparations should be made, taking care to take some of the matter expectorated from the air cells or a cavity, and not merely from the bronchi; this should be spread in as thin a layer as possible and dried, after which they should be thrown rapidly through the flame of a spirit lamp or bunsen burner. To stain the preparation, various methods may be followed but Ehrlich’s or Giffes’ methods are the most useful.

Ehrlich’s Method - Cover-glass preparations are allowed to float in a watch glass, containing a solution of gentian violet of quinoline, added to aniline water. A saturated alcoholic solution of the dye is added till precipitation commences (10 ccm. aniline water, and 10-20 drops of the colour solution).

The covers glasses are left in the solution for about half an hour, then washed for a few seconds in strong nitric acid (one part-commercial acid to two of distilled water), and rinsed in distilled water. After stain with cresylic or methylene blue, rinse in water, dry and preserve in Canada balsam . . . . . (Fig. 22)

Giffes’ New Method - Cover-glass preparations are placed in the double staining solution, which has been warmed in a test tube, and, as soon as the steam rises showed into a watch.
Dr. Gibbes 'double stain' is prepared thus:

Hydrochlorate of mordant

Hydrochlorate of potash

Hydrochlorate of arsenic

I

Methylene blue

I

1

Mix in a mortar, add

Strychnine oil, Jasmelone, &c., in 10 vols. of methylated spirit and add to the above, to which finally 15 parts of distilled water are added. This is very convenient from the short time preparations take to stain.

To examine Bacilli 1/2 0.2 with a 93 or 94% of cupric oxide gives excellent results.

The other matters found in the sputum are fatty acid crystals, crystals of tyrocin, cholesterol, hyaluronic acid, coal dust, fragments of atelectatic particles of food &c.

Dyspnoea—orthopnoea—shortness of breath.

The feeling of want of air, occurs both in health and disease, and may be so slight that the breathing is scarcely altered and a momentary rest, or a slight change in position is sufficient to relieve it; or it may be so extreme as to cause the most violent efforts, into which nearly all the muscles of the body may be pressed, in order to obtain relief.
In health dyspnœa occurs under the same conditions which it does in disease, that is, when the supply of oxygen is insufficient for the expenditure; then a violent effort the circulation is quickened, the oxygen in the tissues is exhausted more rapidly than usual and the aspiration must be increased in rapidity or depth to supply the want.

In rarified air at high altitudes, dyspnœa is a common symptom with those who have ascended rapidly from the dense atmosphere of the plains, while the residents at such elevations are unaffected, probably owing to the great expansion of the lungs which takes place in them who habitually breathe rarified air. (Hirsch, Anatomical Pathology Vol. 1 P. 9. Syd. Soc.)

In disease, dyspnœa occurs whenever the process of blood aeration is interfered with and is thus a symptom of cardiac and pulmonary mischief. In affection of the lungs, large areas may be shut off from participation in aërating process without any dyspnœa unless on exertion, provided that the diminution has taken place gradually. Thus dyspnœa occurs only on exertion in many cases of pneumonia, pleuritis, or pleurisy when the consolidation of the lung has taken place slowly. When however the aërating surface is rapidly diminished dyspnœa is marked and often most painful. This is best seen in collapse of one lung in pneumothorax, the
Result of the sudden entrance of air into the pleural cavity through an opening in the lung substance or in the wall of the thorax. In pleurisy also when the expansion takes place very rapidly and in pulmonary aspiration where a large portion of lung is rendered useless suddenly, dyspnoea is often extreme. In sudden plugging of one of the larger bronchi as sometimes occurs from a foreign body slipping into the trachea through the glottis and becoming impacted in a bronchus will give rise to a great amount of dyspnoea with a sense of suffocation.

In cardiac cases, everything which tends to hamper the action of the heart will tend to produce dyspnoea. Thus it occurs in puricarditis especially when adhesions form; in compression or distortion of the heart by a tumour, and to a minor extent by a distended stomach. When the heart's action is weak also, the walls degenerate, or loaded with a deposit of fat, dyspnoea is frequent. The most marked cases however are in those forms of valvular disease in which the pulmonary circulation suffers, thus in central stenosis and incompetence, in pulmonary and tricuspid disease dyspnoea is often very marked, and orthopnoea (that is when the patient is unable to lie down on account of the difficulty of breathing) is frequently present. In coarctation disease so long as the mitral valve remains healthy inspiration is only slightly interfered with, and any dyspnoea present is probably due to the rapidity of the heart's action. Pain in the thorax or in its neighbourhood will
Often causes dyspnea owing to the shallow inspiration which the patient adopts to ease the pain.

Certain conditions interfere with the respiratory centre, paralysis of the muscles of inspiration, obstruction of the larynx or trachea, and the inhalation of irritant gases, such as sulphurous acid by causing spasm of the bronchial muscles are amongst the other causes of dyspnea. Anaemia is also a very frequent cause of dyspnea.

The amount of dyspnea present depends to a great extent on the wants of the patient, thus in phthisic though the greater parts of both lungs are rendered almost useless, the patient experiences comparatively little difficulty in breathing owing no doubt to the little exertion he is capable of, and the very low state of the vital process which is seen in the emaciated phthisical patient. A healthy full blooded man on the other hand if deprived of the use of even a small part of his lungs would suffer to a greater extent from dyspnea.

The depth and rapidity of inspiration vary greatly during dyspnea. As a rule, the rapidity is in inverse proportion to the depth, very rapid inspiration being more shallow, while deep inspiration is slow. In dyspnea from disease of the lung substance or caused by pain, the inspiration is very shallow and rapid, while in that caused by obstruction of the larynx or trachea the depth is increased, and the duration of inspiration prolonged.
while expiration, unless the expulsion of air is likewise impeded, as it may be in bronchitis with cough, sticky secretion, may be normal or shortened.

Dr. Brookwell gives the following as the chief forms of dyspnoea in cardiac disease:

1. Dyspnoea on exertion, the breathing being normal when the patient is at rest. Chiefly met with in mitral lesion; in dilatation of the right cavity of the heart; and in cases of anaemia, in which it is due in great part owing to the altered condition of the blood.

2. Dyspnoea as a result of change in position independent of lung complications. Patient-say when sitting up, becomes breathless on lying down, after a time the heart accommodates itself to the altered position, breath good down and patient falls asleep. Probably due to the altered position of the diaphragm or to reflex impulses passing from the stomach through the vagus to the heart.

3. Paroxysmal attacks of dyspnoea. Due in some cases to sudden overdistension of the cardiac cavities in others to spasm of the glottis, produced by pressure of an aneurism of the aorta or a recurrent laryngeal nerve; in others to the pressure of an aneurism on the trachea; in others to sudden oedema of lungs produced by overdistension of the left ventricle (rare); to sudden distension of right ventricle and imperfect supply of blood to the lungs; in others to plugging of the pulmonary artery (very exceptional).

4. Typical asthmatic — Difficulty of breathing comes on
gradually castit permanent orthopnea is established, common in late stages of cardiac disease, mitral disease, and dilated right ventricle. Patient more or less cyanotic, dyspnoea, hydrothorax, bronchitis, oedema of lungs the prominent symptoms.


In some cases of cardiac disease, more particularly when right heart is dilated and fatty, a peculiar rhythmic "dyspnoea is observed." There is difficulty of breathing for a few respirations, the dyspnoea gradually subsides then breathing becoming shallower and slower until for a time — half to three quarters of a minute — it is suspended. Breathing gradually recommences becoming deeper and quicker until the height of the respirations is reached. The same sequence of events then occurs, the cycle lasting about one or two minutes, less than half being occupied by the period of rest.

It is not pathognomonic of any one condition and occurs in:
(a) Advanced cardiac cases — dilated and fatty right heart, atheroma of coronary arteries, dilatation of aorta; (b) certain cerebral conditions affecting neighbourhood of medulla; (c) alkalosis; (d) very exceptionally in other conditions.

It is a grave symptom, as a rule directly followed by death. (Cited from B. Browning, "Dis. of Heart," P. 66-69)

Diagrammatic representation of Cheyne-Stokes Respiration.
Dyspnoea then as a symptom points to:—

1st. In the Respiratory System—obstruction of larynx, trachea or bronch; partial or complete compression of the parts of the lungs; infiltration of the air cells of the lungs; destruction (rapid) of lung tissue; pain in the thorax.

2nd. In the Circulatory System—valvular disease especially of the internal and valves on right side of the heart; dilatation of the cardiac cavities especially the left auricle and right ventricle; rapid action of the heart; heart heart-(fatty) adherent-pericardium; aneurysm.

3rd. In the Abdomen—Pain,—distension by tumour, gas fluid,—preventing diaphragmatic action, or hampering action of the heart.


5th. Condition of the Blood—Anaemia on

Pallpitation—Hyperacropsia—

Fast action and rapid action of the heart occurs in neurosyphillis of varying length, which last for a few minutes or may extend for some hours. The sensation is often painful and somnolentia is accompanied by the idea of approaching death. Pallpitation is occasionally observed in valvular disease last is most frequently due to functional disturbance. The rate of pulsation
they be as high as 200 per minute. Single or short action is felt in those lesions where hypertrophy has occurred to a great extent - the heart's pulsation is slowed rather than quickened and the sensation is altogether different from the rapid erratic beating of palpitation.

Intermittent action of the heart. Sometimes the patient is conscious of the stoppage of the heart and this alone may bring him under observation. Intermittency is sometimes purely functional but may indicate serious cardiac lesions or cardiac dilatation so that in all cases a thorough physical examination is required.

Syncope. This is frequent in anaemia and in simple debility and may be entirely independent of the condition of the heart, but - due to vasomotor influences causing a sudden emptying of the vessels of the brain. In dilatation of the right ventricle and some other cardiac conditions, syncope is not unfrequent especially after exertion.

Headache and malaise often precede acute diseases such as pneumonia, pleurisy and a distinct rigor may occur. A continued throbbing headache is sometimes suggestive of vascular disease but is by no means a constant symptom. The severe objective symptoms, rash, epistaxis have been already noticed under the "general condition."
Physical Examination of the Thorax

Disease of the Respiratory System

Inspection - The patient should be stripped to the waist, and placed in a good light in front of the observer; he may be seated, standing, or lying, the position varying according to his condition and the convenience of the physician - to inspect the dorsal aspect of the thorax of course it is necessary to have the patient raised even though he be confined to bed. The light should be so arranged as to fall evenly on the surface, and it is as well to avoid a strong light from one side, which is apt to throw shadows and exaggerate any irregularities in the conformation.

Shape of the Thorax - The thorax presents many varieties in its form and configuration, and it is impossible to describe exactly what constitutes a perfectly formed thorax. The symmetry of the two sides is essential, the sternum perfectly in the middle line, slightly convex forwards but free from any decided bends or irregularities, the spinal column straight, that is, with no curvature to either side, but with a slight convexity backwards. The two segments of each pair of ribs should correspond in their direction and curvature; and the thorax as a whole should have a general roundness and fulness that is more
Unilateral enlargement — Sometimes this can be seen at all stages of the respiratory movements, at others when the expansion is less it is only at the end of expiration that it is evident, that the one side is less than the other. The enlargement is brought about by the distension of the pleural sac with fluid, gas or a combination of both. The movement of the affected side is restricted and the intercostal spaces are flattened (levelled off) or bulge forwards. Unilateral enlargement is seen in pleurisy or empyema in which the amount of fluid is large and in pneumo-thorax or false pneumo-thorax.

Extensive pneumatic infiltration of one lung is occasionally accompanied by considerable enlargement of the corresponding side of the chest. Vesicular emphysema of one lung can scarcely ever occur to such a marked degree as to alter the form of the thorax on that side, the author at least has never seen such a case (Hutchison loc. cit. p. 30).

Local enlargement — External swellings such as abscess or solid growth, enlargement of the bones will cause a local bulging which must be distinguished from those occurring within the thorax. The sternum may bend in spiral curvature or in ricciuto, or in cases where the accessory muscles are constantly brought into use, as in consumption, a local enlargement takes place. In some growths within the thorax, such as mediastinal
tumours of aneurism a local enlargement is sometimes produced, which in the latter case will often be seen to pulsate. Enlargement of one side of the chest may be caused by upward pressure from the abdomen, an enlarged spleen, dilated stomach, a hypertrophied liver, or a solid tumour, ascites, or will sometimes local swelling of the thorax generally confined to the lower part.

The causes of pressure by lymph may be referred to later.


dilation in size.

Contraction of one side occurs chiefly in connection with chronic or old standing exudation into the pleura. The lung becomes consolidated and in many cases bound down by adhesions, so that when abscession does take place or the effusion is artificially withdrawn, effusion cannot take place, as that and the wall of the thorax must sink to meet the lung. The side becomes flattened, and the whole side becomes less, the middle being nearer the middle line and the scapula nearer the spine, which itself is sometimes laid with the convexity towards the affected side. The diaphragm rises higher on the contracted side, and the abdominal viscera are displaced. Thus if the disease be on the right side the liver will be displaced upwards, and the heart either drawn by contracting adhesions to the right, or thrust out of its place by the expanding left lung. If on the left side the spleen, or stomach will rise higher and the
heart can be pushed or dragged more to the left. These changes occur when the whole of one lung fails to expand and are always most marked in young subjects when the bones yield easily; in the adult the natural yielding requires sometimes to be brought about by surgical means and part of 2 or 3 ribs cut away to allow the chest-wall to fall to the level of the unexpanded lung.

Local depressions. These arc frequently seen in the supra or infraclavicular regions more rarely lower down, the result of condensation and contraction of the lung in pleurisy or catarhal pneumonia; when the depression affects only on one side, it is easily detected even through slight but should there be a depression on both sides, it might easily escape notice assigned to emaciation. Such depressions are also produced by the non-expansion of parts of the lung after compression by pleurisy, empyema or pneumo-thorax. The greater part may expand while a small portion remains bound down and collapsed and to meet this part of the chest-wall sinks and a local depression results.

Other depressions may be the result of mechanical pressure, thus in brick-makers and in some athletic trades where some of the implements are held against the chest,
the wall after a time gives way. In rickets and
diseases of the skin, also in some cardiac cases the
chest becomes entirely deformed; the sternum bends,
& one side may be thrown forwards and the other
backwards and the walls bent, flattened or bulged
so that the natural configuration is lost. Local, or
sometimes general contraction occurs in those suffering
from diseases in which there is difficulty in inspiration
or in expelling cough, stenosis of the bronchi or especially
when they occur in young children. In circumstances
of the lungs' frictionless contraction is also seen.
Especially shaped thoraces as the 'pigeon breast'
are often the result of rickets and do not
indicate any special change in the lungs. Guttmann
describes the thorax in individuals of a plethorical habit
which he states may itself give rise to cancers degen-
eration and tubercles of the lungs'. This variety is
due to imperfect development. "It is characterized
by a long, narrow, and shallow chest, by sloping of the
'supra-' and 'infra-clavicular' regions, wide intercostal
spaces (on account of the diminished power of the inter-
costal muscles), complete projection of the shoulder blade
(from the pubic action of the serrati), undue prominence of
the acromial ends of the clavicles, and diminution of the
antero-posterior diameter. The mammalian sternum teta
(1) Want of oxygen in the air - carbonization of the air.
(2) Obstruction to the entrance of air into the lung, provided that the obstruction is not sufficient to cause inspiration to be prolonged, when inspiration is rather decreased in rapidity.
(3) Cardiac bronchitis - more rarely bronchitis affecting the larger tubes; though this, when occurring in a patient whose lungs are already weakened or infiltrated, will cause rapid respiration.
(4) Collapse of lung (rapid) the result of pleurisy.
(5) Infiltration of the alveoli, as in pneumonia.
(6) Changes in the heart especially those vascular lesions which interpose with the pulmonic circulation.
(7) Condition of the blood - Anaemia.
(8) Viscous lesions or functional disturbance.
(9) Abdominal distension interfering with the action of the diaphragm.

Diminished frequency of respiration.

The respiration may be slowed by the influence of the will and may cease altogether for 30 to 60 seconds or more. It is slow when oxygen is inhaled pure or in greater proportion than it exists in the atmosphere. It is slower if the respiration is habitually slow.

In disease the respiratory rate is slower, when obstruction to the entrance of air exists. Thus in asthma, the larynx, oedema of the glottis, diphtheritic comp
Inspiration is prolonged and as a rule the breathing is deep and the rate of respiration diminished.

In bronchial asthma, when the bronchi are closed by the contraction of the bronchial muscles, the respiration is slow and laboured, differing materially from the obstruction of the bronchi caused by swelling of the mucous membrane and exudation.

The breathing is slowed by certain drugs, such as opium especially when taken in large doses, also by certain central conditions, paralysis of the vagus, apoplectic coma and does not necessarily indicate any respiratory affection.

The action of the heart may be accompanied by slow inspiration or the respiration may be normal or increased in rapidity.

The character of the respiratory movements.

There are two types of inspiration, the thoracic or costal, and the abdominal or diaphragmatic. Under ordinary circumstances, the breathing is carried on by a combination of the two, and is thoraco-abdominal. In the male, the abdominal type of inspiration is more marked than the thoracic, and in the female the reverse obtains.

The diaphragmatic action may be lessened or entirely abolished under the following conditions:— Paralysis of the diaphragm, which may be the result of spinal disease or injury, injury the cause of cough (pneumonia), or by the action
of dextro (chloroform), by distention of the abdomen by fluid, or gas, or the presence of a solid tumour; by pain in the abdomen. The type of the respiration may be entirely or almost entirely costal. The breathing is hurried and dyspnoea, on exertion at all events, is present. Costal respiration may be lessened or entirely prevented by paralysis of the respiratory muscles, but a paralysis so extensive as to hinder both the ordinary and extraordinary muscles of the same respiration is scarcely consistent with the prolongation of life. The costal respiration is restrained when the movement causes pain or by the application of a tight bandage or tight clothing. In emphysema there is very little movement in the thorax or abdomen, and owing to the non-contraction of the lungs during expiration, the thorax remains in an extended condition.

Diminution in the movement on one side only is often seen; it occurs when from any cause the lung does not follow the movement of the thorax. Thus in pleurisy, emphysema, or pneumothorax, the lung is incapable of complete expansion and the movement on the affected side is distinctly lessened. The same is seen in pneumonia and other conditions where the alveoli are infiltrated with plastic material. The presence of pain is also a powerful agent to restrict the movement of the thorax on the side affected.
The restriction may be still more local and affect only a part of one side, as when the apex is consolidated or excavated, the thorax is generally flattened, and the movement limited over the affected area. Restriction of the movements has been in cases where retraction has occurred, the result of an old healing, or where from any cause complete expansion of the lung is prevented.

The appearance of the interphrenic is important during both inspiration and expiration. In a well-nourished individual with healthy lung tissue, no bulging or indentation of the interphrenic, but should fluid be present and the thoracic wall thin, distinct bulging will be seen especially during expiration.

When the lung does not expand easily, as is the case when bound down by adhesions after healing or the interphrenes are drawn inwards during inspiration, generally recovering during expiration, though, in some cases, they remain drawn inwards then also.

When the entrance of air into the thorax is obstructed, the interphrenic are also drawn inwards, thus in obstruction of the larynx there is a marked symptom; and if one bronchus were entirely stopped, as by a foreign body, it is seen on one side, that is the affected side, more than on the other.
A laboratory difficulty is the action of the extra ordinary muscles, in the neck and elsewhere, will be evident on inspiration, while in difficulty of expiration, the extra muscles of expiration, which are chiefly the abdominal muscles will be seen in strong contraction.
Relation of Inspiration to Expiration.

Formally, the inspiratory and expiratory acts are equal or nearly so, separated by a short-interval or pause. (This does not apply to the respiratory movements.)

Inspiration may be prolonged while expiration remains of the usual length, when there is obstruction to the air entering the lungs, but where there is an impediment to the air leaving the chest. This occurs in paralysis of the laryngeal muscles, where the phrenic nerve ends form an impediment to inspiration, because to expiration. In atresia of the larynx, or in other obstructive diseases, both inspiration and expiration are prolonged, but occasionally inspiration only is affected. An increase in the length of expiration is seen in some cases of chronic bronchitis, where the tubes are filled with sticky exudate, the inspiratory remaining of normal length.

Disturbances in the rhythm of respiration are common both in health and disease. In health they are due to external influences, fear, grief, etc., while in disease, they may point to respiratory or cardiac mischief; the significance of the former cases has been sufficiently indicated in what has gone before. "Cheyne-Stokes respiration," which is most marked case of disturbance of rhythm, has also been described.
Diagram of Spirometer

Fig. 23
The movements of respiration may be graphically represented by the stethograph. This instrument is of different forms, but its principle is a lever, one arm of which will move with the thorax while the other will record the movements on a revolving cylinder or a slip of paper drawn in front of it. A double stethograph which will enable a companion to be made at different points of the chest—at the same time—has been invented but—owing to the trouble of application and the scant information to be obtained, none of the instruments have come into use in general practice, though for teaching purposes and for hospital work they are of service.

The capacity of the lungs and the depth of respiration can be measured by the Spirometer, an instrument resembling the ordinary gas-measurer. It consists of two cylinders the smaller and outer one (A), contains water and into this the second is inverted (B), the patient breathe into through a tube which opens under (B) but above the level of the water. The cylinder is balanced and its rise will indicate in cubic feet and inches the amount of air expired. The process may be reversed the cylinder being filled with air, the patient will inspire through the tube, when the fall of the cylinder
will indicate the amount of air drawn into the chest at an inspiration. The apparatus is cumbersome and could hardly be used in those cases where acute disease is present, as in acute pneumonia where it might be of service to know how much of the lungs could contain air.

Palpatometry (Waldenburg) — The ordinary manometer may be used to indicate the force of inspiration and expiration. The respiratory force varies in health within the limits shown below:

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<td>120 - 160</td>
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These points are reached only when the movements of inspiration are executed rapidly; when they are performed slowly the manometer indicates a much lower pressure, and the mercury remains longer at its highest point, oscillating slightly upwards and downwards.

The diseases of the respiratory organs may be divided into two principal pneumatometric types: in the first the condition of health are reversed; [the expiratory force is normally greater than the inspiratory] the positive expiratory pressure being less than the negative inspiratory force, while the latter may be increased, normal, or subnormal; in the second, the negative inspiratory pressure is lower than the physiological minimum.
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while the positive expiratory force may be normal or subnormal, in the latter case being still slightly greater than the inspiratory force. In the first class, that in which the expiratory pressure is diminished, being

... pulmonary emphysema (the lowering of pressure here being due to diminution in the elasticity of the lung tissue), bronchitis and narrow asthma. In the second class in which it is particularly the inspiratory power that is lessened, an sound ... difference being observable here even when the disease is of but slight extent), stenosis of the larynx and trachea and generally those diseases of the respiratory organs which offer increased resistance to the expansion of the lungs (pneumonia, phthisis); in the more advanced stage of each case the expiratory pressure may also be decreased. Among diseases of the heart Mitral lesion most usually produce diminution of Respiratory Power, the result of the consecutive hypoventilation of the lungs (Waldenström). Tumors of the abdominal organs (pregnancy, effusions &c.) inasmuch as they impede expiration rather than inspiration, tend chiefly to lessen the expiratory force (Eichholz).

"It is worthy of notice that in comparing the pneumo-ad

... metric with the spirometric signs, in health and disease, we find no evidence of any fixed relation between respiratory capacity and vital capacity; the former may be high while the latter is low, and vice versa." (Buttman

loc. cit. P. 61)
Palpation of the thorax

The patient remains in the same position as for inspection, and as a rule, inspection and palpation go on up to a certain point together, for palpation is to a great extent used to confirm the information gained by inspection. The hands of the observer must be thoroughly warmed, or cough may be excited, respiration disturbed, and even pain set up.

All irregularities of the surface are carefully examined by palpation, and their locality carefully noted. Differences also in the size of the two sides of the thorax can be definitely determined and necessary measurements made. That there is a difference present may be easily recognised, but when variation in the size of the enlarged or diminished area occurs, as in acute pleurisy, measurements become necessary. The diameters of the thorax can be made with an ordinary pair of calipers, while the circumference is measured with a tape measure. It must be remembered always to take the circumference at the same point in the respiratory movement, either at the end of expiration (the most usual time) or at the
effect of pressure not felt. In neuralgia the pain is localized to the course of the nerve or nerves affected and generally, especially tender spots can be discovered by pressing along the intervertebral spaces, while in nearly every case a sensitive spot is found at the root of the nerve close to the spine or over the corresponding spinous process. The pain of neuralgia is also increased by pressure and the muscles appear tender when pinched, and here the pain is not so distinctly localized as in neuralgia. The pain of pleurisy appears to be more deeply seated than either the pain of neuralgia or muscular rheumatism. It may only be elicited by pressure, and if present is always increased.

Vocal or pleural pneumitus: This is a name given to the vibration of the thoracic walls caused by phrenitis. When the patient speaks or the hand is placed on any part of the chest wall a distinct vibration is felt - the patient coughs. The vibration is conducted chiefly through the air tubes and then through the pulmonary tissue to the external walls. The intensity of the vibration depends on (1) the strength of the voice, being greater when the patient
A Increase

The vocal resonance is increased by
1st Increase in the strength of phonation, which may indicate increase in the strength of the patient
2nd By alteration in lungs which increase the conducting power. Consolidation of the lung tissue by the presence of pneumonic or other exudation in the lungs causes a marked increase in the intensity of the vocal resonance over the affected area. The vibrations are conveyed more readily through tissues embedded in solid tissue and through the solidified tissue itself than through the free air cells. Vibrations when superficial and in direct communication with a border will increase or amplify the vocal resonance and therefore it is more marked over a spot corresponding to the situation of such a cavity.

3rd By removal of bad conductors. The resonance is increased when the chest walls are thin, free from fat or from any great mass of muscular tissue, provided that the strength of the patient is maintained.

In thin diaphragm however where the chest walls are the thinnest that is where emanation is most
This only applies to small tumours near the surface of the lump. A large growth in connection with, a surrounding a large border with conduct usual precautions and cause its increase, if the growth is not separated from the surface by healthy laryngeal tissue, just as condensation from other causes does.
marked, as in tuberculosis phthisis, the strength of the patient is so much diminished, and consequently his power of phonation lessened, that the vocal cords is often diminished instead of increased. The same is frequently seen in cases where the cordis would naturally be increased, as in pneumonia, the patient's voice becomes too weak to produce any vibration of the chest walls, but too the presence of a plug of mucus in a bronchus communicating with a consolidated area, may diminish or altogether stop the phonation in that area. If the plug be removed by coughing the phonation will at once return.

B. Decrease.

The vocal cords is diminished or may be wanting altogether when the reverse of the conditions just described is present. Thus:

1. When the patient's strength is diminished his voice is weakened and the vibration produced by phonation is lessened or may be wanting.

2. A solid growth in the lung substance does not conduct the vibrations in the same way that exudation into the air cells does and therefore the phonation over such a tumour, (i.e. if situated superficially) will be diminished. The tumour will act as a damper and thus prevent the phonation from reaching the surface.
(3) When the walls of the thorax are thick, and loaded with fat, pneumitus, which otherwise should be increased will appear normal or diminished, or may be absent altogether. Inflammatory thickening of the pleura, independently of the presence of fluid, will diminish or entirely prevent the pneumitus from being perceived.

(4) Effusion into the pleural sac, whether serous or purulent, or the presence of air as in pneumo-thorax will diminish if the amount be slight; or completely abolish the pneumitus if the amount be large. As the fluid tends to gravitate to the lowest parts it is usual to find that the pneumitus is wanting at the base of the lung affected, and as the fluid increases the area gradually rises until the pneumitus may be absent from the whole side. The level of the fluid will change within certain limits, a change in position of the patient and the pneumitus may be felt in one position and absent in another, if the lung first touch the surface in the first instance and in the second is separated by a layer of fluid.

(5) As already stated the presence of a pleuropneumonic area large enough to occlude the bronchus supplying a large area of the lung will be sufficient to diminish or abolish the pneumitus. Such an area is limited according
to the extent of lung supplied by the branches. The
pleuritis is rescued as soon as the obstruction is
removed by coughing.
In testing the vocal pleuritis, it is best always
to use one hand and test the different areas on
either side in order. The diseases which occasion
variations in the pleuritis are as a rule unilateral
in their distribution so that the difference from
the normal is easily perceived by comparing the
sound side with the affected, and by using one
hand only, there is no chance of a difference in the
sensibility causing confusion.

Clearer Preliminary or Pleural Preliminary

When fluid occurs the two surfaces of the pleura
become conjoined by changes in the epithelium and by
the deposit of lymph or the surfaces, so that with
collection

Every expansion of the lungs they rub together and
communicate to the chest walls a sensation of a rough
scratching, cringing nature that is distinct from any
other sensation. It is absent when the breath is
held and the movement ceases; it gradually ceases as
effusion occurs which separates the two conjoined surfaces
and prevents them rubbing together. It is often present
in the upper parts of the chest—often it has ceased
in the lower, and may sometimes be felt by changing
the position of the patient—so as to alter the level of the
fluid. It is increased by pressure into the inter-
estinal spaces, and by deep inspiration.

Friction rubs in pericarditis. On this the friction corresponds to the
action of the heart - in its rhythm, and is not affected
by holding the breath. It is occasionally difficult,
however, in local friction in the neighborhood of
the heart - to exclude pericarditis, especially when the
abduction is very rapid - or in cases where the heart
has become adherent to the pericardium.

Bronchial Friction - This is sometimes produced
when the bronchial walls are thickened and inflamed
and their caliber reduced by the presence of exudation.
The friction occurs with both inspiration and
expiration and somewhat resembles vocal friction
in its character but is independent of friction.
It is altered or disappears after coughing, and the
friction which is communicated to the hand as friction
is evident to the ear as a bronchial sometimes loud
enough to be heard at some distance from the chest
and can generally be heard by the patient. It can
as a rule be felt over the whole of the thorax but
is more evident over the area of the large bronchi
and occasionally is more distinctly felt at one side
than the other, indicating the presence of a quantity of
Circum secretion in the tubules of the affected side. When present it points to diffuse lymphatic oedema.

Necrornia Sensibility - A peculiar bubbling sensation may sometimes felt over cavities containing fluid which have a free communication with the bronchi. The sensation is attended by coughing and may disappear when the fluid is expelled. It can be best felt when the cavities are near the surface and the walls of the patient's thorax thin. Occasionally it is felt in empyema when there is a sinus into the plural cavity especially if the amount of fluid is small and the lump near the surface.

Fluctuation - When the quantity of fluid present in pleurisy or empyema is so great that the interfaces are bulged outwards, it is possible to detect fluctuation by placing the fingers of one hand along the interfaces, especially the lower, and tapping at a little distance with the other fingers taking care not to tap above the level of the fluid. This sign of the presence of fluid is by no means reliable and mistakes may easily be made.

Palpatometry as a means of diagnosis. A Russian physician, Dr. V. V. Filipovich has recently published a pamphlet containing some observations...
on the advantage of ascertaining the degree of
tenderness over particular areas by means of an
instrument—corresponding to Eulenberg's fascettometer,
it may be compared to a vertebral spring letter-weigh,
the plate of which is replaced by an extremity having
the desired form. The term used is "palpometry",
the highest pressure by variously shaped extremities,
which could be borne without pain, was tested. This
was found, by trial on a number of healthy subjects,
to vary from 1500 to 2000 grammes, when the
instrument with the Leeds was used. The work
of Mr. Peter is referred to, as also O'Brien's Lectures on
Path in the Region of the Heart- and Palpitation (which have
been translated into Russian), and several diagrams and
charts are given of heart and other diseases, where the
mapping out of the surface, according to the its-section,
or, rather, its-analytic, areas, indicates with great
exactness the course of the disease whether favorable
or otherwise. The author has observed, that in typhoid
fever, the spleen undergoes a marked and sudden increase
of sensitiveness within the forty-eight hours immediately pre-
ceding delirium. This was quite appreciable to ordinary
manual palpation, and, during an epidemic of typhoid, he
was able to predict with extraordinary accuracy the occurrence of
delirium. He points out the value of more
exact means of estimating the tenderness in 
"effects when peritonitis is present" (Brit. Med. J. 1886 Vol II P1049). So far as I am aware this 
method has not been much used in this country, 
but it appears from the account given of the method 
that it might be applied in pulmonary disease with 
advantage in those cases where pain is a significant 
feature, such as pleurisy, especially when of limited 
extent, pneumonia, pericardial friction. 

Percussion of the Thorax 

Definition of Percussion 

"By percussion is meant the investigation 
of the condition of internal organs by the sounds 
which are yielded by sharply striking the surface 
over them" (British Medical P346) 

Methods. There are two methods of percussion; 
the Indirect and Immediate. The position 
of the patient varies according to the area to 
be percussed. Thus for the anterior surface of the 
thorax, it is most convenient to have the patient 
lying flat-on his back or a bed or couch so 
that stooping is not necessary, the physician being 
sitted or standing by the bed side. To the back and sides 
the patient should be either sitting or standing, but if found necessary he may
The surface should be exposed and the thorax free from any external pressure.

Immediate or Direct Percussion. This was the method used on the introduction of this mode of investigation by Ausenburger in the middle of the 18th century. The chest is struck directly by the fingers, two or more being bent together so as to form a hammer, or the forefinger is slipped from the thumb against the surface, or the knuckles may be used. This method of percussion has fallen guilty into disuse chiefly because it caused a considerable amount of pain to the patient, but rather because the results were not so good as with other methods. It is still sometimes used in percussing over the clavicle, or over the ribs when they are prominent and the chest walls thin and when no tenderness is present, also over the general surface when very light percussion is required, for example over a very thin layer of lung such as the extreme apex, or the inferior margin.

Indirect or Indirect Percussion. Hammer and Pleximeter. Of these there are three varieties. 1st using the finger of one hand as a pleximeter and one or more fingers of the other as a hammer.
2nd. The finger still used as a hammer but a pleximeter of ivory, wood or other material being used.

3rd. Percussion with Westnich's Hammer.

The first is the most common and convenient method, dispensing with any form of instrument and capable of being used all the varieties of percussion sounds as well as the sense of resistance.

The finger to represent the pleximeter, which is usually the middle or index finger of the left hand is placed with its pulp side surface downwards flat firmly on the chest wall so that the long axis of the finger is parallel to any dull area whose limits it is proposed to map out, while the finger or fingers of the striking hand are so bent that a firm sharp stroke may be made with the tips. The finger may be used and for this the middle finger answers best and gives a clearer note and has the advantage of localising the stroke better than when other fingers are employed, though some find that they can more easily produce a clear note by using two or even three fingers. In striking the hand should move principally from the wrist with only a slight or no motion at all from the elbow.
Pleximeters

Fig 24
and thence does not deaden the sound as a finger might be supposed to do. Its disadvantage is that there is apt to be some noise made by striking the instrument itself which might conceal or alter the ordinary percussion sound.

The third variety is that with Wintrech percussion hammer. The ordinary form of hammer is shown in Fig. 25. The head is generally weighted and the striking end is protected by a pad of india-rubber so that the noise of the hammer striking the pleximeter is as far as possible avoided.

Advantages: 
1. Its use is soon learnt and more easily performed than the other methods.
2. The sounds are clearer and can be heard at a greater distance which is of great advantage in clinical teaching.
3. Sounds are brought out which are only elicited with difficulty by using the fingers.
4. The fingers are not hurt.

Disadvantages: 
1. An instrument is not always at hand.
2. The finer degrees of percussion are lost unless the correct cane be taken, and may be overpowered by the noise produced by striking the pleximeter itself.
3. For large an area is apt to be thrown into vibration.
The percussion sounds and their production.
The sounds produced on percussion of the thorax are dull or resonant, the dullness and resonance varying within certain limits and under certain definite circumstances.
The dull sound which is naturally produced by percussing over certain areas is caused by the presence of solid bodies, either within or in close contact with the chest-walls. These (the heart, liver, spleen &c.) from their nature are incapable of being thrown into vibrations, and percussion over them causes a noise only with complete absence of resonance — this is known as absolute dullness or “flatness”.
The normal resonance of the thorax is variously explained, some attributing the note to the vibration of the air in the vessels, others to the vibration of the chest-walls. Both factors enter into its production. In order to produce a resonant note like that of a drum, it is necessary to have an air-containing chamber with walls capable of vibrating in waves of definite and regular length. In a drum so long as the tension of the parchment and of the contained air remain unaltered, the note
Remains the same, but the note can be raised or lowered by raising or lowering the tension, and if this be carried to excess in either direction the tympanitic resonance is lost. In the thorax the walls are capable of vibration, but certainly as perfectly as the drum parchment, but sufficiently to produce a definite note provided that it be filled with air at a certain tension, but the air in the thorax is contained in the minute vessels of the lungs and the pressure varies with every respiratory act—so that instead of having a note possessing the musical qualities of pitch, intensity and timbre we have a note in which pitch and intensity are present—but timbre is wanting. The sounds thus produced by percussion are varieties of resonance and dulness, the former occurring over the whole area not occupied by the lungs, and which under certain circumstances may acquire a tympanitic character or may be muffled and lose its resonance and pass into absolute dulness, the latter being normally present over solid bodies, and under certain circumstances taking the place of the normal resonance.

Rules to be observed—
(1) Percuss systematically the various regions and mark exactly the limits of resonance or dulness present.
(2) Always make a comparison of the note at
the same point on both sides, percussing with
equal force in both cases. This is necessary in
order to detect slight inequalities in the sound.
For, though well marked dulness is easily detected
the slightest degree are not detected unless when
compared with a normal area. Should the note
on both sides be impaired the comparison fails
between the two sides and it is necessary to compare
the note with some other area which is not affected.

(3) Percuss gently where pain or tenderness is present,
where distinctive processes are going on when the patient's
condition is much lowered; over palpating areas (not
the heart), especially when the walls are thin. Also
where the layer of lung tissue is very thin, as at
the apexes, or at the lung margins unless it is desired
to bring out the dulness of some solid body lying
beneath as in percussing the deep cardiac dulness.

(4) Percuss firmly or forcibly, when the chest
walls are very thick, covered with deep layers
of fat or muscle. Great force is needed for the
posterior surface owing to the thickness of the
walls and the difficulty of throwing them into
vibrations. The difficulty is got rid of, to a certain extent, if the scapulae are drawn forwards and it is usual in percussing the back of the thorax to cause the patient to lean forwards and fold his arms across the chest.

Percussion of the Normal Thorax.

Taking first the anterior surface, the percussion note is clear and resonant on both sides, from the apex to the level of the third intercostal space. The apex lies above the clavicle for about one and a half inches, the right apex being sometimes a little higher than the left; the note here is not so loud as lower down, but distinct resonance can be made out, by percussion lightly, even at the extreme apex. The apices are separated widely in the neck, and the line of resonance marking their anterior and inner borders curves downwards and inwards till they meet behind the manubrium sterni, at which point the lungs are only separated by the mediastinum.

At about the level of the third intercostal space a slight difference is noticed in the notes on the two sides, the note on the left side being distinctly less resonant than the other, which is especially marked in deep percussion. As we percuss lower the note on the left side becomes more and more impaired till at about the level of the fourth rib it becomes absolutely dull, while the note on the right side remains...
Fig. 26 The regions of the chest

Diagrammatic representation of the relations between Heart and Lungs

(after Walsh & Bramwell modified)

1. Supra-sternal region
2. Upper
3. Lower
4, 4'. Right & left supra-clavicular regions
5, 5'. Clavicular
6, 6'. Infra-clavicular
7, 7'. Mammary
8, 8'. Infra-mammary

Lungs represented by blue shading. Heart by red.
its normal resonance. The compound note indicates the
thin border of the lung which overlaps the heart, which is
again heard if we pursue outwards from the area of
absolute dulness, which is the area of heart uncovered by
the lung, the note becoming resonant after we pass
beyond the area occupied by the heart. On the right
side the note is clear till the lower margin of the fifth
rib when it becomes impaired owing to the presence of the
liver below the inferior border of the lung, while absolute
dulness marks the external limit of the lung about the
upper border of the sixth rib, the dulness extending
downwards to the border of the thorax below which
the tympanitic note of the colon can be heard. If
we pursue in a curved line outside the nipple the
pulmonary resonance can be heard from the apexes on
both sides to the level of the 5th rib when it becomes
impaired or snuffed on the right side and a little lower
absolutely dull (at the 6th rib) while on the left side at
the 5th rib an almost tympanitic note is heard on
deep percussion and at the 6th rib provided that the
stomach contains air the note is truly tympanitic, and
remains so over the lower part of the thoracic surface in this
line. In the axillary line the note is resonant on
the right side as far as the 8th rib, below which the
liver dulness begins and on the left to the 9th rib where
the splenic dulness is generally heard. While at the
tympanitic note
11th rib the tympanitic over the colon is made out.
Posteriorly the resonance at the apex is heard as high as the seventh cervical vertebra, and proceeds downward as far as the tenth pair of ribs on each side. The note on the posterior surface is not as clear as on the anterior, excepting perhaps at the base, owing to the greater thickness of the walls, the presence of the scapulae and the great amount of muscle, also because the ribs being bound to the spine and spinal column are less easily thrown into vibrations than are the more free anterior extremities.

The note over the sternum is peculiar; here a more or less resonant note can always be heard even though the tissue below be not resonant. The bony itself vibrate easily and it is probable that the vibrations are communicated from it to more distant tissue and so a resonant note is produced.

The normally resonant areas are more striking during expiration, they are increased as the lung expands with inspiration, the spires rise higher, the area of heart uncovered by the lung is lessened and the lower limits of the lung descend, the liver dulness also descends with each contraction of the diaphragm, and rises with expiration when also the lungs contract and the resonant areas diminish. The distribution of resonance may be altered also by displacement of the heart or of the abdominal viscera without the presence of any respiratory disease or any pulmonary symptoms, so that any deviation from the limits described is not necessarily indicative of pulmonary disease.