THESIS

FOR THE DEGREE OF

DOCTOR OF MEDICINE,

CAMBRIDGE.

Read before the Regius Professor of Medicine,
on April 30, 1885.

BY

THOMAS GLOVER LYON,
M.A., M.D.,
EMMANUEL COLLEGE, CAMBRIDGE; ST. THOMAS'S HOSPITAL, LONDON.

SUBJECT—"THE THORACIC PERCUSSION NOTE CONSIDERED IN RELATION TO THE PARTS PLAYED IN ITS PRODUCTION BY THE CHEST-WALLS, THE PLEURÆ, THE LUNG TISSUE, THE BRONCHI, AND THE AIR CONTAINED WITHIN THE CHEST."

THESIS.

DR. AUSTIN FLINT, in one of his Clinical Lectures, lately declared that the physical elements of the percussion note are too varied to be embodied in mathematical calculations.

Without disputing the truth of this statement, no one who has made careful experiments in the subject can fail to observe that the different anatomical parts of the chest, not only by means of their own vibrations, contribute characteristic elements to the percussion note, but also by their action upon contiguous parts introduce into the sound characteristic modifications.

I intend, first, to give a slight glance over the history of percussion, with special reference to the different theories as to its production which have been held by the various writers on the subject.

Secondly, I shall inquire into the nature of the sound produced on percussion by each of the anatomical parts of the chest.

Thirdly, I shall consider the character of the normal percussion note, treating it as a combination of the notes due to each of the parts of the chest.

Lastly, by means of the results obtained, I shall attempt to explain the causal relation existing between some of the various changes which occur in the percussion note and the attendant anatomical changes.

In 1761, Auenbrugger of Vienna published his "Novum Inventum ex Percussione Thoracis humani ut signo abstrusos interni pectoris morbos detegendi," the first treatise in which the method of percussion is described.

Little notice was taken of this invention until Corvisart, in 1808, published his translation, into French, of the "Novum Inventum," and it was by means of this translation that percussion was really first made known to the world. Auenbrugger made the following contrast between the qualities of different notes :—

Altior—Profundior.

Clarior—Obscurior—prope Suffocatus—illustrating the last quality by the percussion of the thigh.

Disease was said to be present at those parts where the sound is found to be higher (altior), duller (obscurior), relatively to the other side, or where the note is like that produced by percussing flesh.

Corvisart here introduces great confusion into the subject, which must have gone far to produce that indifference concerning percussion displayed by the physicians of his day.

He first prefers to translate altior by plus superficial rather than plus élevé when expressing a contrast with profundior. But when, in Aphorism XII., Auenbrugger declares that where there is a great height (altitudo major) in the sound, disease is present, Corvisart chooses to translate altitudo by profondeur, for he says he does not think it possible that a superficial sound could indicate disease in the parts beneath.

This is the first instance, but far from the last, where confusion is introduced into the subject of percussion, owing to an attempt on the part of a writer to reconcile the phenomena observed with some falsely conceived principles of their production.

The contrast of the qualities of the percussion note made by Auenbrugger is clearly very rough, and omits all mention of the quality afterwards called tympanitic, and indeed he does not include pneumo-thorax in the list of the diseases which he had diagnosed by his method.

Auenbrugger does not give any definite explanation of the cause of the variations in the percussion note; he refers them to the variations in the volume of air contained in the chest. He instances the percussion of a barrel which, when empty, is resonant at all its parts, but which diminishes in resonance as it is filled either with fluid or solid substances—that is, according as the volume of air contained in it diminishes.

It is upon this loose statement that most of the theories of the production of the percussion note have been founded, the sound being almost universally referred to the vibration of the air contained in the chest.

In 1819, Laennec published his treatise on "Diseases of the Chest and Mediate Auscultation." He pointed out that it is impossible to distinguish pneumonia from pleurisy by means of percussion alone, and asserts that no physician had up to the date of the discovery of auscultation diagnosed a pneumo-thorax.

He defines the limits of thoracic resonance as determined by immediate percussion, describing as dull all parts above the clavicle, and as low as the lower angle of the scapula behind.

In 1828, Piorry introduced the method of mediate percussion. He mentions the tympanitic quality of the note in pneumo-thorax. He gives no explanation of the production of the percussion sound.

In 1835, C. B. Williams wrote as follows:—"The true explanation of the physical principles of percussion is not the mere throwing of air into vibrations, but it is the body struck that vibrates and derives the character of its vibrations from the density of the matter under it; thus if the matter is air, the vibrations are unresisted, free, and the sound more or less deep and prolonged; if the matter is a rigid solid, the vibrations are abruptly returned and quick, and the sound is higher, giving the expression of hardness; if the matter is a liquid or soft solid, the vibrations are destroyed or absorbed, and the sound a sort of short hard tap.

In 1850, Joseph Skoda published a book on Auscultation and Percussion, which was translated into English by Dr. Markham in 1853.

The author at the outset lays down the following principle of procedure which should be pursued in the investigation of the subject of percussion. First determine every possible variety of percussion note, and then try and reconcile these with well-ascertained laws of sound. He, however, at once goes on to reverse this principle in practice; he begins with a discussion of the mode of production of the percussion note. He refuses to accept Dr. Williams's theory referring the origin of the sound to the vibrations of the walls, chiefly for two reasons: first, because the note elicited varies when percussion is performed at different parts of the chest; and secondly, because the parts of the thoracic walls when detached give a dull sound. He also denies the possibility of the production of the note by means of the tissue of the lung, because he says that the soft tissues of the body must be in a state of high tension in order that they may produce any other sound than that one peculiar to all soft tissue. Having thus acquitted the chest walls and lung tissue of taking any part in the production of the percussion sound, without inquiring into the possibility of the theory, he at once declares the cause of the note to be the vibrations of the air contained in the chest. Throughout his treatise Skoda constantly acknowledges the inadequacy of his theory to account for the results obtained by experiment, but he never allows his theory to bias him in his observations; and so accurate and exhaustive were his experiments, that no important advance has been made in the subject of percussion since this treatise appeared.

Skoda was the first to observe that the percussion note in pleurisy above the level of the fluid often became tympanitic. He also mentions the metallic ring present in pneumo-thorax.

Niemeyer, in 1869, evidently considers the air contained in the lungs to be the chief agent in the production of the percussion sound.

Dr. Walshe, in the edition of his book on "Diseases of the Chest" published in 1871, says that the resonance of the lungs depends not on their proper tissue, but on the air they contain and the construction of the case. Dr. Walshe points out that the percussion shock is conducted by the walls of the chest by what he calls a horizontal impulse even to the other side, hence the note does not entirely depend on the parts immediately beneath the point struck.

Dr. Gee, in the edition of his book on "Physical Signs" published in 1877, abandons his former theory, which explained the production of the percussion note by the vibration of innumerable sacs containing air. He considers that the different phenomena observed in percussion can be explained only by assuming that the note is produced in the middle-sized and larger bronchi. Further on he admits that "neither the clearness nor the pitch of the tone depends merely on the quantity of air in the part percussed; in other words, the theory of percussion is not so simple as many deem it to be.

Paul Guttman, writing in 1879, says that the percussion note is produced principally by the vibrations of the air, for it becomes duller as the capacity of the chest for air diminishes; he admits, however, the vibrations of the walls to be a factor in its production, and even that the note is modified to a certain extent by the varying state of the lungs.

Stokes, in 1882, gives no definite theory of percussion, but says that the usefulness of percussion depends on the fact that, *cæteris paribus*, the sound of percussion varies directly as the quantity of air contained within the chest.

Dr. Bristowe says, "The chief cause of the resonant quality of the percussion note is the vibration of the struck walls which is permitted by the fact that an elastic medium—the air—is situated on either side of them. It is obvious, however, that the elasticity of the inflated lung is less than that of air, and hence the vibrations of the thoracic walls must be to some extent less perfect than it would be were the air on both sides equally free to move." He points out the difficulty in determining in what way the vibrations of the walls is effected by the underlying parts. "It seems reasonable, however," he says, "to assume that so much of each half of the thorax as bounds lung tissue vibrates bell-like when any part of that half is struck, and that the impure musical sound which is elicited comprises a fundamental note due to the vibration of the whole or a large portion of the side, and harmonic tones due to the vibration of aliquot parts of it." He adds, "some, though a variable quantity, of thoracic resonance is independent of the presence of air beneath the chest walls."

Dr. Austin Flint, as I have before said, despairs of explaining the production of the percussion note on mathematical principles, and advises his pupils to make experiments on bodies, such as a loaf of bread or a sponge, which give out a sound closely resembling the pulmonary percussion note.

From the foregoing abstract of the theories propounded by the chief writers on the subject to explain the origin of the percussion sound, it appears that all agree in attributing the sound almost exclusively to some particular part of the chest, the favourite agent being the contained air. All likewise agree that no important part is taken in the matter by the proper lung tissue.

It is my intention now to inquire what part each of the anatomical divisions of the chest take in producing the percussion note, but in so doing I make no pretensions of exhausting this complex and difficult subject.

In attempting to investigate the formation of the sound given out by a body whose parts are of variable density, for the active agents we look to the portions whose densities are the greatest. The bodies of lower density, unless they are in such bulk as to be able to form appreciable independent vibrations, or by resonance to assist the denser parts to vibrate, act only by permitting the vibrations of the denser parts.

In order that a body may vibrate at all it must possess elasticity—*i.e.*, a power of returning to its initial shape when a part of it is displaced. It is also necessary, in order that a steady vibration be maintained, that a certain finite relation exists between the force of restitution and the mass of the part displaced. Bodies of high specific gravity and small elastic power, such as soft solids, have little power of vibration and great power of preventing the vibration of bodies in contact with them. Bodies which possess a certain amount of rigidity always vibrate when struck. Bodies which are perfectly flexible, such as strings, require a certain amount of tension to give them the power of vibrating. It seems almost incredible that Skoda, while using the elastic tissue of his vocal cords in the act of speaking, should deny the power of the same tissue in the lungs—the power of producing sound except under high tension.

The thoracic walls, besides contributing to the percussion note by means of its own vibrations, act as a large and indefinite pleximeter upon the parts beneath. Thus arises Dr. Walshe's horizontal conduction of the percussion shock, so that an abnormal note at any part may indicate, as Dr. Walshe asserts, changes at a part of the lung some distance from the point percussed, and even in the opposite lung. The more forcible the stroke the greater is the area of the walls which acts as a pleximeter, and consequently the less accurate is the sound as an indicator of the state of the parts immediately beneath the point percussed.

Again, since the object of percussion is to investigate the pulmonary resonance, and not the parietal, the pleximeter should be held firmly against the walls during percussion, for by this means the parietal vibrations are stopped, and the note, though not so bright as if the pleximeter were removed, consists almost entirely of the note due to the pulmonary tissue.

The high-pitched, peculiar osteal sound due to the substance of the ribs must not be forgotten, though it is inappreciable except when the parts beneath are nearly or quite dull.

The part of the chest walls which by their vibration contribute a factor to the percussion sound, consist of the ribs, spine, and sternum, united together by the articulations and the intercostal muscles. This case, when struck, vibrates as a whole and in segments, the result being a note of a drum-like or tympanitic nature, consisting of a combination of a certain number of inharmonic notes. The note which governs the pitch of this, which may be called the parietal sound—that is to say, the predominant component note of it—is due to the segment which vibrates most freely. The intensity and pitch of the sound varies much, as we shall see, according to the state of the parts beneath.

Let us now consider the factors of the percussion note due to the lung tissue and pleura. These are best determined by making experiments upon lungs removed from the body.

I. If a lung partly collapsed be percussed, we obtain a note of a low pitch and tympanitic in character. The note is difficult to elicit unless the pleura be indented with the pleximeter.

II. If now the lungs be inflated up to about the bulk they possess when in the body, the percussion note changes. It is raised in pitch and assumes the character which distinguishes the ordinary percussion note of the chest—that is, a note composed of an extremely large number of inharmonic notes.

III. If inflation be continued further, the pitch continues to rise until the point is reached at which the pleura begins to be tightly stretched. The sound then quickly falls in pitch and diminishes in intensity, until almost absolute dulness is obtained.

IV. If the bronchial tubes be moderately injected with water there is no appreciable difference in the sound from that when they are inflated with air; but if the injection be continued under greater pressure the sound becomes like that of wood percussed, or, in Skoda's phraseology, empty.

V. If a lung be immersed in water and the surface of the water be percussed, we get the typical pulmonary note which, as the lung is sunk deeper, gradually fades away, but does not change in character.

These results are described by Skoda, except so far as pitch is concerned. This author makes no mention of pitch in the description of his experiments, and throughout his treatise he lays little stress on this quality of the percussion sound; for he says that changes in it are always accompanied by other changes which are more easily recognized.

Besides these results, the following may easily be observed on a healthy lung removed from the body:—

VI. The sound is lowest in pitch, and most intense, wherever the lung is thickest. A very marked change is observed as we pass from one lobe to another.

VII. If the mouth of a stethoscope be fitted into the trachea and the lung be percussed, a sound in no way resembling the normal note is obtained; it seems to be a combination of a cavernous and hissing sound—in other words, a variety of cracked-pot sound.

VIII. If a lung moderately distended be percussed, first hanging in the air, and then nearly immersed in water, the sound in the latter case is much lower in pitch than in the former, and resembles much more closely the ordinary percussion sound of the chest.

The higher element in the note obtained when the lung is percussed in the air, is, I believe, due to the vibrations of the pleura, which are abolished when the lung is immersed in water, and probably also when the lungs are in their normal position in contact with the thoracic walls.

Hence, when the lungs are normally inflated in the body, the pulmonary part of the percussion sound is due to the vibrations of the proper lung tissue together with the smaller bronchi. In this tissue we have just the physical conditions necessary to produce this complex note. We have elastic tissue slightly stretched, of various lengths and thicknesses, intersected by the smaller bronchi and separated by air broken up into minute cells. The resulting sound is one of an exceedingly complex nature, it is a combination of an immense number of inharmonic notes due to a great number of series of regular vibrations. The sound is musical in so far as the vibrations are tolerably regular, but unmusical in the fact that the different series of vibrations are very numerous and produce component notes which do not harmonize with each other. The pitch of this note—that is, the pitch of the predominant component note—is very indefinite, and can scarcely be ascertained exactly by the ear.

This confused and indefinite, but at the same time very characteristic, sound forms the pulmonary factor in the ordinary percussion note, and changes in it are the only direct evidence by means of percussion of changes in the lung tissue. It differs from the parietal note in the fact that its component notes are much more numerous.

It is possible that the change in the note generally observed as we pass from the third to the fourth rib on the right side, is explained by the fact that the point percussed passes from the upper to the lower lobe.

The phenomenon of the partly collapsed lung has always been acknowledged to be difficult of explanation. The lowering of pitch is easily explained by the loss of tension of the part. The simple nature of the note, which gives it its tympanicity, is I believe due to the fact that many segments of the lungs, which by their vibrations add component notes to the sound of the normally distended lung, are incapable of vibrating owing to their relaxed state; and so the component notes of the sound become fewer in number and the sound simpler in nature.

The phenomenon of the lung inflated up to dulness never, I believe, arises when the lungs are in the body, but it illustrates the principle of a condition which does occur in exceptional cases in pneumo-thorax.

The pleura is elastic when stretched up to a certain point, but after this the membrane is almost inextensible. If now a part of it be displaced, a force of restitution is called into play out of all proportion to the mass of the part displaced; hence the part returns to its initial position with a jerk, the momentum it has acquired is not sufficient to carry it past the initial position to any appreciable distance, and no to-and-fro motion is possible.

The fourth and seventh of the above experiments prove conclusively that the larger and middle-sized bronchial tubes take very little part in percussion. If, however, those tubes become dilated, and the dilated parts approach the chest walls, the dilatations will virtually become cavities, and will give the ordinary signs to cavities.

We now come to consider the part taken in the percussion note by the air contained within the thorax. We shall see later on that in the case of pneumo-thorax the peculiar sound of the metallic ring is due to the active vibrations of the contained air, but we shall see also that, even in this instance, where the air has the most favourable opportunity for free vibration, the sound given out by it after traversing the parietes is of the feeblest possible intensity, and only well distinguished when the stethoscope is applied to the chest. This being the case, it is impossible to imagine that under other conditions, where the air is broken up by solid matter into more or less minute spaces, that its active vibrations can contribute any factor to the percussion note. In other words, except in the case of pneumo-thorax and cavities, the air takes no active part in the production of the note, its function being to allow of the vibrations of the solid parts.

It thus appears that the normal percussion note is formed almost entirely by the combination of two groups of vibrations—one, the *parietal* set, due to the chest walls, producing a drum-like and tolerably simple note; the other, the *pulmonary* set, due to the lung tissue including the smaller bronchi, contributing a note of an exceedingly complex nature. It is to the latter set of vibrations that the peculiar character of the normal percussion note is attributable.

We shall now trace the connection between some of the changes in the parts of the chest and the attendant changes in the percussion note.

First, let us consider the effect of changes in the chest wall.

An accumulation of fat or of muscle about the chest diminishes the capacity of the wall, both as a vibrator and a pleximeter, hence both the pulmonary and parietal parts of the note are diminished, and in consequence the sound is reduced in intensity, but remains normal in character. A similar result, and for a similar reason, arises in the case of a thickening of the pleura.

Rigidity of the walls, such as occurs when the cartilages become ossified, exaggerates the parietal portion of the sound; the note therefore becomes more tympanitic in quality.

The accumulation of fluid in the pleural cavity gives rise to the following conditions. The whole lung is partly collapsed to a variable degree, most markedly at the base. Above the level of the fluid the lung and parietes are in contact; below they are separated by a layer of fluid which increases as we pass downwards.

Referring to experiments I. and V., we see that under these conditions the note due to the lungs will everywhere be of a somewhat tympanitic character, it will be difficult of production, and will fade away as the layer of fluid increases in thickness.

Above the fluid the parietal resonance will be well-marked and of a high pitch; for the portion of the walls in contact with the relaxed lung will be able to vibrate more freely than when percussed against normal lung tissue. Below the level of the fluid the parietal sound will diminish gradually as we pass downwards, the vibrations being reduced by the fluid in contact with the walls.

Thus, on the whole, below the level of the fluid we have dulness increasing gradually as we pass downward, the remaining resonance being of a tympanitic nature. Above the fluid the resonance is of a peculiar kind, called Skodaic, from the author who first described it. Being a combination of the notes due to the relaxed lung tissue, and the segment of walls in contact with relaxed lung tissue, it must necessarily be tympanitic. It will also be high-pitched, for the parietal part will predominate. This note differs, on the one hand, from the normal note in the absence of the confused note emitted by normal lung tissue; and, on the other hand, from the note obtained in pneumo-thorax, in the fact that it lacks the brightness of the latter note due to greater freedom of the parietal vibration in pneumo-thorax, and the resonance and vibration of the air in the pleural cavity. Skodaic resonance is not obtained when the chest of a man partly immersed in water is percussed; hence the altered state of the lung tissue is an essential condition of its production. We also see that it is not necessary to assume that the apex of the lung is over-distended in order to explain the tympanicity of Skodaic resonance. Also, by experiment V. it is evident that the lung must have receded a considerable distance from the point percussed before well-marked dulness will appear in cases of pleural effusion.

Whenever a communication is established between the atmosphere and the pleural cavity, the lungs immediately collapse to a certain extent in all these parts, and a layer of air separates them from the chest walls. The opening is generally valvular, and at each respiratory act more air is pumped into the pleural cavity, the lungs being compressed, and at length lying collapsed around their roots. Sometimes this process goes on until the walls are tightly distended over the contained air.

Under all these conditions the pulmonary portion of the note disappears, and the parietal part only remains, hence the sound is tympanitic.

When the lung is compressed against its roots, leaving space for a considerable volume of air, and the walls are moderately distended, the note becomes of a bright drum-like quality. In this case not only are the walls free to vibrate, but they are assisted in doing so by the resonance of the contained air. Under these conditions, also, the cavernous or metallic ring is heard. This sound is due, no doubt, as explained by Dr. Bristowe, to the reverberations of the air in the pleural cavity, and is, I believe the only one occurring in percussion where the primary and active agent is the air contained within the chest. The sound is best explained by reference to a sound absolutely identical in nature to it, which may be produced by percussing an india-rubber ball. If a hole be made in an india-rubber ball, and the ball be percussed, two sounds are distinctly heard. One of a drum-like nature, the other of a much higher pitch and more musical character. When the hole is turned towards the ear, the second (musical) sound predominates, when the hole is turned away, the first (drum-like) sound comes into prominence. If the hole be stopped up the second sound vanishes, unless the ear be pressed against the ball, in which case it is feebly heard, its pitch being raised considerably. The first sound remains nearly unchanged.

It is evident in this experiment that the first, drum-like sound is due to the vibrations of the walls of the ball, and the second, musical sound, to the vibrations of the air within the ball. When the hole is open, the vibrations of the air in the ball are freely transmitted to the air outside, and pass on to the ear. When the hole is stopped up, the vibrations of the contained air change in time of oscillation, as when an organ-pipe is stopped, and are only feebly heard through the dense wall of the ball. In pneumo-thorax we have an exact counterpart of the conditions and phenomena observed in percussing the closed ball; and in large smooth cavities, communicating with a bronchus, we have possibly illustrations of the sound obtained both when the hole in the ball is open and closed. Let percussion be made over a cavity in the chest. If the patient's mouth and nose be closed, we should hear only the tympanitic note, due to the vibration of the chest walls and the walls of the cavity. If the ear be aided by a stethoscope placed over the cavity, the feeble high-pitched musical ring due to the vibrations of the air in the cavity and air-passages may be heard. If the patient's mouth be open we may hear the note due to the vibration of the air without the aid of the stethoscope. In this case Guttman has observed that the whole note is raised in pitch; this may possibly be accounted for by the predominance of the aërial vibrations heard through the mouth over those of the walls. Guttman also asserts that the note is still more raised when the nose as well as the mouth is open, a change possibly caused by the addition to the sound of a high-pitched note due to the air in the nose.

When the cavity does not communicate with a bronchial tube, these changes cannot take place.

Changes in the lung separated from the walls by healthy lung cause no appreciable alteration in the percussion sound. This might be expected, for the healthy lung remaining gives out a certain amount of pulmonary resonance, and the part of the note due to the walls remains unaltered. However, according to experiment VI., we should expect a rise in pitch of the pulmonary part of the note.

Changes in the lung situated in contact with or near the walls usually have a twofold effect upon the note; the pulmonary part is diminished, and the parietal part is either increased or diminished. In some cases a new factor appears in the note by the addition of a sound due to the vibrations of the altered part of the lung.

In cases of simple relaxation of the lung tissue, the pulmonary part of the note is reduced, and assumes a somewhat tympanitic quality. The parietal portion due to the adjacent segment of the walls is increased, as in the case of Skoda's resonance, and the note becomes tympanitic and high-pitched. This probably occurs in œdema and congestion, and certainly in the early stage of inflammation; such conditions often holding in the parts around lung consolidated by inflammation.

Lung in an extremely congested and œdematous state, such, for instance, as occurs at the base behind in specific febrile cases, is almost dull itself, and forms an increased impediment to the vibration of the walls. Hence the part tends to become dull on percussion.

A portion of soft consolidated lung abutting on the walls gives out no sound of its own, and forms the most complete impediment to the production of the parietal part of the note; hence it is in this case that we have the most absolute dulness. When a piece of lung becomes solid and hard it emits a sound due to its own vibration, closely resembling the sound obtained from wood. The parietal vibrations in this case are also less interfered with than in the case of soft consolidation.

Hence we get a sound which is not nearly so dull as in the case of soft consolidation.

When cavities form, if they are separated by a certain thickness of healthy lung or soft consolidated tissue from the walls, they give no evidence by percussion of their existence as might be expected; in the former case, for reasons given above when considering the effect of deep-seated consolidation; and in the latter case because the soft solid tissue, as we have seen, forms an absolute impediment to the production of any percussion sounds; in every case causing marked dulness at the part where it exists. If the cavities are near the walls, or separated from them by hard solid tissue, we get a tympanitic note of high pitch, due to the vibrations of the part of the chest wall over the cavity and of the walls of the cavity, assisted by the resonance of the contained air. If the cavity be of large size and its walls be tolerably smooth, we get the various phenomena which I have described when considering pneumo-thorax.

From what has been said above, we should expect no change in the percussion note as a consequence of disease of the larger and middle-sized bronchi, but that disease of the smaller tubes would be attended by some change in the percussion note. No appreciable alteration has, however, been recorded in either case.

Emphysema of a part of the lung reduces the pulmonary portion of the note, and increases the parietal by allowing a freer vibration of the adjacent segment of the walls; hence we get a high-pitched tympanitic note, not so bright, however, as the note obtained over a pneumo-thorax or cavity.

Miliary tubercles would scarcely be expected to affect the percussion note to any appreciable degree by their mere presence when scattered throughout the lung, for neither the pulmonary nor the parietal vibration would be much interfered with. They must, however, declare themselves immediately they cause any marked change in a part of the lung near the parietes. Now, as the first change of this kind which is likely to make its appearance is a commencing inflammation, the first sign that we should expect to find would be a high-pitched tympanitic note at some part of the chest. This agrees with Skoda's observations, but is at variance with the results of most other authors.

It is not my intention to enter fully into the discussion of the cracked-pot sound. It is distinguished by the super-position of a hissing sound upon the ordinary percussion note. This hissing sound may be produced by the rush of air through a narrow opening or by the grating of surfaces of a certain nature against one another, and may occur wherever these conditions exist.

In conclusion, I am well aware, first, that in a large proportion of cases the production of the percussion note cannot be definitely traced to the parts concerned in its origin; secondly, that the ordinary method of considering the sound to be produced by the chest as a whole, and of dividing the different notes into Resonant, Dull, and Tympanitic, is sufficient for most clinical purposes. But at the same time I feel assured that a knowledge of the mode of production of the percussion note cannot fail to be of service, both in giving an accurate description of the sound observed, and also in arriving at a definite idea as to what conditions of the parts are indicated by the different sounds produced by the percussion stroke.

BALLANTYNE PRESS: CHANDOS STREET, W.C.