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ANNEX

ON THE DIAGNOSIS

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OF

DISEASES OF THE CHEST;

BASED UPON THE COMPARISON OF THEIR PHYSICAL AND GENERAL SIGNS.

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ANNEX
Respiratory

TO

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AND TO

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FROM THE AUTHOR.

PREFACE.

The utility of physical exploration is now so generally appreciated, that those physicians who have hitherto undervalued its aid, are in some measure obliged to familiarize themselves with this means of investigation.

In order to acquire the requisite knowledge of the physical signs, and of their relation to each other, as well as to the general symptoms, it is, in the first place, necessary to examine a well characterized example of each sound, and to fix the recollection of it as firmly as possible in the memory. After the signs have been learned, their relative importance is to be estimated, and they should then be compared with the general symptoms of the disease.

The object of this little work is to facilitate such a study of the physical signs, and to render them more generally useful, by showing their intimate relation with the ordinary symptoms. It is, therefore, strictly clinical, and embodies most of the facts relating to auscultation; these were always subjected to the personal observation of the author, unless the exception is

expressly stated. It was thought most expedient that the work should be as concise as possible; but reference is made to those general signs which are indispensably necessary to a correct diagnosis. A complete history of pectoral diseases could not be attempted within the limits of so short a treatise.

The facts detailed in the work, are chiefly derived from Drs. Laennec, Louis, and Andral. I am also indebted to the excellent treatise of Dr. Williams, and to that of Dr. Hope, on the diseases of the heart. Laennec had investigated the signs of diseases of the lungs so minutely, that few new facts have since been discovered, but some additions have been made to various points connected with auscultation; a different value has been affixed upon various signs, and they have been more intimately connected together, and with the general history of disease.

Much valuable matter was derived from the private instruction and public lectures of M. Louis, at the Hopital de la Pitié; almost the whole chapter upon the conformation of the chest, and numerous isolated, but important facts, were obtained from that source. The original matter chiefly consists of an analysis of the normal respiration on the two sides of the chest; a new classification of the varieties of the bronchial respiration; some facts relative to the auscultation of children; and a concluding chapter, which is designed to facilitate the inquiries of those physicians who are not yet familiar with physical examination.

The last chapter is especially designed for those physicians who are distant from the large cities of America, where a knowledge of physical investigation is more general than it is thoughout the country. The want of hospitals in small towns and villages, renders it expedient to adopt a mode of study, which is less necessary in our larger cities, where the physical means of investigation are habitually practised. In Philadelphia they were introduced soon after the discovery of auscultation, by Professor Jackson, who has since diffused a taste for exact physical observation amongst his numerous pupils.

Philadelphia, November, 1835.

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ANNEX
Resp.

ON THE DIAGNOSIS

OF

DISEASES OF THE CHEST.

INTRODUCTORY CHAPTER.

The diagnosis of diseases of the chest is derived from a comparison of their functional and physical signs. The functional signs or symptoms, are the alterations caused by the disease in the function of the lungs and of other organs of the body. The physical signs are the alterations in the texture and mode of action of the thoracic viscera, which are appreciable by our senses, especially that of hearing.

The above definition shows that these two varieties of signs are not always very different from each other. Some signs, as the mode and degree of dilatation of the thorax, may be classed either as rational or as physical. For practical purposes, the physical signs should be divided into—1. Those derived from the conformation of the thorax. 2. Those from percussion. 3. Those from auscultation. The manner in which the respira-

tion is performed, and the characters of the expectoration, may be regarded as an intermediate class.

It will be readily conceived, that the indications of the physical signs are much more precise than those derived from the symptoms; since the former indicate the physical state of the pulmonary organs, as their density, the liquid or solid matter infiltrated in their tissue, and the nature of the bronchial secretion. When the physical signs are distinctly marked, we infer, with absolute certainty, that there is a corresponding internal lesion; the comparison of the physical sign with the symptoms, informs us what the nature of the lesion may be. If the investigation of the disease be at first limited to the functional signs, we can, in a large majority of cases, determine its nature—whether it be phthisis, pneumonia, &c.; but the degree of development, and the extent of the lesion, can only be known from the physical signs.

It is well known that many diseases assume a latent form: that is, they pass through their course without their presence being indicated by the ordinary symptoms. Pneumonia, pleurisy, phthisis and other affections of the chest, may be latent, and can only be detected by physical examination, which explains the local cause of the disease. In such cases, the non-existence of the rational signs does not prove that the lungs were not diseased, but it merely shows that for some reason the anatomical lesion was not accompanied with the usual functional disturbance. When the physical signs of these latent diseases are as clear as they usually are, the evidence is entirely sufficient for an accurate diagnosis.

On the other hand, there are cases of pulmonary disease in which the physical signs are obscure or doubtful; but the rational symptoms tolerably well marked. This variety is produced by very deeply-seated lesions, or slight alterations of the tissue in different parts of the lungs. It is also owing, in some cases, to great irritability of constitution, giving rise to strongly marked symptoms, disproportioned to the slight anatomical lesions. This irritability of some individuals contrasts with the comparative insensibility of others, in whom a latent disease may have disorganized a large portion of the pulmonary tissue.

When the symptoms indicate a pulmonary disease, have we a right to infer, from the absence of the physical signs, that it does not exist? Clearly not. We can only affirm that the disease is not far advanced, or there would be direct proof of the alteration of structure of the lung. A neglect of this precaution has thrown great and unmerited discredit upon auscultation. The degree of skill possessed by physicians in the art of auscultation, is necessarily various; but those most experienced, know that cases of disease do occur, in which the functional signs are tolerably marked before the development of a palpable physical lesion. It is precisely in cases of this kind, that the counsel of a physician, who can assure his patient that the lungs are but little, if at all, diseased, is the most useful. The rules of hygeine, best adapted to the case, should from that moment be rigidly enforced.

The preceding remarks will, I think, clearly point out the invaluable aid rendered by physical exploration, in resolving a problem as complicated as a disease of the chest sometimes becomes.

Diseases of the lungs may be recognized tolerably well by the rational signs alone; but it is as unwise in a physician to reject the aid of auscultation, as it would be in a surgeon to despise the use of the sound. A moderate share of knowledge enables a surgeon to determine, with great probability, a particular disease of the urinary organs, from the description of the symptoms, given by the patient himself. Would he venture to prescribe, without passing a sound into the urethra, to convert that probability into complete or nearly complete certainty? The evidence derived from auscultation is quite as certain as that obtained by the surgical mode of exploration, and is equally useful in giving clear and precise knowledge of disease.

Note.—To show that the absence of physical signs of disease is only valuable as negative evidence of the degree, and not of the existence of disease, I will mention one example.

A gentleman was suddenly taken in August, 1834, with hæmoptysis, after moderate muscular exertion. The discharge of blood continued for several days, with acute fever, slight cough, emaciation, &c., indicating the occurrence of an acute form of phthisis. The physical signs were limited to a little alteration of the softness and fulness of the respiratory murmur and a few bubbles of mucous rhonchus, when he was spitting blood. The diagnosis was not, that the patient was free from consumption, but that the disease was not sufficiently advanced to cause much alteration of the pulmonary tissue, and, consequently, the physical signs were doubtful. The phthisis proved to be acute, and produced rapid emaciation, tuberculous cavities, and death.

CHAPTER II.

The physical exploration of the thorax consists in—

1. Examination of the conformation of the chest, including mensuration.

2. Percussion directly upon the thoracic parieties, or on a solid body, in contact with them, in order to ascertain the degree of resonance yielded by each part.

3. Auscultation, or the application of the ear to the chest, or to an acoustic tube, interposed between the thorax and the ear of the auscultator.

Physical exploration is not confined to these three modes of investigation, although, as they admit of an application much more extensive than the other methods, it is necessary to enter into greater details relative to them. Other physical signs are derived from succussion, or agitation of the patient, in such a way as to communicate a slight shock to any liquid that may be contained within the pleura. Some signs belong partly to the class of physical and partly to that of functional signs. These are, the thrill communicated to the hand, placed upon the thorax, while the patient is speaking, and the more or less perfect expansion of the chest during the act of respiration. The last mentioned signs are all of secondary importance.

OF THE CONFORMATION OF THE CHEST.

The conformation of the thorax should be examined in the following manner:

The patient should stand or sit erect; the chest being bare, or covered with a garment drawn closely over it. The arms of the patient should hang by his side, and the shoulders be thrown a little backwards. The shape of the chest may then be examined by the observer, who must place himself directly in front of the patient, in as good a light as possible.

The thorax, in healthy individuals, forms an irregular cone, the apex of which is upwards and truncated. The cone is not regular, but presents on each side a plane, instead of a regularly rounded surface. One of the planes forms the anterior surface of the chest; another the posterior; and the two others, which are the shortest, form the lateral parieties. On each of these planes several prominences and depressions exist naturally, in healthy subjects; but in disease, there is frequently increase or diminution of the natural inequalities, or formation of others, which did not exist in the state of health.

On the anterior surface of the chest, the following inequalities are found:—Behind the clavicles, in subjects who are neither very thin nor very corpulent, there are obvious depressions, the internal edge of them being formed by the sterno-mastoid muscle. These depressions are necessarily a little more evident in thin than in corpulent persons, and are sometimes extreme in those who are reduced to the last degree of emaciation. In very fat subjects, there may be a prominence instead of a depression, without corresponding disease

of the lungs. Unless the post-clavicular depressions be different on the two sides of the thorax, it is therefore very probable that they indicate no morbid state of the lungs. If one of the hollows be much deeper than the other, we infer that the corresponding portion of the lung has become contracted, and occupies less space than in the natural state; this depression is produced by adhesions between the two surfaces of the pleura, following inflammation of that membrane. As inflammation of the pleura, at the summit of the lungs, is almost invariably produced by a deposit of tuberculous matter in the pulmonary tissue, an important sign is thus derived from the increase of a post-clavicular depression. If the lungs be distended from dilatation of the vesicles, or if there be an effusion of liquid into the pleura, the post-clavicular hollow on the side affected is nearly effaced, or is sometimes converted into a prominence. In patients of moderate corpulency, there are depressions below the clavicles, corresponding to those above them; they are increased or diminished under the same circumstances as the post-clavicular spaces, but from the unyielding nature of the bony walls of the chest, the difference between the two sides cannot be so great. The chest becomes gradually more prominent from the clavicles to the sixth or seventh ribs; the swell is gradual, and is partly caused by the pectoral muscles. It is a little greater on the right than the left side, except just over the region of the heart, where there is frequently a very slight local prominence. The prominence is increased by emphysema of the lungs, or by effusions of liquid into the thorax. The increased prominence is most frequently observed along the margin of the lung, which is the usual seat

of emphysema. When the pericardium is distended by liquid, there is a very evident pyriform projection in the region of the heart. If the pleura be the seat of the effusion, the dilatation is more extensive and more equable. A slighter degree of prominence usually accompanies enlargement of the heart. The anterior part of the chest offers deeper depressions than usual, when adhesion of the two surfaces of the pleura has succeeded to extensive inflammation of this membrane; the depression, in such cases, extends to the whole surface. It is local, when adhesion of the pericardium occurs after the absorption of large collections of liquid contained in that sac.

The posterior part of the chest offers a more irregular plane than the anterior, on account of the situation of the spinal column and the scapulæ. The surface is flat between the spine and the scapulæ, and below these bones is convex. It is less easy to recognize partial depressions or prominences at the upper and posterior part of the chest, than at the anterior surface. The scapula, and with it, the whole shoulder rises, when large effusions have taken place into the pleura, and sinks again when adhesion has followed their absorption. In emphysema, there is elevation of both shoulders, but it is greatest on the side most affected. There is, in cases of emphysema, a double cause for the dilatation, arising partly from the habitual efforts made during inspiration, and partly from the actual distension of the vesicles. The inferior parts of the chest are dilated to a very evident degree in emphysema, and still more in pleuritic effusions, or pneumo-thorax. The affected side is not dilated when the lung is inflamed, but there is sometimes a slight enlargement of the

sound one, from the great efforts made during respiration. The effusion of liquid occurring in pleurisy, causes distension of the lowest parts of the chest. Contraction succeeding a cured pleurisy, is also better seen near the base of the thorax, where the false membranes are the most extensive, and the consequent adhesions are strongest. The axillæ which present the most regular of the four planes, constituting the thorax, are dilated or contracted under the same circumstances as the posterior and inferior regions; but as their alterations of conformation are less evident, it is not necessary to enter into other details. In whatever part of the chest the dilatation or contraction may occur, they are always more perceptible in the intercostal spaces than at the ribs.

The conformation of the thorax varies to a certain extent, in the different ages of life. In children, the chest is more rounded than in adults, the depressions are scarcely perceptible, and the upper part of it is more narrow. The anterior surface is much smaller, and the lower and posterior portion is proportionably more developed than in advanced life. In old age, the rigidity of the ribs and their cartilages diminishes the roundness of form, and renders the imperfect planes, observed in adults, much more evident.

Mensuration of the thorax is performed by drawing a cord around the chest, upon a horizontal line, and measuring, on each side, the distance from a spinous process to the middle of the sternum. The difference in the measurement of the two sides, is most evident just below the nipple.

CHAPTER III.

OF PERCUSSION.

As the walls of the thorax form a firm and elastic case, which is filled by a spongy tissue, containing much air, it is evident that it must yield a hollow sound when struck. The sound must be more hollow when the air is in large quantity, and less hollow when there is less air and more solid or liquid matter. Upon this simple fact is based the art of percussion, which is one of the most important means of physical exploration.

This mode of examining the chest, invented by Avenbrugger, and revived by Corvisart, has but recently attracted the attention it deserves. Laennec relied so much on his admirable skill in auscultation, unassisted by other physical signs, that he was rather disposed to undervalue them. M. Piorry, the inventor of mediate percussion has applied this mode of investigation to a number of diseases, but he does not seem perfectly aware of the necessity of combining it with accurate auscultation. Percussion, as now practised by that class of physicians at Paris, who consider the art of diagnosis as the solution of a problem by a comparison of all its elements, is a necessary complement to auscultation. These two means of investigation are perfectly identical in their object, which is to ascertain the phy-

sical condition of the lungs. Auscultation is, however, of more extensive application, as it discloses alterations of the bronchial tubes not distinguishable by percussion, which can only indicate the greater or less proportion of air, compared with solid or liquid matter, in a given portion of the thorax.

Percussion shows the state of that portion of the lung which is immediately beneath the part of the thorax struck by the fingers. This fact may be easily verified by a simple experiment. If a vessel be half filled with water, and be struck with the ends of the fingers, near the level of the liquid, the sound will be hollow above this level, and flat below it. It must, however, be recollected, that the sound near the line of division is partly produced by air and partly by the liquid; it therefore has a mixed character between the clearness of the gaseous resonance and the absolute flatness yielded by a liquid.

On percussing the thorax, the dull sound on the line of a liquid is limited to a very small space, not exceeding half an inch; elsewhere, anatomical demonstration shows clearly that the sound on percussion is in direct accordance with the proportion of gas and liquid or solid matter. The greater or less density of the solid or liquid below the point percussed, causes a difference in the resonance of the chest, which is less easily appreciated than the distinction between gas and liquid. These minor shades can only be recognized by an experienced observer, whose ear is aided by the sense of touch, or the degree of resistance given to the fingers by the body percussed.

The practical application of percussion in the examination of the diseases of the lungs, is directed almost

solely with a view of ascertaining the quantity of air in a given part of the chest. If the air be more abundant than natural, the percussion is more sonorous than in a healthy chest; if less air and more liquid or solid matter be contained in the lungs, the percussion is less sonorous. As the more important diseases of the lungs and heart are attended by alterations of the relative proportions of air and denser bodies, the utility of percussion, in ascertaining these lesions, must be obvious.

When the results obtained by percussion are compared with those of auscultation, the precise physical state of the lungs is discovered.

Of the manual performance of percussion.—Percussion is mediate or immediate. Immediate percussion requires the ends of the fingers, or in some cases, their palmar surface to be struck quickly upon the walls of the thorax. This mode of percussion was once generally employed, but is now very properly and universally abandoned, on account of the production of less sound than may be obtained from mediate percussion, the greater pain caused to the patient, and the absolute impossibility of using this method when the cellular tissue is infiltrated with liquid or loaded with fat. Mediate percussion was introduced by M. Piorry, now physician to the Hotel Dieu, of Paris. A dense resisting body is placed in contact with the patient, and held with the fingers of the left hand, while percussion is made upon it with the right. The body interposed between the fingers and the skin is called a pleximeter; it may be a thin plate of ivory, leather, or metal, or, what is generally the most convenient, the fore-finger of the left hand. An excellent pleximeter

is a piece of caoutchouc, or common gum elastic, about a quarter of an inch thick, and tolerably firm. This pleximeter is very elastic, gives a good full sound, and prevents any pain being felt by the patient.

The percussion should be made in such a manner as to produce the greatest possible sound, without giving pain. These two requisites are perfectly compatible; if percussion be well made, it gives little or no pain; if awkwardly, it is almost always painful, and frequently mischievous. When the fore-finger of the left hand is applied to the chest, the percussion may be made upon its palmar or dorsal surface. The sound is clearer, but accompanied by a slight clacking noise, when the dorsal surface is percussed; it is purer, more completely hollow, and not less loud when the palmar face is struck. The latter surface is necessarily percussed when the depressions above the clavicles are examined; in that case, the convex surface of the finger is readily placed in contact with the concavity of the chest. When the anterior surface of the chest is percussed, it is almost indifferent which surface of the finger is struck. When the back is examined, it is most convenient to strike upon the convex surface of the finger. Whether the pleximeter be the index-finger, or a piece of caoutchouc, the fingers should strike against it in the same manner. The four fingers of the right hand should be brought into a line, and the blow be given as quickly as possible, with the ends of the fingers, and not with the bulbs. The motion should be performed in the wrist and in the metacarpal joint of the fingers, the arm being perfectly passive, and much care should be taken to withdraw the fingers immediately after they have touch-

ed the pleximeter.* It is frequently very convenient to use the middle finger only in percussing, if the patient be thin. The tap is then extremely light, but gives a very perfect sound.

It is usual to percuss slightly the different parts of the chest, before making a more careful examination to ascertain the precise alteration of the diseased parts. The pleximeter must then be passed carefully from the top to the bottom of the chest, percussing first on one side, then on the corresponding point of the other, in order to ascertain their relative sonorousness. If the finger be the pleximeter, it should be applied in the intercostal spaces.

The chest is usually divided into several artificial regions for facilitating the description of the sound obtained on percussion. Distinct names, derived from their anatomical characters, have been given to these regions—but some inconvenience results from this artificial arrangement. The method pursued by M. Louis is preferable. He divides the chest into definite parts, and when he wishes to render his description very precise, he mentions the anatomical relations. The following arrangement is chiefly based upon his practice: The posterior part of the chest is divided into three regions on each side. The upper is bounded inferiorly by the spine of the scapula; the middle third extends from the upper termination to three inches below it; the lower third includes all the inferior part of the chest. Each of these divisions, when necessary, may

* Physicians unpractised in percussion, are apt to commit two errors:—they strike with the bulbs instead of the ends of the fingers, and allow them to remain in contact with the pleximeter, after they touch it. This awkward mode is painful to the patient, and gives imperfect results.

be subdivided into an internal and an external portion, the inner margin of the scapula forming the line of division. The axillæ are each divided into two equal portions, by a line passing transversely through their middle. The anterior region of the chest is divided into three nearly equal regions on each side; the upper extending from the clavicle to the third rib, the middle from the third to the sixth rib, and the third including the space below it. Each of these regions, like those of the back, may be divided into external and internal parts. Besides these divisions, there are others more strictly anatomical; these are the post-clavicular and the præcordial region. The former is the depression immediately behind the clavicles; the latter is the space corresponding to the heart, extending from the left nipple to the middle of the sternum, and from the base of the chest obliquely to the junction of the sternum and the fourth rib.

The intensity of sound in each of these regions is in proportion, first, to the greater or less pulmonary tissue; secondly, to the distribution of the bronchial tubes; and lastly, to the thickness of bone, muscle and cellular substance covering the lung. The sound on percussion is, therefore, most sonorous in the axilla and the inferior regions of the chest. It is a little less sonorous below the clavicles, and still less resonant upon and behind them. The middle anterior region is more sonorous than the upper, if the patient be thin; less so, if muscular. The two superior dorsal regions give a comparatively obscure sound at the external portions, where a thick layer of muscle covers the scapula; at their internal portion, the percussion is more sonorous.

The annexed cut, (No. 2,) shows these regions, and the different degrees of sound afforded by each of them.

Of the position of the patient when examined by percussion.—This must vary according to his strength and the degree of pain he may suffer. In chronic diseases which are not far advanced, the patient can easily place himself in the most favourable position. In acute affections, or in the advanced stages of phthisis, the position of the patient cannot be changed from the recumbent posture; it frequently cannot even be altered from one side to the other. The latter class of diseases may almost always be recognized by such obvious physical signs, that it is of little consequence in what position the patient is examined. When the anterior surface of the chest is percussed, the patient should sit erect upon a chair, the shoulders thrown a little backwards and the arms hanging by the sides; the muscles and skin covering the chest are thus made tense, and yield the loudest sound. In percussing the axilla, the arms of the patient must be raised above his head. When the back is examined, he may sit with his face towards the back of a chair, or simply fold the arms upon the chest and incline his head forwards; in either case, the skin is put upon the stretch.

In young children, percussion affords very important signs, which are the more valuable from the comparatively little aid we can receive from the auscultation of such patients. It is best performed by tapping lightly with a single finger along the back. Very little result can be obtained from percussing them on the anterior part of the chest, which is narrow and covered by a layer

of fat. Besides, almost all the diseases of the lungs in young children begin at the posterior margin or base.

If the child be an infant, it should be laid upon its face, or supported, so that it may lean forwards and make the skin of the back tense.

Percussion is performed in the same manner in the case of aged persons as in that of young adults.

CHAPTER IV.

OF AUSCULTATION.

Auscultation is the art which relates to the discovery and appreciation of the sounds produced in the different parts of the body, in health or in disease. In other words, it is the application of the sense of hearing to the investigation of diseased action.

Any organ which, in a healthy or morbid state, yields an appreciable sound, may be examined by the ear; but as the lungs and heart produce a much greater variety of sounds than any other viscera, auscultation is chiefly applied to the examination of these organs. When the ear is directly applied to a part of the surface of the body, auscultation is immediate. When an acoustic instrument, called a stethoscope, is used as a conductor of sound, we employ the term mediate auscultation. The stethoscope was exclusively used by Laennec, the discoverer of auscultation. His attention was first directed to the subject, from accidentally placing his ear upon some paper rolled into a cylindrical form, and then applying it to the chest of a patient affected with a disease of the heart. The great distinctness of the sound induced Laennec to examine, by means of the stethoscope, patients affected with various diseases of the thoracic organs; and after the labour of

a few years, he was able to bring the art of auscultation nearly to its present degree of perfection.

Later observers are more accustomed to immediate auscultation, which has many advantages. The sound is more intense when the ear is applied directly to the chest; the position of the patient need be less constrained than is necessary for the accurate adaptation of the instrument; the different regions of the chest may be examined with greater rapidity, and, above all, the sounds heard may be easily compared with each other. Immediate auscultation is not practicable, for obvious reasons, over the anterior part of the chest in females, nor can the space in which the sound is heard be as accurately circumscribed as with the stethoscope. The reason last assigned, is of great importance in the auscultation of the voice and of the præcordial region. The auscultator should, therefore, not neglect the use of the stethoscope, although, in the majority of cases, the unassisted ear answers not only as well, but better, than if aided by the cylinder. When the stethoscope is used, the results should generally be verified by immediate auscultation.

The best material for making stethoscopes, is some of the lighter kinds of wood, of rather close grain; none answers the purpose better than cedar; the metals, ivory and other substances, have been tried, but they were all soon abandoned. In its simplest form, the stethoscope is a cylinder of wood, eight to twelve inches in length, about an inch in diameter, perforated in the centre by a canal, one-fourth the diameter of the whole instrument. One end of the stethoscope is excavated in a funnel or trumpet-shaped cavity, to collect the sound from a larger surface. The excavated end

is applied to the chest of the patient, but in auscultation of the heart, the hollow is first filled up by a wooden plug, fitting accurately into it. The length of the stethoscopes now used is about eight inches; the original dimensions of the instrument are retained at the excavated end, but it gradually diminishes in diameter to the other extremity, upon which a flat piece of ivory is attached, for the more convenient application of the ear. The diameter of the central canal is the same throughout its whole length. The modifications which different individuals have made in the stethoscope, are very numerous, but in the essential parts of its construction the instrument remains the same as when first used by Laennec.

The application of the stethoscope demands some care; the extremity of the instrument must be exactly in contact with the chest, which must be perfectly bared or covered by a thin and soft garment; the position of the observer must be as unconstrained as possible, and his ear should be accurately placed upon the instrument. At first, the rustling of the patient's clothes, or other external sounds, may be confounded with the respiratory murmur; but this mistake can only occur to a very inexperienced auscultator.

The position of the patient should be the same as has been already indicated when treating of percussion. If his strength should not be sufficient for him to sit up, he may be carefully placed first on one and then on the other side, in such a manner that the ear or the stethoscope may be successively applied to the different parts of the chest. If his prostration be very great, the examination must be confined to the anterior part of the chest; in cases where this occurs, the signs are

usually very distinct. In the early stages of consumption, the patient should always be placed in the most favourable position, and, if practicable, should be examined both with the stethoscope and by the direct application of the ear to the chest, previously covered by a soft garment.

At first, the patient may breathe, as he does under ordinary circumstances; but afterwards, he should be directed to respire more quickly. When the respiration has been heard, we should direct the patient to cough; and, lastly, the voice should be examined by the stethoscope, which should also be used when we listen to the sounds of the heart. A single examination is never sufficient when the case is at all obscure; a variety of circumstances may throw much doubt upon the signs, which a subsequent auscultation may remove. The sounds vary according to the greater or less expectoration, the degree of fever and other circumstances independent of the original lesion.

The preceding remarks show that I attach but little importance to the kind of stethoscope which individuals may prefer. The important point is to have a perfect knowledge of the sounds yielded by a healthy or a diseased chest. When this knowledge is attained, they may be heard with or without the stethoscope, sometimes better without it, especially when a rapid examination is necessary.

In all cases, the physical exploration of the chest should be made as quietly as possible, and in such a manner as to avoid exciting the attention of the patient.

Of the sounds produced by a healthy lung during the act of respiration.—When the ear is applied to the

chest of a person in good health, a faint rushing sound is heard during the act of inspiration. When this sound is carefully analyzed, it will be found to consist of two elements, more or less blended together. The first element, or the blowing sound, is that produced by the air passing through the bronchial tubes. It resembles the sound made in the mouth and fauces, when the air is quickly inhaled. It is heard most distinctly at the root of the lungs, over the trachea, and near the clavicles, especially the right. The second sound is the soft murmur caused by the expansion of the vesicles; it is the best characteristic of a healthy pulmonary tissue. This sound is termed the vesicular murmur, or the vesicular respiration, from its anatomical seat. It is best heard where the tissue of the lungs contains the greatest number of vesicles, and the smallest bronchial tubes—that is, at the base of the lungs, in the axilla, and at their anterior margin.

The sound of expiration is much more feeble than that of the inspiration, and in a healthy subject is almost confined to the parts where the first or blowing sound is heard. It is short, feeble, blowing, and does not resemble the inspiratory murmur.

The original seat of the blowing sound seems to be in the fauces and the nasal cavities, as may be readily tested by placing the ear near the mouth of a person who inspires strongly. However faint the inspiration may be, a noise is produced in the mouth, but this sound does not in the least resemble the respiratory murmur or the second sound. The sound of expiration is produced very perfectly in the fauces, as may be verified by the experiment just mentioned.

The blowing sound of inspiration and that of expira-

tion are partly conducted from the fauces into the chest, and in part originate in the bronchial tubes of large caliber. The physical condition of the large bronchi and of the cavities of the mouth, is very analogous. The resemblance is still closer when the pulmonary tissue loses its spongy structure and becomes indurated. In this case, the sound of respiration, in the indurated parts of the lungs, resembles very nearly the sounds produced in the mouth; sometimes it becomes much louder.

The vesicular murmur is not heard except near the vesicular structure of the lungs; it cannot be produced artificially, and does not resemble the sounds made by the air passing through the fauces. The cause of this sound is probably the rustling of the air against the sides of the vesicles, as it passes in to fill the vacuum made by the elevation of the ribs. As the pressure necessary to drive out the air from the vesicles is uniform, the air is gently expelled from them, and consequently produces no sound until it reaches the bronchi.

NOTE.—The distinction between the sounds produced in tubes, such as the fauces or large bronchi, and those originating in the vesicular structure of the lungs, may be exemplified by the following experiment:—Take a stout gum elastic bag, into which a short tube is fitted, such as is used in injection for hydrocele. If the air be expelled from this bag, and the pressure be suddenly removed from it, its sudden dilatation produces a partial vacuum, and as the external air rushes in to fill it, a loud sound is produced by its passage through the tube. An analogous sound is heard on expelling the air by compressing the bag. If this process be repeated, while the bag is applied to the ear, the sound produced by the air, as it is forced in, is distinctly heard, but with the addition of a new element originating in the bag and not in the tube. No sound is heard in the bag when the air is expelled from it. If the sound produced by the dilatation of the pulmonary vesicles could be substituted for that caused by the air passing into an unyielding bag, we should have a perfect representation of the sounds of respiration.

OF THE VARIETIES OF THE HEALTHY RESPIRATION.

(A) *Varieties dependant upon anatomical structure.*—I have already stated, that the respiration was more blowing and less vesicular in those parts of the lungs in which the bronchi were largest. The vesicular murmur is, however, always perceptible in every part of a healthy chest. The respiration is most blowing at the inner part of the scapula, in a space about two inches in length, below the spine of the scapula, and in breadth extending from that bone to the spine. The largest bronchi correspond in situation to this part of the chest. The blowing respiration is heard, but less distinctly, at the upper posterior part of the right lung, and still more feebly at the corresponding portion of the left. On the anterior part of the chest, the blowing respiration is confined to the breadth of about two inches at the summit of the right lung.

The blowing sound of the respiration is not heard, except in the portions of the lungs just described, when the patient breathes moderately, but fully expands the chest. If he should drive the air forcibly through his mouth, then the sounds always produced in the fauces are so much exaggerated, that they may be heard throughout the whole extent of the thorax.

The singular fact, that the respiration was always a little blowing at the upper part of the right lung, and not of the left, has been familiar to me for some years. I have recently made a number of dissections of the lungs, to ascertain whether this fact could be explained by their anatomical structure. It will be seen, by referring to the cut, No. 1, at the end of the work, that the bronchi distributed to the upper lobe of the right

lung, pass nearly in a straight line from the trachea; those proceeding to the left lung, make a much longer circuit, in consequence of the curve made by the left bronchium, as it passes beneath the aorta. The length of the principal bronchium, on the left side, is two inches and a-half; that of the right is less than an inch and a-half, measured from the middle of the bifurcation. The caliber of the bronchi, passing to the right lobe, is nearly double that of those on the left. There are, therefore, three circumstances which render the respiration more blowing on the right side—1. Proximity of its bronchial tubes to the trachea. 2. Their straight course. 3. Their greater size.

The vesicular murmur is heard, unmixed with the blowing respiration in the other parts of the thorax. In adults, it is stronger on the anterior surface of the chest; in children, it is louder at the back, which is not covered by thick muscles in early life. The respiration, in most persons, is loudest towards the base of the thorax, where the thickness of the lung is greatest. In the axilla, the respiratory murmur is pure, and very distinct. At the præcordial region it is distinct, but is rather more feeble than on the right side.

(B) *Varieties produced by the difference of age.*—In children, the respiration is much stronger than in adults; the difference is so considerable, that the respiration of children is regarded as a distinct variety, to which the name puerile respiration is commonly given. The greater loudness of the respiration characterizes both the blowing and the vesicular sounds, which, throughout the chest, are more mingled together than in adults. It depends partly upon physical causes; that is, the thinness of the parietes of the chest, and

the short distance between the fauces of the child and the ear of the observer. From the first of these causes, the respiration in thin persons resembles, to a certain extent, that of children. Another cause must be the greater activity of the function of respiration in early life, when the number of inspirations is nearly double that of adults, and each effort of breathing drives the air forcibly into the lungs.

In old age, the respiration becomes more feeble, partly from enlargement of the vesicles and rigidity of the walls of the chest, and in part from diminished activity of the vital functions. The diminution of force extends to both the sounds, but is, perhaps, still more perceptible in the blowing than in the vesicular sound.

(C) *Varieties caused by the constitution of the patient.*—The respiration of corpulent persons is more feeble than that of thin ones, from the obstacle produced by the interposition of the fat, which is a bad conductor of sound. Infiltration of the cellular tissue, from dropsy or other causes, produces a similar effect. In emaciated subjects, the distinctness of the respiratory murmur is very great, unless the function of respiration be imperfectly performed. In women, the respiration is heard more imperfectly beneath the mammæ than in other parts of the chest, where it is generally louder than in men, and approaches to the characters of the puerile respiration. Digestion or muscular exertion both increase the loudness of the vesicular sound. The nervous excitement sometimes produced in irritable persons by an examination of the chest, also exaggerates the respiration, a circumstance to be recollected when we examine patients of this character.

OF THE ALTERATION OF THE RESPIRATORY SOUNDS PRODUCED BY DISEASE.

1. *Of the signs which consist in changes of the sounds yielded by the normal respiration.*—These changes may be limited to an increase or diminution of the sounds of respiration, without alteration of the relative loudness of their elements; or the relative intensity of these elements may be much changed from the natural state. In all the varieties of this class, we shall discover the blowing or the vesicular sound, but always more or less altered.

(A) *Increase of the normal sounds of respiration.*—In this variety, both the blowing sound and the respiratory murmur are augmented. Cases have been mentioned, in which this increase was occasioned by peculiarities of temperament, or habit of body, or by some accidental circumstance affecting the patient. The force of the respiration may also be increased by diseases of the lungs. When a portion of the pulmonary parenchyma becomes impervious to the air, and incapable of performing the function of respiration, the portions not diseased act with increased energy, and, therefore, render the sound of respiration louder. This is especially the case when one lung is compressed by a pleuritic effusion. A lung, which is partially diseased, may yield a puerile respiration in its healthy portions. The same variety may occur in bronchitis and in fever, though there is no alteration of the parenchyma, but merely a lesion of the bronchial tubes impeding the passage of the air.

(B) *Diminution of the normal sounds.*—The sound of respiration may become less loud than natural, from

lesions occurring in parts external to the lungs, or from alterations in the structure of these organs. If the pleura contain a liquid, whether it be pus, blood or water, the respiration becomes more feeble, in part from the compression of the pulmonary tissue, which prevents the perfect dilatation of the air-cells; and partly from the interposition of a stratum of liquid, which removes the lung to a greater distance from the ear. The respiration is constantly feeble in emphysema, the feebleness extending to both the blowing and the vesicular sounds. The same is frequently, but not invariably, the case in bronchitis. In phthisis, the respiration is generally less loud than natural, but the feebleness is usually attended with other alterations of the respiratory sounds.

(C) *Increase of the blowing sound of respiration, with feebleness or absence of the respiratory murmur.*—This division includes the most important alterations of the respiratory sounds; that is, the different varieties of the bronchial, cavernous and amphoric respiration. I shall describe them in order, beginning with the cases which differ least from the characters of the normal respiration.

(*a*) *Imperfect bronchial or rude respiration.*—In this variety, the blowing inspiratory sound is more distinct than usual, and more prolonged; the vesicular murmur is still heard, and is usually more feeble than in a healthy lung; in some cases it is louder, but has a rougher sound. The feebleness of the vesicular respiration arises partly from condensation of the tissue obstructing the passage of air into the vesicles, and partly from the increased loudness of the blowing sound, by which it is masked. The vesicular sound is never entirely destroyed in the rude respiration of which it is the

distinctive character. The expiration is still more blowing and prolonged than the inspiration, and is more marked if the lesion be upon the right side of the chest than if on the left; in the first case, the natural sounds of respiration are exaggerated, but in the second, a new sound is produced. Some care and experience are necessary to discriminate between this variety of the respiration and that which exists in the natural state, at the upper part of the right lung. The best differential mark, when the lung is not diseased, is the presence of a pure and decided vesicular respiration, a little more feeble than on the left side, but similar in character. Though rude respiration be accompanied with a respiratory murmur, it is rougher than natural, and the expiration is also much more prolonged and blowing.

The rude respiration is heard in pleurisy, when the effusion is moderate; in the very earliest stage of pneumonia, and near its termination; almost always in the early stages of phthisis. It is scarcely ever produced at the base or along the anterior margin of the lungs.

(*b*) *Bronchial respiration.*—The vesicular murmur disappears when the pulmonary tissue is perfectly indurated, the blowing sounds are still heard, but much more strongly than in the natural state. Both the inspiration and expiration become more loud and more prolonged, but especially the latter. The sensation communicated to the ear is that of the air passing through solid tubes, and not through the spongy tissue of the lungs. The bronchial respiration may be produced by disease in any part of the chest, except very near the base of the lungs, where the bronchial tubes are too small for the production of this sound, though

the pulmonary tissue should be indurated. It may be well developed on the anterior part of the chest, in the upper half of both lungs, and in the upper two-thirds or three-fourths on the posterior part of the thorax, as well as in the upper half of the axilla. If the lesion be on the right side of the chest, the bronchial respiration is more distinct than if it be on the left. Although the loudness of the blowing inspiration, and especially of the expiration, are always greater in the bronchial respiration than in the normal respiration, the essential character of the morbid variety is the total absence of the vesicular murmur. The loudness of the sound depends upon the size and unobstructed caliber of the bronchial tubes, and the hardness of the matter with which the tissue of the lung is infiltrated. The bronchial respiration is heard in the large majority of cases of pleurisy, in phthisis, when the bronchial tubes of large or middle size are surrounded with masses of tubercular matter, and in pneumonia.

(*c*) *Strong bronchial or tubal respiration.*—This may, with propriety, be separated from the ordinary bronchial respiration, although it is but an exaggerated form. It must be studied separately, because it forms an important link between the variety last described, and the cavernous respiration. The inspiration and expiration are not only strongly blowing, without the least trace of vesicular respiration, but they are both very loud, and resemble the sound which would be produced by some one blowing strongly into the ear. This character is best marked in the expiration. The puff of air does not seem to proceed from a single spot, but from a large extent of lung. During the inspiration the sound seems diffused through a consider-

able portion of the pulmonary tissue, until it is gradually lost. This variety of the bronchial respiration can only be produced under very favourable circumstances; the bronchi must be large, and the induration of the pulmonary tissue so complete that no air can pass into the vesicles. It is scarcely ever observed, except in pneumonia, when it is heard near the root of the lungs in the larger bronchial tubes, and in dilatation of the bronchi. It is remarkably loud when the bronchial tubes are dilated, at the same time that the pulmonary tissue is indurated.

(*d*) *Cavernous respiration.*—The cavernous differs from the tubal respiration in being limited to a circumscribed portion of the lung, into which the air is heard to pass, and from which it is forcibly expelled; sometimes it seems as if it were blown directly into the ear. This variety of the respiration is produced, as its name implies, by a cavity in the lung, which, in an immense majority of cases, arises from the softening of tuberculous matter. It is consequently most frequently observed at the summit of the lungs, where tubercles are usually deposited; if it be caused by cavities, resulting from pneumonia or gangrene of the lungs, the most common point of origin is about the middle of the posterior part of the thorax; that is, at the upper part of the lower lobe of the lung. A lesion which occasionally gives rise to cavernous respiration, is the dilatation of the bronchial tubes, when it exists in a very marked degree; this is, however, a rare circumstance. All cavities do not give rise to an equally perfect cavernous respiration; to produce it in the most marked degree, the cavity should be about the size of a walnut, should communicate freely with a large bronchial tube, and

its walls should be firm and surrounded by an indurated parenchyma. When the cavity exceeds the size of a walnut, the cavernous respiration is a little less loud, especially if the pulmonary tissue around it be still permeable to the air. The large size, and the softness of the walls of the cavity, reflect and conduct the sound imperfectly. It is not always possible to distinguish between the cavernous and the tubal respiration; the physical state giving rise to them, and the sounds themselves, are sometimes so similar as to deceive a practiced ear, unless the progress of the case has been carefully watched. When cavities are of very long standing, the cavernous respiration may become less distinct. I believe this change sometimes arises from the contraction of the bronchial tubes communicating with the cavity, and the diminished hardness of its walls.

(*e*) *Amphoric respiration.*—As the air passes into cavities of very large size, it produces a sound not unlike that caused by blowing smartly into a glass or metallic vessel. The intensity of this sound varies; sometimes it is very similar to that just described; at other times, it is merely a slight whizzing noise, which may resemble, to a certain extent, the sibilant rhonchus. The expiration is never so loud as in bronchial respiration; it ceases entirely if the opening be small, as is frequently the case in pneumo-thorax. Amphoric respiration is produced by large cavities, which cannot reflect the sound as sharply as smaller ones; it is, therefore, usually a less distinct variety than the cavernous respiration, especially in those cases in which the expiration is wanting. The cavities which give rise to it are most frequently either the pleura, when a

fistulous opening has occurred between this membrane and the bronchi; a gangrenous excavation, or one produced by softened tubercles. In extremely rare cases it may be caused by a cavity following pneumonia. The same cavity, which at first may yield a well marked cavernous respiration, will produce an amphoric sound when much enlarged; and as the latter is less easily recognized than the former, cavities of very large extent may be unnoticed, particularly where the pulmonary tissue around them remains permeable to the air. The only sure means of avoiding this error is to examine the patient carefully, and more than once. There is no probability of mistaking the case when the patient has been long under the care of the physician, who may then easily trace its progress from cavernous to amphoric respiration. It is hardly necessary to add, that no trace of vesicular murmur can be detected in the amphoric respiration.

OF THE RHONCHI AND OTHER MORBID SOUNDS.

The second class of alterations of the respiration comprises the accidental or adventitious sounds produced during the act of respiration. The sounds are of two classes:—1, Those produced directly by the passage of the air through the bronchial tubes or vesicles; and, 2, The sound produced by the dilatation and contraction of the lungs reacting upon the matter secreted into the pleura.

Of the sounds produced by the passage of the air through the bronchial tubes or into the pulmonary vesicles.—These sounds are termed rhonchi, or râles, a French word, equivalent to the English rattles. For several reasons, the word rhonchus is preferable to that

of râle, which, after the discovery of auscultation, was very generally used in the English works on the subject. The rhonchi are of two kinds, humid and dry; they are either produced by the air passing through a liquid of different degrees of tenacity, and giving rise to a succession of bubbles, or they originate from the thickening or other alteration in the structure of the bronchial tubes.

1. *Of the humid rhonchi.*—As these sounds are produced by the air in its passage through a liquid, forming bubbles of different sizes, they must vary according to the tenacity of the fluid, the size of the bronchial tubes, and the greater or less rapidity with which the air is forced through the bronchi. When the bubbles are large and produced in a bronchial tube of large caliber, or in a cavity communicating freely with the bronchi, the rhonchus is either cavernous or mucous. When the liquid is contained in the smaller tubes, the rhonchus is the subcrepitant; when its tenacity is great, and the rhonchus originates in the vesicles or smaller bronchia, it is termed the crepitant.

(A) *Cavernous rhonchus, or gurgling.*—This is the loudest and most easily heard of all the humid rhonchi; the air passes into a liquid of moderate tenacity, contained in a cavity of a size varying from that of a small almond to a large orange, or in some cases limited only by the pleura and the thoracic parietes. The gurgling is not in exact proportion to the size of the cavity, but varies according to the quantity of liquid, the greater or less condensation of the surrounding pulmonary tissue, the caliber of the bronchial tube opening into the cavity, and its position above or below the surface of the liquid. The thickness of the pulmonary

tissue between the cavity and the ear, does not materially diminish the intensity of the sound. The character of this rhonchus is best described by the word gurgling—the impression is exactly such as we should suppose produced by agitation of a liquid and air in a circumscribed cavity. The gurgling is generally preceded by a dry mucous rhonchus, or crackling, which becomes more liquid and distinct as the cavity increases. The cavernous rhonchus is always heard where a cavity in the lungs, containing a liquid, communicates with the bronchi. It occurs by far the most frequently in cavities following the softening of tuberculous matter, but it is sometimes produced by dilated bronchi, or by pneumonic abscess, or circumscribed gangrene. When the gurgling is from a tuberculous cavity, it is heard most frequently and most distinctly near the summit of the lungs; when it proceeds from a dilated bronchus, it is found near the root of the lungs, between the shoulders; if from pneumonia or gangrene, the rhonchus is most frequent near the posterior and inferior part of the thorax. This rhonchus is the surest means of diagnosticating cavities in the lungs, because they almost always contain liquid, but are very frequently so much obstructed that the cavernous respiration is obscured. The gurgling may cease for a short period, from temporary obstruction of the tubes, but it may be readily reproduced by directing the patient to cough, which will remove the impediment.

(B) *Mucous rhonchus.*—This is analogous in character to the cavernous; it is more diffused, but less intense. It is produced, like the gurgling, by the passage of air through a liquid of little tenacity, but it must be

contained in the larger bronchi, instead of a circumscribed cavity. The sound is rather that of a succession of bubbles than of a confused gurgling; the bubbles are not always of equal size; at times, they seem produced by a thinner liquid, which breaks quickly; at others, they are larger, and approach more nearly to the cavernous rhonchus. When the liquid is chiefly contained in the bronchi, near the root of the lungs, the mucous rhonchus cannot be certainly distinguished from the cavernous; the resemblance is most perfect when the surrounding pulmonary tissue is indurated. There is scarcely a disease of the lungs in which the mucous rhonchus is not occasionally found; its presence may be presumed when the expectoration is abundant, and not tenacious; and, if wanting for a short time, it may be easily heard again by making the patient cough. Mucous rhonchus is almost always heard in the second stage of pulmonary catarrh, when the expectoration has become abundant; its seat is the posterior and inferior part of the lungs. In pneumonia, mucous rhonchus is often present after the termination of the crepitus; in phthisis, this rhonchus is very frequent, and varies according to the quantity of liquid contained in the bronchi; it is most constant when the tuberculous masses begin to soften, but it is then caused by the secretion from the mucous membrane of the bronchi, rather than by the softened tubercle which is confined to the cavity, where it gives rise to the cavernous rhonchus.

(C) *Crepitant rhonchus*, or, as it is often called, *moist crepitant rhonchus*.—This sound is produced in the small bronchial ramifications, or, as some suppose, in the pulmonary vesicles; and is caused by the passage

of the air through a very tenacious liquid. The bubbles are, therefore, much smaller, and break with a sharper noise than the mucous rhonchus. It has been compared to the sound caused by the crackling of salt thrown upon hot coals, to the effervescence of cider, and other analogous sounds, which do not perfectly represent the character of the rhonchus. It is described with some difficulty, but when once heard, is always recognized. The crepitant rhonchus may occur in any part of the lungs, but it is most frequent at the lower and posterior part, and is heard chiefly during the inspiration. Sometimes it can be traced from point to point of the lungs, by the peculiar crackling sound, like that caused by igniting a train of moist powder. The crepitant rhonchus is peculiar to pneumonia; it occurs in this disease, even when it arises from external violence, and the expectoration is entirely wanting. It is, therefore, probable that this sound is sometimes caused by the dilatation of the inflamed vesicles, and not by the liquid contained in them. The crepitation is heard in the early stages of pneumonia, and when the part of the lung first affected has passed to the stage of hepatization, it is usually surrounded by a belt of crepitant rhonchus, which extends with the progress of the disease.

(D) *Sub-crepitant rhonchus.*—This variety is distinguished from the preceding, by the larger size of the bubbles, made by the air passing through the smaller bronchial tubes, and the greater quantity of liquid. It resembles the crepitant rhonchus in the regular succession of the bubbles, which seem nearly of equal size, and are not so irregular as they are in the mucous rhonchus. Its characters are thus intermediate be-

tween those of the sounds just described, and it passes into them by such insensible gradations, that it is sometimes impossible to determine when the one ends and the other begins. The sub-crepitant rhonchus is very frequent in catarrh, when it is usually heard at the base of the lungs; in lobular pneumonia, including the peripneumonia notha; in true pneumonia, when the disease is passing to resolution; in œdema of the lungs, and in other affections of these organs, accompanied by inflammation of the smaller bronchial tubes.

2. *Of the dry rhonchi.*—These are two in number, the sonorous, and the sibilant; they are not produced by the passage of air through a liquid, but by changes in the caliber of the bronchial tubes from thickening of the mucous membrane, or the accumulation of viscid mucous upon its surface. The changes in the respiratory sound caused by diminution of the caliber of the tubes, resemble the alterations of tone made by blowing through reeds of various dimensions. The dry rhonchi are not confined to cases of inflammation of the bronchi; they may be heard when there is simple congestion of the mucous membrane. Sometimes they are heard singly, at other times, mingled together or combined with the moist rhonchi. They are signs of secondary importance.

(A) *Of the sonorous rhonchus.*—This rhonchus resembles the cooing of a pigeon, or still more nearly the sound of the bass-string of a violin. It is so peculiar, that when once heard, it cannot readily be forgotten; it is not produced in the smaller bronchi, but is most distinct where these tubes are largest. It is common to the inspiration and the expiration, but in a majority of cases, it is most evident in the expiration, and on that

account is sometimes confounded with bronchial respiration. This mistake may be avoided by observing the sharper and more musical tone of the sonorous rhonchus, the vesicular respiration which is heard, either at the same time with it, or alternately; and lastly, by percussing the patient, when the clearness of the resonance will show that the respiration is masked by the sonorous rhonchus, but is not bronchial. The sonorous rhonchus is common in those stages of catarrh, in which the bronchial mucous membrane is congested, while there is little secretion of liquid; it usually disappears when the liquid rhonchi are heard, but is sometimes mingled with them.

(B) *Of the sibilant rhonchus.*—This sound resembles a low whistle, and, like the sonorous rhonchus, is heard both in the inspiration and the expiration. It is confined to the smaller bronchial tubes, and occurs in pulmonary catarrh, in emphysema, and in the bronchial congestion, produced by typhus fever and other diseases.

(C) *Dry crepitant rhonchus.*—This is a very rare and unimportant sound; it occurs occasionally in emphysema, when the distended vesicles or the interlobular tissue, inflated with air, are compressed against the pleura during the act of inspiration. It is a very feeble rhonchus and resembles the crepitant in some respects, but does not communicate the sensation of a liquid contained in the bronchi.

3. There are two adventitious sounds not classed amongst the rhonchi.

(A) *The grating sound* (*bruit de frottement*).—It is caused by the friction of the two surfaces of the pleura, lined with false membrane upon each other, and is

heard in the latter stages of pleurisy, when the more liquid part of the effusion has been absorbed. The more solid portion, consisting of coagulable lymph, remains, and forms two rough surfaces, which chafe against each other at every act of respiration, and give rise to a peculiar creaking noise, like that made by rubbing together two pieces of parchment or dry leather. The grating sound is heard at the lower part of the chest, where the motion of the ribs is most considerable and the false membranes are usually thickest. It is heard both in inspiration and expiration, and, when well marked, is attended with a peculiar quivering of the chest, easily felt by the hand.

(B) *Metallic tinkling.*—This is a rare sound, and is heard only in the pleura, or a very large cavity in the substance of the lung, following tubercles or gangrene. It is produced by the fall of a drop of liquid from the upper part of a cavity, upon the surface of a fluid contained in it, which gives rise to a peculiar tinkling sound, a little similar to that produced by striking a pin against a glass vessel. The sound is not permanent, but when suspended, may be often reproduced by making the patient cough. The essential condition for its production is a cavity of large size, containing both air and liquid.

OF THE AUSCULTATION OF THE VOICE.

When a person whose lungs are not diseased, speaks, a slight tremor is felt throughout the whole chest, but no distinct sound is heard. In certain parts of the chest, although the distinct articulation of the voice is lost, a confused resonance is quite perceptible. These parts are the two fossæ above the spines of the

scapulæ, the upper half of the space included between these bones and the spine, and the depression immediately below the right clavicle. The resonance is greater at the upper part of the right than of the left lung, for reasons stated in the description of the characters of the normal respiration. It is heard in these parts of the thorax, because the voice is conducted from the larynx and mouth, by the column of air contained in the larger bronchial tubes. The small size of the bronchial tubes in the inferior part of the lungs, and the spongy texture of these organs, prevent the transmission of sound. The resonance of the voice is augmented by induration of the pulmonary tissue and increased size of the bronchial tubes, which render the lung a much better conductor of sound.

OF THE ALTERATIONS PRODUCED IN THE RESONANCE OF THE VOICE BY DISEASE OF THE LUNGS.

1. *Increased resonance.*—The resonance of the voice may be louder than natural, though the lungs are not diseased. If the patient be much emaciated, the resonance is very loud near the large bronchial tubes; it is greater when he has a deep bass voice, than when the voice is feeble. When the lungs contain more solid matter than in a healthy state, the resonance of the voice is increased. In the first degree of this increase, the words are confused, but the voice vibrates a little more strongly beneath the ear than in health. This alteration is heard when the rude respiration occurs, and is produced by a similar physical state of the lung; it is most distinct at the upper and posterior parts of the lungs, and is more frequent on the right than the

left side. The same anatomical structure which causes a slight degree of resonance in the right lung of healthy subjects, gives rise to a considerable increase of sound when it is but little diseased.

2. *Bronchophony* is a variety of resonance of the voice, which is much louder and much more distinct than is ever heard in a healthy lung. It is always found when the respiration is bronchial, and varies in intensity according as it is simple or tubal. In the less marked form, the voice is heard very plainly, but the words are not distinct. In the variety accompanying the tubal respiration the voice is very loud, and sometimes the articulation is quite distinct. The words seem almost to enter the ear, but are evidently diffused through a considerable portion of the lung, and do not come from a single point. The first degree of bronchophony is a very frequent and most important sign in the course of phthisis, and is usually heard in pleurisy, when the effusion is considerable. The tubal resonance of the voice is almost peculiar to pneumonia, when it is very loud at the posterior and middle parts of the chest, where the bronchi are largest, and the induration of the lung is greatest. Dilatation of the bronchi will often give rise to a very loud resonance of the voice, especially when the surrounding tissue is indurated. In all cases, bronchophony is a phenomenon ever existing with the bronchial respiration, and heard most distinctly under circumstances which are alike favourable to both, that is, large size of the bronchial tubes and induration of the surrounding tissue.

3. *Pectoriloquy* is the resonance of the voice yield-

ed by a cavity in the lung of moderate size. When pectoriloquy is perfect, the voice seems to proceed from the cavity and to enter the ear; when it is not perfect, it resembles so closely the different varieties of bronchophony, that no distinction can be made between the two sounds. It must be evident that a cavity will yield nearly the same resonance of the voice as a large bronchial tube, and if the bronchus pass through hardened tissue, it may even give rise to a more perfect resonance than a cavity not communicating very freely with the external air, and surrounded by sound pulmonary structure. A cavity capable of yielding a perfect pectoriloquy, must be of moderate size, not exceeding that of a small pullet's egg; it must be completely emptied, and its walls must be indurated. Although the surrounding lung be hardened, and the cavity of suitable size, it will not yield perfect pectoriloquy if it be temporarily obstructed with liquid. Pectoriloquy is not one of the most important physical signs; it is rarely perfect, and is not permanent, so that the presence of a cavity may generally be detected more certainly by the cavernous gurgling.

4. *Amphoric resonance of the voice.*—Like the amphoric respiration, this sound is not always easily recognized when the progress of the disease has not been watched during its earlier periods. The voice seems more hollow, more distant and more diffused, than in pectoriloquy; sometimes it has a peculiar rumbling sound. It is scarcely possible to describe the amphoric resonance, although it is unlike any of the sounds mentioned in the preceding paragraph. Sometimes it resembles the sound made by speaking in a glass tumbler,

especially when it arises from a communication between the pleura and the bronchi. But if it depend upon a large tuberculous or gangrenous cavity, the tone is much less sharp, and the resonance is sometimes quite obscure. It ceases entirely when the bronchi are obstructed.

5. *Egophony.*—When the voice is transmitted through a layer of liquid contained in the cavity of the pleura, it has a peculiar quivering intonation, resembling the bleating of a goat or the voice heard through a speaking trumpet. The sound is not often so loud as it usually is in bronchophony, unless the lungs be indurated at the same time that there is a collection of liquid in the pleura, when the bronchophony is loud and distinct, but has a peculiar vibrating tone, resembling egophony. The resonance of the voice is always greater than natural in egophony, but while it sometimes approaches the loud tone of bronchial resonance, at other times it is like a faint whisper; in all cases the essential character of the sound is its vibration. The quantity of liquid necessary for the production of this sound, must be sufficient to interpose a layer of moderate thickness between the lungs and the costal pleura; but if the quantity be so considerable as to compress the lungs against the spine, the resonance of the voice ceases, because the air no longer passes into the bronchial tubes. The usual seat of egophony is about two inches above the base of the lungs; it is most distinct at the posterior part of the chest, but varies as the position of the patient changes the level of the liquid. It is a useful sign in the diagnosis of pleurisy and hydrothorax; but as it is not constant and is confined to certain stages of these diseases, it is always of secondary value.

6. *Diminished resonance of the voice.*—When the quantity of air contained in the chest is so much increased as to diminish the fitness of the lung as a conductor of sound, the resonance of the voice is less strong than in health. The sound is extremely feeble in the parts of the lung affected with emphysema. When effusions of liquid into the pleura are so considerable as to obliterate the spongy texture of the lung, and flatten the bronchial tubes, the resonance of the voice is entirely lost. Infiltration of the walls of the chest, or a large deposit of fat, must necessarily enfeeble it; but in a large majority of the diseases of the lungs, the voice resounds more strongly than natural.

Of the auscultation of the voice and cry of children.—It is difficult to examine the voice of children; when such an examination is practicable, the signs do not differ materially from those heard in adults. The bronchophony is well marked in children older than six or seven years; it is usually doubtful in those that are younger.

Pectoriloquy is rare, partly because cavities are not frequent, and partly from the copious mucous secretions which obstruct them. Egophony is distinct when there is a pleuritic effusion.

The cry of children does not give rise to the same loud resonance in the chest as is caused by the voice. The cry is a sound produced in the larynx and nasal cavities, by the forcible expulsion of the air from the chest, and does not communicate a distinct vibration to the column of liquid contained in the bronchi. There is, however, some sound heard over those parts of the lungs which are hepatized, which is probably owing to

the conducting power of the hardened tissue. As the cry of children is followed by a quick and full inspiration, distending the vesicles to the utmost, and reproducing any rhonchi which may have been suspended, it is useful to auscult them when crying, in order to hear the sounds caused by a perfect dilatation of the air cells.

CHAPTER V.

OF THE COUGH AND THE EXPECTORATION.

The characters of the cough, and the appearance of the liquid expectorated, are closely connected, and afford valuable indications in the diagnosis of pulmonary diseases. The cough is, in itself, a useful symptom, and serves to render the signs of auscultation more distinct, by removing the liquid accumulations which obstruct the bronchial tubes. It is, therefore, usual when ausculting a patient, to request him to cough before concluding the examination. There are several varieties of cough, caused by different diseases of the chest, and by the successive stages of the same affection.

1. *Short, dry cough.*—In the early stages of phthisis, and in some affections of the fauces, there is a short, dry cough, usually limited to a single effort, rarely exceeding two or three successive expirations. When this cough exists in the earlier stages of phthisis, it is sometimes so slight that the patient himself is not aware of its existence, until it is pointed out by his physician. When his attention is directed to the fact, the cough is often rendered more rare from the efforts of the patient to suppress it. This variety of dry cough, which may either depend upon disease of the

throat or of the lungs, is not important in itself, but becomes of value when combined with other signs. In febrile affections, not immediately connected with the lungs, there is frequently a short, dry cough, not unlike that of phthisis. This symptomatic cough is especially frequent in children, who are scarcely ever ill without having more or less of it. The short, dry cough, common in some chronic diseases, is owing, in a large proportion of cases, to irritation about the fauces; but in other instances no such cause can be detected.

2. *The suppressed cough.*—When the pleura is inflamed, the effort of coughing causes much pain, and is, therefore, as far as possible, repressed by the voluntary efforts of the patient, who checks the motion of the ribs. The suppressed cough attends inflammation of the pleura, whether it be simple or connected with disease of the lungs. It is readily recognized by its abrupt termination. Another variety of suppressed cough is frequent in pertussis, and other affections of the chest, in which violent paroxysms of coughing occur; the patient's fears suppress the cough as long as possible.

3. *The sonorous cough* is loud and hoarse, but at the same time dry. It occurs in the early stages of bronchitis, before the secretion of liquid has commenced. There is a peculiar nervous cough, which is loud and shrill; sometimes it is not unlike the crowing of a cock; very frequently it may be heard at a distance. This variety of cough is usually attended with some uneasy sensations at the larynx, and both physician and patient are often led to suspect some important disease of this organ, until the history of the case, and the negative

physical signs, show that there is probably no organic disease.*

4. *The laryngeal cough.*—In affections of the larynx, the cough has a peculiar character. When the mucous membrane is thickened, and the opening of the glottis is of course diminished, the cough is stifled, or sometimes whistling; it is never loud and sonorous. Ulceration of the larynx is attended by a feeble but hoarse cough, proportionate to the aphonia which exists under such circumstances.

5. *The loose mucous cough* is marked by a loud sound, with the rattling of a liquid passing through the fauces. It is the usual cough of catarrh, when there is copious secretion of liquid into the bronchial tubes. Other diseases, in which the expectoration becomes abundant, as phthisis and chronic bronchitis, are attended by the loose cough. It frequently is heard in the third stage of pneumonia, when there is pus infiltrated through the lung.

6. *The hollow cough* of advanced consumption, when the lungs contain numerous cavities, is perfectly indicated by its name: it is almost characteristic of the presence of cavities in the lungs.

7. *The spasmodic cough* is most marked in pertussis, when there is spasm of the muscles of the chest and larynx during the expiration, which is followed by a

* I have seen two remarkable examples of the loud nervous cough, which was so sonorous that it might have been heard through the whole house. One of these patients died of another affection; his larynx was found to be perfectly natural; the other patient recovered, after the application of a blister to the back of the neck. In both these cases, the absence of all signs of organic lesion led to a suspicion of the true nature of the disease.

noisy sonorous inspiration. A similar variety is occasionally met with in other diseases of the lungs. The asthmatic cough scarcely differs from the preceding; it is frequent in emphysema, when it occurs in violent paroxysms during the convulsive fits of dyspnœa. They usually last until free expectoration commences.

The varieties of cough might be greatly multiplied, but for practical purposes, the classification I have just given will be found sufficiently convenient. All these different forms are most marked when the disease of the lungs has not extended to a very large portion of the parenchyma, in which case the excessive dyspnœa prevents the quick expiration which constitutes the cough. The diseases of the lungs sometimes run their course almost without cough, especially in the aged. In children it is always present, when the lungs are diseased, and it continues until a large portion of their parenchyma has become indurated.

OF THE EXPECTORATION.

The sputa may vary in quantity, colour, consistence, form and odour; they may also contain foreign matters, as blood, pus, tuberculous and calcareous concretions. As the sputa are chiefly secreted by the mucous membrane lining the bronchial tubes, they indicate its lesions, which vary in the different diseases of the tubes, as well as of the parenchyma. Besides the secretion from the mucous membrane, the expectoration, in many diseases of the lungs, arises in part from cavities formed in their substance.

The secretion of liquids into the bronchi is necessarily independent of the will, but the expectoration is a

voluntary act. It is performed imperfectly when a person is averse to making the necessary muscular effort, on account of the pain it may give him, or other reasons; there are no sputa when the feebleness of the patient prevents his making an effort. For similar reasons, children below the age of six years do not expectorate; they do so but rarely until the age of puberty. In very old people the expectoration is rare, and not proportioned to the extent of the disease.

When the sputa are not copious, they are chiefly expectorated in the morning, on waking from sleep, during which they accumulate in the bronchi. When the sputa are copious, but the expectoration causes pain, they are also retained in the lungs until a paroxysm of coughing comes on, and they are discharged in large quantities.

Except in the cases above mentioned, the sputa are rarely wanting during the whole course of a disease, but they do not usually assume their characteristic appearance until the disease is sufficiently advanced to be recognized by the more certain physical signs. In some exceptional cases the sputa are pathognomonic, when the physical signs are doubtful, on account of the remote situation of the lesion or the state of the surrounding tissue.

1. *Of the quantity of the expectoration.*—It is small when it does not exceed a wine-glassful in the twenty-four hours; moderate when from two to six fluid ounces; large from six ounces to a pint, and very large if more than a pint. In descriptions of the sputa, it is advisable to state the quantity.

2. *Of the colour.*—The saliva and the mucus of the bronchial tubes are transparent; it may be more abund-

ant than usual. A higher, or rather more prolonged, degree of inflammation of the bronchial mucous membrane, gives a whitish colour to the sputa, if the catarrh pass into resolution; or, if it assume a chronic form, the sputa are yellowish, and frequently of a greenish tinge, and altogether opaque. In acute inflammations of the air-vesicles and of the minute bronchial tubes, the sputa are at first transparent and colourless, but soon become tinged of an orange hue, or they are rust-coloured or of a bright scarlet colour. In inflammations of the lungs, with great prostration, the sputa are brownish, of a mahogany colour, or like that of stewed prunes.

3. *Consistence.*—In general, the sputa, if colourless, are thin and very liquid, those that are yellow and opaque, are thick, and flow less easily. The shining transparent sputa of pneumonia are more viscid than any other, are often heaped up in the centre of the cup, and adhere strongly to its sides. In one variety of chronic catarrh, and in some affections of the tonsils, the matter expectorated is very small in quantity, and almost solid. The sputa frequently consists of two parts, one more solid, and the other nearly of the consistence of water. If much air be mingled with the sputa, they are light and frothy.

4. *Form.*—The sputa generally run together, and form a mass which is nearly homogeneous: they unite more perfectly if they are nearly similar to the natural secretion of the bronchial tubes. The viscid transparent sputa of pneumonia blend together perfectly well; the yellow expectoration of catarrh less perfectly, a part of the sputa is in irregular shreds, intermixed with a whiter liquid. The form assumed by the expectoration in phthisis, is often peculiar; a thin liquid

forms the greater part of the mass, in which float irregularly rounded masses, generally as large as a shilling, with loose cottony edges. The sputa in gangrene of the lungs, and in the last stages of phthisis, run together, and do not retain a peculiar form.

5. *Odour.*—Transparent sputa are without decided odour; the thick, yellow liquid has generally a faint, nauseous smell, which is very marked in cases of phthisis. Gangrene of the lungs is distinguished by a peculiar fœtor, sometimes gangrenous, at other times resembling the smell of moist plaster. Occasionally, a variety of chronic catarrh and of tuberculous phthisis, in their advanced stages, are attended with fœtid expectoration.

6. *Of the foreign matters mingled with the secretions of the bronchial tubes.*—Pus is often intermixed with the mucus secreted in bronchitis, phthisis, and the latter stages of pneumonia, when the sputa are said to be muco-purulent. Sometimes a portion of the pus is uncombined, and sinks to the bottom of the mass. Blood may be intimately combined with the sputa, as it is in pneumonia, when it communicates a general rusty or reddish tinge to them; or it may be mixed in streaks with the mucus, and still retain its florid red colour; or, lastly, it may be unmixed with the bronchial secretions, when it constitutes hæmoptysis. The tuberculous matter may sometimes, though rarely, be detected in the sputa, under the form of minute yellowish opaque grains, not often exceeding the size of a pin's head; this appearance coincides with the softening of the tubercles. Calcareous matter is sometimes, though rarely, observed when the tubercles are dry and con-

tain much of the salts of lime. Portions of gray or dark pulmonary tissue have also been expectorated after separation from the adjacent tissue. In cases of jaundice or pneumonia, complicated with disease of the liver, the sputa may be tinged with bile. I have seen the expectoration composed almost entirely of pure bile from a fistulous opening between the liver and the lungs, following a wound of these organs.

CHAPTER VI.

ON THE MOVEMENT OF THE THORAX.

In health, the act of inspiration is performed partly by the elevation of the shoulders and ribs, and partly by the depression of the diaphragm. The passage of the air through the nostrils does not cause them to dilate evidently. When the respiration becomes difficult, the different muscles, whose action concurs in respiration, act irregularly, and much more forcibly than in a state of health. When there is dyspnœa, without pain in any part of the thorax, all the muscles concerned in respiration act with increased energy. The nostrils dilate widely, the shoulders and ribs are forcibly elevated, and the diaphragm depressed. In acute diseases, the degree of the dyspnœa is nearly commensurate with the extent of the pulmonary affection. In chronic diseases, this is by no means the case. There are even some instances in which there is extreme dyspnœa, but no appreciable lesion of the lungs. When there is acute pain in the sides of the thorax, or at the diaphragm, from inflammation of the serous membranes, the parts of the chest nearest to the inflamed pleura move less than they do in a state of health. The motion becomes free as soon as the pain subsides. If effusion of liquid occur into the pleura or the pericardium,

the motion of the ribs at the corresponding part is impeded by the mechanical distension, though there be no acute pain. When the liquid is absorbed, and false membranes unite the two surfaces of the pleura, the dilatation of the diseased side is always imperfect. The diminished motion of the side of the chest, most affected in phthisis, depends upon the adhesions produced by the frequent inflammations of the pleura.

The number of the inspirations is generally from twelve to sixteen in the minute; but when the lungs or the pleura are much inflamed, the inspirations may increase to thirty or forty; and, when the disease is extremely violent, the number may be as high as sixty or seventy. This extreme frequency is most remarkable when all the serous membranes of the chest are inflamed at the same time. In acute diseases, the frequency of the inspirations is at first nearly proportioned to the violence of the affections; when they have lasted a certain time, the patient seems to accommodate himself to a diminished supply of air, and breathes less frequently. The respiration of children affected with diseases of the chest is very frequent, especially when the lobular pneumonia has extended to a large portion of both lungs. The irregularity and the morbid slowness of the respiration more frequently indicate affections of other organs than the lungs. When the extreme frequency of the respiration in acute diseases has ceased, the inspiration remains more hurried than usual; sometimes it is performed in as short a time as the expiration —after which a pause ensues. In health, the time required for the inspiration is twice as long as that of the expiration, both in children and adults.

CHAPTER VII.

BRONCHITIS, OR PULMONARY CATARRH.

Anatomical characters.—When the mucous membrane of the air tubes is inflamed, it is reddened and thickened. The secretion of mucus is diminished in quantity, or entirely suppressed. The dryness and thickening of the bronchial mucous membrane form the most important characteristics of the first stage of bronchitis.

When bronchitis has reached the second stage, the secretion of liquid recommences; it is at first thin and watery, or whitish and semi-transparent. It becomes yellowish and opaque as the disease proceeds towards resolution, when it also augments in quantity. The thickening of the mucous membrane often gradually ceases when the secretion of liquid diminishes in quantity.

Physical signs.—Percussion, in this disease, gives no certain results; the sonorousness of the chest is not sensibly diminished, unless the inflammation has extended to the smaller bronchial tubes, when there is sometimes, but not always, a slight diminution of the sound.

The respiration is altered in bronchitis; when the disease is in its earliest stage, there is a diminution in the intensity of the respiratory murmur. The feeble-

ness of sound does not extend to the whole of a lung, but is confined to portions of one, or both, of these organs. It is usually most evident at the anterior margin of the lungs, and varies during the progress of the disease. When the respiration is not enfeebled, it is often stronger than natural, and has a peculiar roughness of sound; but, as the vesicular murmur is still distinct, it does not resemble the blowing or bronchial respiration.

In not a few cases of bronchitis the respiration presents no other changes than those just mentioned; but in a majority of patients, especially if the disease be intense, the dry or moist rhonchi are heard. The sonorous rhonchus precedes the secretion of liquid. It is loudest near the large bronchial tubes, and from its great distinctness in the expiration, may be easily confounded with bronchial respiration. The sibilant rhonchus is less frequent, and is found at the anterior margin of the lungs, where the bronchi are of smaller size. It is much more common in secondary than in idiopathic catarrh.

When the disease is so far advanced that liquid is secreted into the air tubes, either the mucous or the sub-crepitant rhonchus is heard. They originate at the base of the lungs, or along their posterior margin, rarely at the anterior surface. When the rhonchus is the coarse loose mucous, it is easily recognized; but a fine sub-crepitus may be confounded with the crepitant rhonchus of pneumonia. It is the more easy to commit this error from the seat of the sub-crepitant râle at the base of the lungs.

Expectoration.—In the early stages of acute catarrh there is no expectoration. When liquid is secreted into the bronchial tubes, the sputa are thin and transparent,

but never tenacious and viscid, as in pneumonia. They usually run together, and flow readily from the cup. When the disease is farther advanced, the sputa are yellowish, opaque, or only semi-transparent; they are thicker than in the earlier stages, but not tenacious, as in pneumonia. The opacity and increased consistence of the sputa indicate the approaching resolution of the disease.

Cough.—The cough of bronchitis is peculiar; at first loud and hoarse, it becomes loose and more frequent when the expectoration begins. It does not resemble the short dry cough of pneumonia or pleurisy, nor the faint and rare cough of commencing phthisis.

Rational signs or symptoms of bronchitis.—The degree of fever, the prostration and the state of the digestive functions, vary to so great an extent in bronchitis, that no general description of them can be given. In the slighter forms of disease, the functions of other organs than the lungs are scarcely impaired; in some severe forms of disease, nearly all the organs participate in the disturbance.

VARIETIES OF BRONCHITIS.

Epidemic bronchitis, or influenza, differs from the common form in the greater intensity of the general symptoms, compared with the slight cough and alteration of the respiration. The physical signs of epidemic catarrh do not differ from those already described.

Chronic bronchitis.—There are three varieties of chronic bronchitis—one is the chronic mucous catarrh; another the dry catarrh; and the third, the pituitous.

1. *Chronic mucous catarrh.*—This form of the disease may occur at all ages of life, but is most frequent

in the aged. Its physical signs are precisely similar to those found in the acute disease, and the expectoration returns its yellow, opaque, muco-purulent aspect. The functional alterations are generally slight, but in some rare cases the fever is considerable, and scarcely differs from the hectic of consumption.

2. *Dry catarrh.*—In this variety the sonorousness of the chest is not diminished, indeed it is often greater than natural, from the complication with emphysema, (*q. v.*) The sonorous rhonchus is frequently heard in the larger bronchial tubes, but less constantly than the sibilant, which almost always accompanies the dry catarrh. The frequency of the sibilant rhonchus is supposed to depend upon the secretion of a small quantity of mucus, which concretes and forms temporary obstacles to the passage of air through the smaller bronchi. A more constant cause of it, is the partial thickening of the bronchial mucous membrane.

Pituitous catarrh, or the variety which is accompanied by an abundant secretion of thin liquid, is more rare than the dry catarrh. The expectoration consists of a glairy transparent liquid, sometimes mixed with whitish mucous flocculi, and is extremely copious. It occurs most frequently in persons advanced in life, and may last during a long series of years. The sound on percussion is as great as in the other varieties, but the respiration is partly masked by abundant and very liquid mucous rhonchus, sometimes passing into the sub-crepitant. The dry rhonchi are often heard at the same time with the moist, forming a singular union of sounds, which may, however, be perfectly well distinguished from each other. This mixture of rhonchi was sometimes termed, by Laennec, the song of all

birds (omnium avium cantus), from the number and intermixture of the sounds.

Spasmodic catarrh, or whooping-cough.—Whooping-cough differs essentially from the varieties of ordinary catarrh which I have just enumerated; there is a new element in the disease, which does not exist in the ordinary varieties of bronchitis: that is, the spasm of the glottis. The forced expirations of the cough succeed each other rapidly, and are followed by a loud sonorous inspiration, produced not in the lungs, but the larynx. The cough continues until a free expectoration of thick white glairy mucus terminates the paroxysm. Children who do not expectorate, discharge the mucus by the involuntary contraction of the muscles of the chest or by vomiting. The catarrhal secretion precedes the sonorous cough, but becomes more abundant as the disease is fully formed. At the earlier stages, and even when the cough has become spasmodic, there is no redness or thickening of the bronchial mucous membrane. The bronchi are filled with whitish mucus, which accumulates in their smaller branches. When the disease has been of long duration, the bronchi are thickened, reddened, and contain a yellow muco-purulent liquid. In some cases there is induration of isolated lobules of the lungs; but in general lobular pneumonia is less frequent than it is in many diseases of children. A more common consequence of whooping-cough is dilatation of the bronchial tubes, which very constantly occurs when the paroxysms are frequent, and the expectoration has become muco-purulent.

The percussion is sonorous, unless the lungs have become indurated: it then offers the usual changes observed in the lobular pneumonia. The respiration is,

in the early stages of the disease, expansive and pure after each paroxysm of coughing, but is mingled with much mucous rhonchus when the liquid has accumulated in the bronchi. The rhonchus is first heard in the lower parts of the chest near the base of the lungs.

The respiration is feeble, even when the whooping sound is loudest, although it may be heard in the chest; it is evidently conducted from the fauces and larynx, and becomes less loud in proportion as the distance from these parts is greater.

In advanced cases of whooping-cough, when the paroxysms have become very frequent, the mucous rhonchus is loud and constant; its bubbles in some parts of the chest are extremely large; in others, so small that the rhonchus passes into the sub-crepitant. The dry rhonchi are often mingled with the moist; the sibilant rhonchus is more frequent than the sonorous. The sounds heard in whooping-cough are, therefore, nearly similar to those presented by the pituitous catarrh.

When the mucous rhonchus is very loud and constant it generally coincides with dilatation of the bronchi; if these tubes be much enlarged, there is sometimes a well-marked gurgling.

General remarks on the diagnosis of the different varieties of bronchitis.—It will be evident from the preceding remarks, that, besides the cough and expectoration, the essential characters of bronchitis are the natural resonance in percussion, the feebleness and roughness of the respiration, with the moist and dry rhonchi. The distinction between the varieties of the disease depends upon the quantity of the secretion, and in some measure on its nature. In the spasmodic catarrh, the

peculiar whooping noise, and the strictly paroxysmal nature of the affection in its earlier stages, distinguish it from the other forms. Acute bronchitis differs from pneumonia in the perfect sonorousness of the chest and the absence of fine crepitus, bronchial respiration or acute pain. Chronic catarrh sometimes simulates phthisis, but the dull sound of the clavicular regions, the rude and afterwards the cavernous respiration, added to the functional signs, will scarcely leave room for doubt.*

Secondary bronchitis.—There are few diseases attended with fever in which there is not more or less catarrh during some period of their course. The intensity of the secondary bronchitis is not, however, equally great in all febrile affections: it is well marked in measles and typhus fever, but comparatively slight in small-pox and scarlatina. The seondary bronchitis does not differ in its physical signs from the primary. The bronchitis of children, whether primary or secondary, presents more abundant liquid rhonchi than that of adults, from the very copious secretion of mucus, which is not expectorated, but accumulates in the bronchial tubes. It is almost invariably present in all diseases of very young subjects, and seems to constitute one of their necessary elements. Catarrh in itself is rarely fatal in children, but if it last long and cause much fever, lobular pneumonia is very often developed and quickly proves fatal.

* See chapter on Pulmonary Consumption.

DILATATION OF THE BRONCHI.

The dilatation of the bronchi may be confined to a small portion of one of the tubes: or it may extend to the whole length of one or more bronchi: or, lastly, a succession of dilatations may exist in a bronchus which is of the usual caliber in the intervals between them. Dilatation is one of the consequences of long continued inflammation of the bronchial tubes; their membrane is injected, thickened, and secretes an abundant mucous or muco-purulent liquid; it is rare to find it thinner than usual. The bronchi of any part of the lungs may be dilated in chronic catarrh; this lesion is most frequent in those of the upper lobe—but in whooping-cough it is more common in the lower lobe. When the dilatations are considerable, especially if they extend to several tubes, the intervening pulmonary tissue is indurated, of a grayish-colour, not very unlike that of the tuberculous infiltration.

The dyspnœa in dilatation of the bronchi is rarely considerable, unless it be combined with emphysema. The cough and the expectoration do not differ from those of the chronic mucous catarrh. The fever and emaciation are generally slight, as are the other functional alterations. The patients are commonly advanced in life.

Diagnosis.—There is but one affection with which dilatation of the bronchial tubes can be readily confounded—that is, pulmonary consumption. The physical signs are nearly identical in the two diseases, but the more advanced age, and the few general symptoms

of patients affected with dilatation, will generally distinguish them from consumptives.*

The physical signs, indicating dilatation of the bronchi, are bronchial respiration, passing into the cavernous, if the bronchus be very large, and dull sound on percussion, from the condensation of the tissue of the lungs; as the bronchus is generally filled with liquid, there is either gurgling or loud mucous rhonchus. When the liquid has been expectorated, bronchophony or pectoriloquy are heard, and are sometimes as distinct as in pulmonary phthisis.

The two diseases just mentioned are the most frequent causes of bronchial dilatation, but it is also frequent in pulmonary phthisis, when the bronchi near the cavities are very constantly dilated, and sometimes contain tuberculous matter. When the tubercles are evacuated, the surface of the cavity is so continuous with the bronchial tubes, that it would often be difficult to decide upon the origin of the cavity, if there were not tubercles scattered through the lungs.

Obliteration of the bronchial tubes.—There are no signs, either functional or physical, by which obliteration of the bronchial tubes can be recognized. The lesion is merely mentioned as an anatomical fact.

* See Phthisis.

CHAPTER VIII.

EMPHYSEMA OF THE LUNGS.

THERE are two varieties of emphysema. One is the vesicular, consisting in dilatation of the air vesicles; the other is the interlobular emphysema, so called because the air is effused in the cellular tissue between the lobules of the lung.

Vesicular emphysema. Anatomical characters.—The lung does not collapse when removed from the chest; the dilated vesicles are distinctly visible, and vary in size from that of a large grain of sand to a grain of millet: in rare cases they may be much larger. The dilated vesicles vary from the size of a large grain of sand to that of an egg; in ordinary cases, they are as large as grains of millet. The dilatation is not confined to a particular portion of the lungs, but is generally most evident along their anterior margin, where the vesicles are largest in the normal state. The lung is paler than natural, and is light and spongy to the feel; it yields a crepitating sound, if pressed. These characters clearly show there is more air and less solid or liquid in the lung than usual.

Physical signs.—The conformation of the chest is altered; the distention of the lung, which is increased by the efforts made by the patient in the act of respiration,

gives rise to permanent enlargement of the thorax. The dilatation is of two kinds—one is the rounded form given to the thorax of emphysematous patients by the strong efforts of respiration. This general dilatation is not confined to a portion of the chest near the enlarged vesicles, and is, therefore, probably owing to the strong efforts of inspiration, and to the imperfect expiration characterizing the disease. The second kind of dilatation is local, and consists in a moderate prominence of the intercostal spaces at the part nearest the dilated vesicles, that are generally at the anterior margin of the lungs on each side of the sternum. The prominence is gradual, and may be easily distinguished, by its rounded or oval form, from those caused by effusions of liquid into the pericardium.

Percussion is more sonorous than natural over all the dilated portions of the lung. The increase of sound is quite perceptible in cases where the dilatation of the vesicles is moderate; it is very great when the emphysema is sufficient to cause a local prominence of the chest. The percussion is, of course, most sonorous where the prominence is greatest. The respiration is invaribly feeble in cases of emphysema; the feebleness extends over all affected parts of the lungs, especially where the chest is most prominent. Both the sounds of the normal respiration are weak, but the alteration is most perceptible in the vesicular murmur, because the dilatation of the vesicles is most frequent in those parts of the chest where no blowing sound is heard. In extreme cases, the respiration is completely lost; no sound can be distinguished, though the thorax expands forcibly. The dry sibilant rhonchus is frequently, but not constantly, observed; it is produced beneath the dilated

part of the thorax. The sub-crepitant depends upon accidental complications of emphysema with catarrh, and is limited to the inferior portion of the chest. The dry crepitant rhonchus is very rare, and, when present, is probably owing to interlobular emphysema. The resonance of the voice is diminished, and the pulsations of the heart are heard less strongly than usual in the affected lung. The vibration of the voice, felt by applying the hand to the chest while the patient speaks, is rather increased than lessened.

Functional signs.—The dyspnœa is always considerable in emphysema. In cases of moderate severity, the patient is conscious that his breath is a little short when he ascends a hill rapidly, or makes any violent exertion; in extreme cases he becomes breathless upon ascending a few steps of a staircase. Besides the slight, but constant oppression upon taking exercise, emphysematous patients are subject to violent paroxysms of dyspnœa, which frequently occur without any assignable cause, and oblige the patient to sit erect or even lean forwards: he is not able to lie in any possition. The muscles of respiration are all thrown into violent action; the face of the patient is livid and swollen; great anxiety and constriction are felt at the præcordia, which continue until the paroxysm is relieved.

The cough is dry and wheezing in emphysema, but becomes more loose towards the end of a paroxysm, when there is a rather copious expectoration of transparent frothy liquid. No other sputa are observed in emphysema, unless the disease should become complicated with other lesions of the lungs.

There are no signs of disturbance of the general functions in pure emphysema; nor does it seem ma-

terially to shorten life, although it may cause intense suffering. No age is totally exempted from emphysema, but the disease is much more frequent in persons past the middle period of life than in the young; in children it is very rare.

Varieties and complications.—The interlobular emphysema consists in the extravasation of air into the cellular tissue, beneath the pleura and between the lobules. It often complicates the ordinary variety, and frequently occurs in other diseases of the lungs which have been attended with much dyspnœa. If a large portion of the lung has become impervious to the air, the vesicles in the healthy part are distended beyond their natural limits, and constitute an acute variety of the disease, which is especially frequent in the lobular pneumonia of children. Chronic bronchitis is often complicated with emphysema; in a certain number of cases, it seems to be the exciting cause of the latter disease; in others, there is no evidence of catarrh before the emphysema began. Tuberculous consumption is not very often connected with this lesion: the two diseases seem, in some degree, to counteract each other, and patients afflicted with the one are rarely attacked by the other. They do occasionally occur in the same individual, and present symptoms depending on each disease. If an emphysematous patient is taken with pneumonia, his dyspnœa becomes extreme, and the disease is apt to terminate fatally. Diseases of the heart are very commonly found at the same time with emphysema, and necessarily increase the dyspnœa.

Diagnosis.—The chief signs upon which the diagnosis of emphysema is based, are the dyspnœa, the altered conformation of the chest, the very clear sound

on percussion, and the feeble respiration. None of the signs is found in simple chronic catarrh, except moderate dyspnœa, and sometimes feeble respiration; when the others appear, we may infer that emphysema is taking place. There can be no difficulty in distinguishing pneumonia or pleurisy; but phthisis may be confounded with emphysema, unless the chest be examined with care, when the signs of percussion and auscultation will show the difference between the diseases. When they are found in the same subject, those of phthisis will be found at the top of the lungs; those of emphysema, along their anterior margin; the dyspnœa and paroxysms of cough indicate the latter, while the nature of the expectoration and the emaciation correspond to the former disease. Diseases of the heart are distinguished from emphysema by the local signs, the œdema of the limbs and the greater functional derangement; when they are found together, the local signs of emphysema and the general symptoms of diseases of the heart predominate.

CHAPTER IX.

ON PNEUMONIA.

Anatomical characters.—Inflammation of the lungs presents three distinct stages:

1. First stage of pneumonia, or infiltration of the pulmonary tissue with blood and serum. In the earliest stage of inflammation of the lungs, as in that of the other viscera, a greater quantity of liquid than usual is contained in the organ. If the lung be incised, a reddish spumous serosity issues from it in abundance. If it be pressed between the fingers, it is less soft and yielding, but more friable than the healthy lung. Its colour is livid red externally: it is of the same tinge, but smooth upon its incised surface. The bronchi, in the inflamed portion, are reddened, and contain a whitish mucus.

2. Second stage of pneumonia or hepatization—a term given to it from the singular resemblance of the cut surface of the lung to that of the liver. The pulmonary tissue is hard and resisting when pressed, but upon moderate increase of force, is broken into a reddish pulp. Its colour, externally, is reddish, and in its interior it varies from a brick red to a dark purple, and presents a granulated aspect, as if it were elevated into a multitude of small points. The granulated appear-

ance is most distinct when the lung is torn. The liquid exuding from it is glutinous, whitish and reddish, but contains no bubbles of air. The bronchi are of a deep red colour, frequently thickened, and contain a viscid matter, which is often yellow and puriform. The redness of the bronchi extends to all the inflamed part of the lung, but is most conspicuous in the smaller tubes, which are often obstructed by the viscid secretions. The larger bronchial tubes are flattened, but retain their caliber undiminished. These alterations of the lung are owing to the deposit of lymph in the pulmonary tissue, with which it is intimately combined. It is not positively certain whether the lymph is originally secreted in the vesicles or in the cellular tissue uniting them; but it is probable the secretion occurs simultaneously in the air-cells and the surrounding tissue. The granulations can scarcely be formed by any other part of the parenchyma, than the vesicles to which they are analogous in size and distribution. On the other hand, the phenomena of inflammation of other parts of the body render it almost certain that the cellular tissue largely participates, and that the smaller bronchial tubes are evidently inflamed. When the disease is near the surface of the lung, the pleura participates in the inflammation. In a large majority of patients, the hepatized lung gradually resumes its spongy texture, without passing into the third stage.

3. The third stage of pneumonia has received the name of gray softening, purulent infiltration, and yellow hepatization. The cellular tissue is infiltrated with purulent matter, which oozes abundantly from the lung, when incised, especially if it be subjected to a slight pressure. The granular aspect of the lung is

gradually lost, as this stage begins; the lung afterwards is softened, and does not give a smooth surface, but breaks away before the knife into a pulp. If the disease be still more advanced, the cellular tissue is converted into a yellow purulent liquid, and may be washed away by a gentle stream of water, leaving behind it the vascular ramifications and bronchial tubes. No abscess follows, except in rare cases; the pus is merely diffused throughout the cellular tissue. When an abscess forms, the vessels may often be distinguished in the midst of the pus, which is contained in a cavity lined by a false membrane, as in other parts of the body. The third stage is sometimes called gray softening, at others, gray hepatization, from the different shades of colour; there is, however, no real difference in these cases, except in the more or less perfect diffusion of the pus throughout the whole pulmonary tissue. In some subjects, the purulent deposit occurs a few days after the beginning of the disease; in others, after some weeks duration. The bronchial tubes, in the third stage of pneumonia, are filled with a yellow purulent or muco-purulent liquid, which often closely resembles well formed pus. The redness and thickening of the mucous membrane do not diminish, and the smaller bronchial tubes are completely obstructed.

Physical signs of pneumonia.—These vary according to the different stages of the disease. Percussion, in the early stages, is but little altered, because the lung still contains air, although it is infiltrated with an unusual quantity of liquid, and, consequently, the sound on percussion is a little less clear than if the vesicles were fully distended with air. But if the pneumonia is deep-seated, and not considerable, the diminution in

the resonance is not perceptible. In the second stage, or that of hepatization, the percussion becomes perfectly dull, because no air is contained in the indurated portion of the lung, and there can, therefore, be no resonance; there is the greatest flatness where the walls of the chest are thin, and the hepatization complete, that is, at the lower part of the thorax, between the angle of the scapula and the spine. Although the resonance is not completely obscured until the pneumonia has reached the surface, and is of considerable extent, there is a dull sound, if there be an indurated nucleus, of the size of a walnut, though the greater part of the affected lobe is still permeable to the air. The flatness limits accurately the extent of the hepatization. When the disease has advanced to the third stage, the flat sound is not diminished, because no air is admitted into the lung. If it does not pass to this stage, the lung gradually becomes permeable to the air, and the sound, from flat, becomes dull, and finally clear. A slight degree of obscurity remains in the side affected, for some weeks, and occasionally there is a little permanent dulness. The last mentioned phenomenon is probably due to the formation of false membranes between the ribs and the lung.

Of the respiration.—The characters of the respiration, like those of percussion, vary in the different stages. In the earliest stage of pneumonia, the respiration offers a crepitant rhonchus, and an obscure bronchial or rude respiration. These signs are either found at the same time, or one precedes the other. In my own observations, I have found the rude respiration perceptible before the crepitus was heard. In two cases of pneumonia, admitted into the Pennsylvania Hospital,

last winter, at a very early period of the disease, rude respiration was heard at least twenty-four hours before the crepitus. In other cases, the crepitus seems the earliest alteration of the respiration. This diversity in the symptoms probably depends upon the seat of the disease; if it commence at the root of the lungs, near the large bronchi, and at a little distance from the surface, there will be rude respiration, even if the tissue of the lungs be very little condensed, while the crepitant rhonchus, if it exist, is too distant to be heard. In the majority of cases, the crepitant rhonchus is found at the same time with rude or bronchial respiration, and as its characters are much more easily defined than those of the bronchial respiration, it has almost exclusively attracted the attention of physicians.

In the second stage of pneumonia, the crepitus ceases, or is heard only when the patient respires strongly, especially after the effort of coughing. The crepitus may, in most cases, be reproduced by an effort of coughing, either in the spot where the bronchial respiration is strongest, or immediately around it, in the part of the lung least inflamed. The bronchial respiration reaches its highest degree of intensity in the second stage of pneumonia, when the lung is completely indurated. It is not every where equally loud, although the hepatization may be complete throughout the lung. The larger tubes always yield the most perfect bronchial respiration; it is, therefore, loudest at the root of the lungs, where the large bronchi pass. The hepatization usually begins near the upper posterior part of the lower lobe of the lung, and surrounds the larger tubes, before the rest of the lungs are affected. The earliest and the most perfect bronchial respiration

is, therefore, usually heard between the spine and the middle of the scapulæ. At the base of the lungs, where the vesicles are much developed, and the bronchi are small, bronchial respiration is less loud, and disappears more quickly from the obliteration of the tubes, by thickening of the mucous membrane, and secretion of viscid matter. The bronchial respiration is more distinct in pneumonia than in any other disease; it is generally tubal at the root of the lungs, where both inspiration and expiration are so loud and blowing, that pneumonia furnishes the type of this variety of the respiration. Bronchial respiration is the most important physical sign of pneumonia; it exists in every case in which the disease is formed long enough before death, to be recognized by auscultation. M. Louis observed it in all the cases which were examined by him, at La Pitie; there was not one, of sixty to eighty cases of pneumonia which I have witnessed within the last three years, which did not present bronchial respiration. Laennec was disposed to undervalue bronchial respiration in the diagnosis of pneumonia, and to exaggerate the importance of the crepitant rhonchus, which had attracted his attention at an earlier period.

Bronchophony and bronchial resonance of the cough necessarily accompany bronchial respiration. Bronchophony is most intense where the respiration is tubal, and is, therefore, loudest at the root of the lungs. It exists in a greater or less degree, wherever bronchial respiration is produced; and, like it, is more distinct in pneumonia than in any other disease. The bronchophony of pneumonia sometimes has a peculiar vibrating tone, from the complication of pleuritic effusion.

The third stage of pneumonia, or that of purulent infiltration, offers the same flatness, on percussion, as the second stage. The tissue of the lung is infiltrated with pus, instead of lymph, but remains equally impermeable to the air. The vesicular murmur does not return, but the bronchial respiration ceases, and is replaced by a loose sub-crepitous, or a mucous rhonchus. The intensity of the rhonchus varies according to the quantity of liquid effused into the lungs. The bronchophony and bronchial respiration do not entirely disappear at the root of the lungs, when no traces of them exist elsewhere. The cough produces a loose mucous rhonchus, instead of the trains of dry crepitus.

When an abscess is formed in the lung, which occurs in some rare instances, a loose mucous gurgling and cavernous respiration replace the bronchophony. The extent of the gurgling corresponds to that of the abscess, but probably extends something beyond it, and is partly owing to the liquid secretion in the larger bronchial tubes. Abscess in the lungs is rare, and much caution must be used in not confounding bronchial respiration and purulent infiltration of the lung, with signs of an abscess. The vesicular respiration returns, in a great degree, after an abscess has been cured; but it always remains feeble and less expansive than natural.

As a large majority of cases of pneumonia go no farther than the second stage, they do not offer the physical signs just detailed. As soon as the disease begins to yield, and the hepatized lung becomes permeable to the air, a loose crepitant, or sub-crepitant rhonchus is developed. The return of the crepitant rhonchus is of favourable omen, and indicates the ap-

proach of convalescence; whence it is sometimes called the crepitant rhonchus of recovery. The bronchial respiration lasts longest at the root of the lung, but becomes less acute, and gradually disappears, as the vesicular murmur is heard, mixed with sub-crepitant rhonchus. When the rhonchus has totally ceased, the respiration remains feeble for several days in favourable cases, and for a longer period, in those that have been more severe.

When the disease has gone on to the stage of suppuration, the crepitant rhonchus is not reproduced; the mucous râle disappears, and is gradually succeeded by a feeble vesicular sound. In a case which I witnessed last winter, in the short space of two days a distinct vesicular murmur had replaced the mucous rhonchus, which had been heard in the whole of one lobe.

The expectoration, like the signs of the respiration, varies in the different stages of pneumonia.

In the first stage, the expectoration consists of the natural mucus of the bronchial tubes, and is either transparent or whitish. As the disease advances, the sputa become more tenacious, more transparent, and flow less easily from the cup; they are small in quantity—generally from one to four fluid ounces. The peculiar viscidity of the sputa, their small quantity, and the tenacity with which they adhere to the mucous membrane, and when expectorated to the cup, are characteristic of pneumonia.

In the second stage, the sputa are semi-transparent, and become still more viscid; at the same time, they acquire a peculiar rusty colour. This tint is sometimes precisely similar to that of the rust of iron; but it may vary from orange to bright red. The sputa are

not coloured in streaks or spots, but throughout their whole mass; the colour arises from an intimate combination of blood with the tenacious mucus. When the expectoration has assumed the tint described, it is absolutely characteristic of pneumonia, and occurs in no other disease. The quantity of these sputa is very small—not exceeding a few ounces; they contain no air, and run together at the bottom of the cup. When the disease passes from the second stage towards resolution, the sputa becomes more abundant, less viscous, are yellowish, and adhere less closely to the bronchial membrane. The patient, therefore, expectorates more easily.

The sputa, in the third stage, assume various characters. Most commonly they are yellowish, either muco-puriform, or purulent. I have seen them partly composed of a muco-purulent matter, and partly of creamy homogeneous pus, which sank below the level of the rest of the liquid. A rarer variety is the brownish liquid sputa, like the juice of prunes; this forms a homogeneous, and rather thin liquid. The yellowish sputa are of more favourable omen than the brown. When the disease, at last, terminates favourably, the sputa do not resume the viscid rusty aspect which they presented in the second stage, but become less yellow, and finally consist simply of whitish mucus. The sputa, in pneumonia, are so well marked, that we may often recognize the disease, simply from their inspection. It is, therefore, of high importance to become perfectly familiar with their characters.

The pain is slight in pure pneumonia. When the disease is confined to the central parts of the lung, the patient rarely complains of acute suffering. He expe-

riences general uneasiness, and is oppressed in breathing, without being able to designate the seat of his disease. As soon as the pleura becomes inflamed, the pain becomes acute, and is precisely similar to that of ordinary pleurisy, known by the familiar but expressive term, stitch in the side. As the pleura generally participates in the inflammation from the beginning of pneumonia, the pain in the side is usually one of the first symptoms. It disappears before the expectoration and the physical signs indicate complete resolution of the disease.

The frequency of the respiration is very great in pneumonia; it is scarcely ever less than twenty-four in the minute, and varies from that number to forty; or, in extreme cases, fifty or sixty. It is high, the ribs nearly motionless, and chiefly performed by the diaphragm. The cough in pneumonia is short, dry and suppressed, in the early stages; loose and less painful when expectoration becomes free, and the hepatization passes to the third stage, or resolution begins. The fever and prostration of strength are greater than in any other acute disease of the lungs.

The decubitus is almost always dorsal. When there is much oppression, it is elevated; the patient cannot lie upon the side affected.

OF THE VARIETIES OF PNEUMONIA.

Age.—A marked change in the characters of inflammation of the lungs, takes place at the period of the second dentition. Before the age of six years, the form of disease, known as idiopathic pneumonia of adults, does not occur. After that age, it becomes frequent, and presents a series of symptoms, which is nearly in-

variable in patients of both sexes and all ages, excepting those far advanced in life.* The disease which occurs in young children, is that variety called lobular pneumonia, from the manner in which it originates in isolated lobules of the lung, which become indurated, while the intervening pulmonary tissue remains permeable to the air. The hardened lobules are of a dark purple colour, smooth instead of being granulated, and very firm. The induration advances from each of the points of origin, until a large portion of the lungs is impervious to the air. Death frequently does not occur until three-fourths or two-thirds of the pulmonary parenchyma is hardened. The disease is almost always double, and begins at the lower lobes of both lungs, extending from them to the upper lobes, along the posterior margin of the thorax. It is rarely complicated with pleurisy. This variety almost always succeeds to chronic catarrhs, or other diseases, as the exanthemata, &c.; it, therefore, has not a definite duration. There is no expression of pain, no expectoration, and sometimes no cough; but the disease is in a great degree latent, and, notwithstanding its extreme frequency, is often mistaken. There is not always a rhonchus, but where the disease succeeds to catarrh, a mucous, or sub-crepitant râle is heard. Bronchial respiration is never so distinct in this disease as in idiopathic pneumonia, and scarcely ever becomes tubal; it is best heard at the root of the lungs. At the base,

* For a more particular account of this form of disease, the reader is referred to a paper published in the American Journal of Medical Sciences, in the year 1834.

there is rarely heard any sound, either of vesicular expansion, rhonchus, or bronchial respiration. Bronchophony, in young children, scarcely exists; something like it is heard in the vibration produced by the cry. Percussion yields obscure results, when the lobular induration is very limited; but by retaining a precise recollection of the natural resonance of the chest of healthy children, a slight degree of obscurity may be recognized. We have not the means of verifying the degree of sound by the comparison of the two sides of the chest; for the disease begins in both sides, and advances with nearly equal rapidity. If the chest, along its posterior margin, sounds less than it does in the chests of healthy children, the sound is really dull, although there is no difference between the two sides. The progress of the disease, from a number of isolated points in both lungs, explains the early destruction of all respiratory sound. The hardened lobules press upon the bronchi, and prevent the air from passing into the tissue, which remains permeable. The absence of crepitus is explained by the peculiar secretions of the bronchi; they are never viscous and transparent, as in ordinary pneumonia, but consist of glairy, whitish liquid. This variety of pulmonary induration does not pass to purulent secretion.

Lobular pneumonia is not strictly confined to young children; it occurs as a secondary lesion, in many febrile diseases; but it passes more frequently to the stage of suppuration, in older subjects. The difficulties in the diagnosis are similar to those just described; but it is more easy to examine adults, and, therefore, discover slight alterations in the respiratory sounds.

The sub-crepitant rhonchus is, also, more frequent in lobular pneumonia of adults, than in that of young children.

Pneumonia, in very old patients, offers some anomalies. It is rarely accompanied with great derangement of the functions, and is very often latent. Little cough, little or no expectoration, oppression, loss of strength, and slight fever, are usually the only symptoms. The physical signs are well characterized, and are precisely similar to those already described, as common to all the usual forms of pneumonia. An early physical exploration is the more necessary in these cases, on account of the great mortality of the disease, which destroys a large proportion of the aged.

In all classes of patients, the right lung is more frequently inflamed than the left, and the disease commonly begins at the upper part of the lower lobes. The upper lobes are more frequently affected in the aged than in younger persons.

Pneumonia is frequently consequent upon other diseases of the lungs, especially phthisis and emphysema. Consumptive patients recover nearly as well as healthy subjects from attacks of acute inflammation of the lungs, unless the disease is far advanced, when it often proves fatal. The signs, such as unusually viscid sputa, pain in the side, crepitus and bronchial respiration in the lower lobes, are then added to the general signs of phthisis, and the physical signs, which were already present at the upper part of the lungs. Emphysema causes great distress when the lungs are inflamed, from the extreme difficulty of the respiration, and not unfrequently aged asthmatics perish from this compli-

cation. The signs of pneumonia, in such cases, are perfectly well marked.

In almost every case of pneumonia, there is more or less inflammation of the pleura; the only exceptions are those rare cases in which the inflammation is limited to the central parts of the lung, and the lobular pneumonia of children. As the inflammation of the lungs seems to precede that of the pleura, and is in all cases a vastly more important lesion, it is now usual to consider the pleurisy as one of the secondary lesions of pneumonia, and not to apply to it a distinct term. The word pleuropneumonia is now little used. When the disease of the pleura is very intense, the effusion of liquid may be nearly as great as in ordinary pleurisy.* As a general rule, the inflammation of the lungs and pleura are in inverse proportion.

Diagnosis.—The discovery of auscultation, conjoined with the functional signs, which were already known, have rendered the diagnosis of pneumonia more sure than that of any other internal disease. It is, therefore, usually selected as the type of comparison amongst acute affections. If the case be as well marked as cases of pneumonia usually are, the succession of the physical signs, detailed in the preceding pages, and the characteristic sputa, with the pain and oppression, will prevent the possibility of error. Even in cases where the disease is of small extent, and deeply seated, a rude respiration near the root of the lungs, some bubbles of distant crepitus, and the characteristic expectoration, will rarely leave room for doubt. The lobular pneu-

* See chapter on that disease.

monia of young children is much less readily recognized than the pulmonary inflammation of adults. The signs of it have been already indicated; but when the obscurity, on percussion, is not great, it is sometimes difficult to distinguish between this disease and simple chronic bronchitis; especially in those cases in which the disease has not been traced from its early stages.

CHAPTER X.

GANGRENE OF THE LUNGS.

The pulmonary tissue is not unfrequently affected with gangrene. A small portion of the lung may be attacked; or the mortification may extend to the whole of one lobe; or a considerable portion of the lower lobe of each lung; or, in rare cases, it may invade the whole of one of these organs.

When a portion of pulmonary tissue becomes gangrenous, its colour is greenish brown; gradually deepening to black, as the disease advances. No line of demarcation separates the dead from the living part; but the colour changes insensibly, from black to dark red, as we pass from the softened sphacelated part to the firmer tissue. When the gangrene is circumscribed, an imperfect false membrane may be discovered. I have seen this membrane well developed in idiopathic gangrene, but still more frequently in that variety which follows injuries, or surgical operations.

The tissue of the lung becomes softened as the disease advances, and falls into a soft pulp, or liquid, with a characteristic fœtid odour. The softened portion is gradually discharged by expectoration, and a cavity is formed, corresponding to the extent of the gangrene. When the disease has not been arrested, the walls of

the cavity are formed of the softened pulmonary tissue, with numerous shreds and filaments hanging from it. The filaments are the blood-vessels, which resist mortification longest. It is not known what anatomical appearances follow the cicatrization of gangrenous cavities; the analogy of the lesions render it probable that they are similar to those consequent upon tuberculous excavations.—(*See Note at end of Chapter.*)

The *physical signs* of idiopathic gangrene are at first limited to a mucous, or sub-crepitant rhonchus, near the seat of the disease, without alteration of the resonance on percussion. As the tissue of the lung is softened, and a cavity forms, gurgling replaces the mucous rhonchus, and generally becomes very intense, from the large size of the cavity, and the quantity of liquid constantly oozing from its walls. No disease offers a louder, and more constant gurgling, than gangrene; tuberculous cavities are rarely as large, and do not secrete as much liquid. When the expectoration of the gangrenous lung occurs, cavernous respiration and pectoriloquy accompany the gurgling; they vary with the size of the cavity, and the more or less complete evacuation of the sloughs. The cavernous respiration is, in such cases, loud, and perfectly distinct; but the voice wants the clear resonance given to it by the hard walls of a tuberculous cavity. Should the cavity become extremely large, the percussion over it becomes very resonant; in one case, I found it so loud as to make me suspect that perforation of the pleura had taken place, and, consequently, extravasation of air within that membrane. The gangrene had destroyed nearly the whole of the left lower lobe, leaving a vast cavity, communicating freely with the bronchi. In such cases,

the resonance of the voice becomes amphoric; the respiration assumes an analogous character, and is similar to that heard in pneumothorax, and in very large tuberculous cavities.

When gangrene of the lungs is cured, the gurgling gradually becomes less intense, and is succeeded by a mucous rhonchus, which finally ceases with the expectoration. The bronchial respiration, and bronchophony, diminish until there remains merely a slight blowing sound in inspiration, and expiration, with a feeble respiratory murmur; the respiration never regains its original strength.* It is probable that a cicatrix, similar to those sometimes found in phthisical subjects, is formed after the case of gangrenous cavities; and as the pulmonary tissue is not reproduced, the respiratory sounds heard near the diseased points are conducted from the healthy tissue.

The percussion, in most cases of gangrene, becomes obscure over the affected part. This arises from the condensation of the surrounding pulmonary tissue, which is infiltrated with serosity. In some cases, the percussion is perfectly natural, until a large cavity is formed, when it becomes more sonorous than usual. This phenomenon occurred in a case already alluded to; it was found, on dissection, that the pulmonary parenchyma, around the cavity, was not indurated.

The expectoration furnishes the pathognomic sign of

* I examined a patient more than a year after his recovery from well marked gangrene of the lungs, and detected the alterations described. In another patient, the lower lobes of both lungs were gangrenous, and offered a loud gurgling, with cavernous respiration. The man left the hospital, perfectly cured, at the end of two or three months; but the vesicular remained extremely feeble in the points where the gurgling had been heard.

gangrene. It is always fœtid, but has not always the odour of putrefaction; not unfrequently its smell resembles that of moist plaster. The breath is equally fœtid with the expectoration. The fœtor varies at different periods of the day. It is always increased when paroxysms of coughing come on, and the expectoration becomes more copious. The sputa are most frequently greenish and yellowish; they are at times of a dirty ashen colour, and vary from these shades to a dark brown, or blackish hue. The changes in the appearance of the sputa, from a dark to a lighter colour, and the diminution in quantity, indicate the approach of convalescence.

The cough is frequent and harassing when the gangrenous cavity is formed; it comes on in paroxysms, which continue until the contents of the cavity are expectorated. After copious expectoration, the cough ceases almost entirely, until the cavity fills again.

There is much fever in most cases of gangrene of the lungs; but it may be wanting in this, as in other pulmonary affections. The disease is then latent, and can only be recognized by the physical signs, and the peculiar odour of the sputa and breath.

The dyspnœa is not great at the beginning of the disease; it only becomes considerable when a large portion of the pulmonary tissue is attacked, and is greatest when secondary pleurisy has supervened. The feebleness of the patient is much greater than the extent of the disease would lead us to expect; indeed, gangrene of the lungs is most frequently developed in patients already weakened by previous disease.

The last important symptom is the alteration of the colour of the skin, which is, I believe, always found in

cases of extensive gangrene; at least, I have always observed it. The skin is of a dirty yellow, or has a bronzed aspect; it is shrunken, and less vascular than usual. The discolouration extends to all the tissues which are found after death—pale, and often greenish, or livid.

The prognosis in gangrene of the lungs is always doubtful; the mortality is about one in two patients. The proportion of deaths was once thought to be much greater; but more accurate observation has shown that it is by no means so fatal a disease as was imagined.

The *diagnosis* is based on the following physical signs: mucous rhonchus, gurgling, cavernous respiration; when we add to these signs, the fœtor of the sputa, the colour of the skin, and the great loss of strength, we are sure that no other disease can be confounded with gangrene. Phthisis is a chronic disease; its cavities form slowly; the expectoration is rarely fœtid. Pneumonia is distinguished by the bronchial respiration, the crepitant rhonchus, the flat sound on percussion, and the characteristic sputa. The only disease with which gangrene could be confounded, is bronchitis; some varieties of this affection are attended with fœtid sputa, and when they are secreted in large quantities, the mucous rhonchus caused by them may be mistaken for gurgling. It is difficult to distinguish gangrene of the lungs from this variety of bronchitis, which is well described by M. Andral. The progress of the disease can alone remove the obscurity.

Of the varieties of gangrene of the lungs.—No age is exempt from this disease. I have witnessed it in children under the age of two years, and in patients far advanced in life. Children dying with gangrenous

sore mouth, not unfrequently have circumscribed gangrene of the lungs; it also occurs in them as an idiopathic disease. The lesion occurs most frequently in the winter, but is much more frequent in some years than in others; sometimes there seems to be an epidemic of gangrene of the lungs. In a single winter, I saw six cases of the disease at the Philadelphia Almshouse, and the same year the disease was extremely common at Paris.

Like other diseases of the parenchyma of the lungs, gangrene seldom occurs without consecutive pleurisy. This complication materially increases the pain and dyspnœa, but diminishes the chance of a fatal termination, which might otherwise happen from perforation of the pleura. Tuberculous consumption is rarely complicated with gangrene; when the latter disease comes on, sloughing of the tuberculous cavities are produced, and the peculiar odour of gangrene is developed.

Pneumonia is rarely followed by gangrene. Authors speak of gangrene as a termination of pneumonia, and some have not considered gangrene of the lungs as a distinct affection, but merely one of the varieties of the pneumonia. Mortification, undoubtedly, may follow inflammation of the lungs, as well as of any other organ; but if we carefully trace the history of cases of gangrene, we shall find that few, if any, offer evidence of previous inflammation. M. Louis considers the disease as entirely unconnected with pneumonia, and says, he has found no evidence of inflammation before the sputa and breath became fœtid. The last three cases of gangrene which I have observed, were all seen at an early period of the disease; two died, and one recovered. In the dissections of those who died, there

was no hardening of the lung around the gangrenous cavity; there was not, therefore, even secondary inflammation. Not one of the three cases offered crepitant rhonchus, or bronchial respiration, or viscid sputa, before the breath and expectoration became fœtid.

METASTATIC ABSCESS OF THE LUNGS.

There is a peculiar lesion of the lungs, which follows surgical operations, suppurating wounds, and phlebitis. It was termed metastatic abscess, by Dance, and bears some analogy both to pneumonia and gangrene of the lungs. The lesion passes through the following anatomical stages:

In its earliest stage, a lobule of the lungs is of a dark livid red, or purple colour; harder than the surrounding tissue, but easily crushed by moderate pressure. If the disease be a little more advanced, the hardened part is dotted with purulent points, which are scattered equally throughout it, and a yellow puriform liquid may be forced from it, by moderate pressure. The pus in the centre of the smaller abscesses resembles very nearly yellow tubercles, and, like them, softens from the centre towards the circumference. At a still more advanced stage, the lobule is completely infiltrated with pus, or a liquid of a strong gangrenous odour. When the lesion has reached its last stage, it is surrounded by a distinct false membrane.

As the lesion always occurs near the surface of the lungs, the pleura is very soon involved in the inflammation, and the usual effusion of liquid is secreted into its cavity. The false membranes are thickest near the abscesses, which are most frequent near the base of the lungs, though not confined to any one part of them.

Signs of metastatic abscess.—These are a sub-crepitant rhonchus at the posterior part of the lungs; and, should pleurisy be present, there are flatness on percussion, and egophonic resonance of the voice. No other signs indicate the presence of this lesion, and even they may be wanting, if the affected lobules are very small. The chills, the profuse sweats, and the expectoration of viscid reddish sputa, afford more certain evidence than the physical signs. The cough is not very frequent, nor is there ever abundant expectoration; the dyspnœa is at times intense, and almost always considerable.

The diagnosis of this lesion is usually easy, and is the more certain from the circumstances under which the disease occurs. If a patient who has undergone an important surgical operation, or who has a large suppurating surface, be suddenly taken with a chill, cough, and the other signs described, there is no room for doubting the development of a metastatic abscess.

Note.—While this sheet was passing through the press, I had occasion to examine a cicatrized cavity, following gangrene of the lungs. The patient died of delirium tremens, complicated with fracture of the leg. Nine years before, he had a disease of the lungs, which lasted four months, with so much fœtor of the breath, and expectoration, that no one could remain in the room with him. The cavity was in the lower lobe of the left lung, about the size of an almond, and lined with a delicate mucous membrane; the surrounding tissue was indurated.

CHAPTER XI.

PHTHISIS, OR PULMONARY TUBERCLES.

The diagnosis of pulmonary consumption is more complicated than that of any other disease of the lungs. In its earliest stages, a most careful comparison of the symptoms and physical signs is necessary to give a probable degree of accuracy; but in the advanced stages of phthisis, the disease is recognized at a glance, even by those who are not of the medical profession.

Three stages are observed in this disease: they are not altogether arbitrary, but are based upon changes occurring in the tubercular matter, which is the anatomical lesion constituting consumption.

First stage of consumption.—The lungs of patients dying in the earliest stages of consumption, offer tubercles, under the following forms:—1. Rounded miliary granulations of a semi-transparent gray colour; the largest not exceeding the size of a millet seed, and so hard as to resist considerable pressure. These granulations are usually, but not always, found in the early stages of consumption; when they are very numerous in the lungs, they are often found in other organs of the body, especially the brain and spleen. 2. Tubercles, properly so called, which are rounded bodies, of a yellow, opaque colour, homogeneous, hard, and varying

in size from a grain of millet to that of a large pea. 3. The pulmonary tissue is in some subjects infiltrated with tubercular matter, of a transparent, or yellowish aspect, which fills its cells as water does a sponge, and destroys the porous texture of the lungs, but leaves its tissue entire.

Second stage.—In this period, the gray granulations disappear, or are less numerous. The tubercles increase in size, and as they become larger, press upon each other so as to destroy their regular rounded form; they thus gradually coalesce into masses of considerable size. The infiltration of tuberculous matter changes less in its appearance than the other forms of this lesion; it rarely becomes perfectly yellow in adults. The pulmonary tissue is necessarily more or less compressed by the development of the tubercles; it is atrophied, and is gradually replaced by the morbid product. The vessels passing amongst the tubercles are not obliterated at an early stage; they resist longer than the other parts, and when completely surrounded, are slowly obliterated, but ulceration of them is very rare. The bronchi can be traced directly into the morbid substance; their caliber is then contracted, and their tissue is confounded with the tubercles. The lung around the diseased part, at this stage, is rarely sound; it is hardened and shining, partly from the infiltrated gray substance, and partly from induration, which sometimes seems to depend upon chronic inflammation. The bronchia are often reddened, and thickened near the masses of tubercles, but this is not invariably the case.

Third stage, or softening and evacuation of the tuber-

culous matter. When the tubercles have attained a moderate size, which rarely exceeds that of a large pea, they begin to soften at their centre. The progress of the softening continues from the centre to the circumference, until it reaches a bronchial tube, terminating in the mass. Ulceration takes place into the tube, and the tuberculous substance, as it becomes softer, is discharged through it. A cavity is necessarily produced by this evacuation; it is prevented from encroaching upon the adjacent tissue by a firm cartilaginous membrane, which is sometimes lined upon its internal side by a second membrane of less firm consistence than the first, and secreted at a later period. As each mass or cluster of tubercles passes into the softened state, after attaining a certain size, it is obvious that these cavities, by the successive increase and softening of surrounding portions, will tend to run into each other; but as they cannot touch at all points on account of their spherical shape, the communication from one to the other must take place through a small opening. This opening is gradually enlarged by ulceration, or the softening of tubercles forming the walls of the cavities, until they communicate freely with each other. A small portion of the pulmonary tissue, immediately surrounding the vessels, usually resists the ulceration longer than the rest, and forms a band or bridge, running from one side of the cavity to the other. The disposition of the tuberculous matter to soften and form cavities, is the characteristic of the third stage, and distinguishes it, both by its anatomical and physical characters, from the second. The bronchi communicating with the cavities are always red and inflamed, and consequently

secrete much mucus during life. The pulmonary tissue around them is more constantly indurated than in the other stages.

OF THE PHYSICAL SIGNS OF PHTHISIS.

These necessarily vary with the different stages of the disease. In the first stage, when there are but few scattered tubercles, it is impossible to ascertain their existence by physical examination. When the tubercles are more numerous and larger, and the disease is fully formed, though it should not yet have passed into the second stage, the physical signs become evident. Were the tubercles equally disseminated, as actually occurs in some exceptional cases, the respiration would be little affected by the great dispersion of a small number of tubercles. But as they are both more numerous, and are developed at an earlier stage at the top of the lungs, a small number will give rise to considerable local alteration of the respiration. It is, therefore, necessary to examine the summit of the lungs with especial care, both by percussion and auscultation. Percussion must be made above, upon, and immediately below each clavicle; in these places a very slight deviation from the natural standard may be detected. It should, however, be recollected, that a very small difference in favour of the left side does not indicate induration of the right lung, as the summit of the left is naturally a little more sonorous.

The alteration of the respiratory sound is at first limited to a very slight increase of the blowing noise in both inspiration and expiration; but especially the latter, when it constitutes the rude respiration. It is heard on the right side at an earlier period than on the

left, even if there be equally large accumulations of tubercles on both. This anomaly is caused by the larger size and straighter course of the bronchial tubes passing into the summit of the right lung. The anatomical structure, which, in the natural state, causes a very slight blowing sound on the right side, must exaggerate the blowing respiration produced by a moderate number of tubercles. The sound in the right lung of a phthisical patient should not be regarded as morbid, unless the respiration is decidedly blowing; a slight difference, perceptible by an accurate auscultator, does not necessarily indicate disease. But if the respiration be more blowing at the summit of the left than the right side, there can be no reasonable doubt that the lung contains tuberculous matter. The same peculiarity of structure which gives rise to a rude respiration on the right side, produces a greater resonance of the voice. In the normal state the difference is extremely slight; but if tubercles be deposited at the summit of both lungs, there will be heard a decided resonance of the voice at a much earlier period on the right than the left side.

Percussion, in the earlier stages of phthisis, is best performed on the anterior part of the chest, because the lung is there very near the surface. Auscultation of the voice, and respiration, should be practised at the posterior part of the chest, especially above the spine of the scapulæ, and between this bone and the spinal column, from the summit of the lung to the fifth dorsal vertebræ. Tubercles are most frequently deposited at the posterior margin of the lungs, where the bronchi are largest; and any alteration they may cause in the respiratory sounds, is, of course, most easily detected along the posterior part of the thorax.

As the anatomical lesions characterizing the first stage of phthisis pass insensibly into those of the second, the same gradual transition is observed in the physical signs. When the tubercles are collected in masses about the bronchial tubes, the alterations become so evident, that a very short exploration of the chest will render the case perfectly clear. Percussion near the clavicles becomes dull on both sides, or on one only, as the tubercles may chance to be deposited. In ordinary cases it is dull on both sides, but more on the one than on the other. It is not very often perfectly flat, because a small portion of parenchyma remains permeable to the air. The flatness is, also, well marked at the upper and posterior part of the lungs, notwithstanding the thick covering of muscle.

The respiration, in the second stage, is decidedly bronchial; the blowing sound is well developed, both in inspiration and expiration; the vesicular sound ceases entirely, or is barely heard. The bronchial respiration is best heard at the posterior part of the lungs, for the reasons already stated. It does not in any place acquire the strong characters of the tubal respiration of pneumonia, for the gradual deposit of tubercular matter tends to obliterate the bronchi more perfectly than the induration of pneumonia, and does not form solid masses around the largest tubes. When the respiration is bronchial at the summit of one lung, it is almost always rough at the corresponding part of the other, as tubercles are rarely confined to one of these organs. Some alteration of the respiration is often found towards the inferior parts of the lung, especially at its posterior portion, from deposits of tubercles, which, in this stage, are no longer limited to the summit. In these situa-

tions the respiration may be rough, or puerile, but not bronchial. The soft equable murmur of respiration rarely continues, even in the parts of the lung least altered; the inspiration has a harsh sound, or it is weaker on one side than on the other. The alteration of its rhythm and softness, sometimes occurs in the earliest stage of phthisis, when it forms a valuable sign; it is, however, much more frequent in the second period.

In the second stage of phthisis, different rhonchi are often heard; they are the mucous and sub-crepitant, in those parts where the bronchial respiration is most distinct, and the dry rhonchi in various portions of the lung. The sign is not very important, as they are rarely permanent.

The increased resonance of the voice passes into bronchophony when the bronchial respiration is perfect. It is never as loud as the bronchophony of pneumonia, but is well characterized, and is an invaluable sign. It is best heard at the posterior part of the chest, for reasons already assigned.

A new sign of much importance is often observed when the tubercles are in considerable number, and is sometimes present at a very early period of the disease. It is the greater loudness of the sound of the heart, opposite to the tubercles, which serve as a better conducting medium than the spongy tissue of the lungs. If the tubercles are most numerous in the right lung, the pulsations of the heart are heard more distinctly there than at the corresponding part of the left, and we then infer, with great certainty, that the lungs are indurated. Should the tubercles be much more numerous in the left lung, then a careful examination is necessary to

ascertain the limits of the sound of the heart, and the manner in which it ceases. If the transition from the left to the right side be very abrupt, it is probable that there is disease of the left lung, and not of the right; for the sound of the heart is heard with gradually less intensity, as the points of the chest are more and more remote from it. But if the left lung be much diseased, the sound is nearly as loud at its apex as it is at the præcordial region.*

In the third stage of consumption, when the tubercles are softening, the flatness, on percussion, is at least as great as in the second. It may be more complete from the hardening of the surrounding pulmonary tissue, and its infiltration with tubercular matter. When the cavity is completely evacuated, the sound does not become clear, unless its extent should be very great. In such cases, a gaseous resonance is produced, but it has not the character of the healthy pulmonary sound; it is more hollow, like that of an empty vessel, and if the patient open his mouth, it often has a peculiar tone, called *bruit de pot fêlé*, or sound of a cracked pot. The name is very descriptive of the sound, which is most distinct when the cavity is very near the ribs. The bronchial respiration passes into the cavernous as the cavity becomes complete, but perfect cavernous respiration is not heard until the walls of the cavity are hardened, and its communication with the bronchi is large. It disappears at times, when there is much liquid in the cavity, but is reproduced after free expectoration. The cavernous respiration is most intense when the cavity does not exceed the size of an egg; in

* This sign was pointed out to me by M. Louis, in the winter of 1831–2.

very large cavities, including the whole, or nearly the whole, of one lobe, it becomes amphoric, and is more feeble and confused. In large cavities the sound is not reflected; in small, and moderate sized ones, the vibration of the air is increased by the hardness of their walls. It is not very common to hear cavernous respiration on both sides of the chest at the same time, but on the side least diseased the respiration is rude or bronchial.

The voice acquires a peculiar resonance as the cavernous respiration forms; it seems to enter the ear of the observer from the tuberculous cavity. If the transmission be clear and distinct, it constitutes perfect pectoriloquy; if it be less distinct, the pectoriloquy is imperfect or doubtful. The imperfect and doubtful pectoriloquy are the varieties of bronchophony already described: perfect pectoriloquy should be termed cavernous bronchophony, or cavernous resonance.* All these varieties are more or less analogous, and are sometimes alternately heard in the same cavity, as its communication with the bronchial tubes is more or less free. If the cavity be very large, the sound is amphoric; which is less easily recognized than cavernous resonance.

The rhonchi are abundant in the third stage of phthisis. When tubercles begin to soften, the earliest evidence of it is a sub-crepitant rhonchus; it has a drier, more crackling sound, than it has in pneumonia. The name commonly given to it in the French hospitals, is

* The confusion of names applied to the varieties of pectoriloquy, arose from the discovery of this sign by Laennec, long before he was aware of the existence of bronchial respiration. His description does not, therefore, refer to bronchophony.

crâquement, or crackling. As the cavities become larger, and contain more liquid, mucous rhonchus is heard. It is partly owing to the softened tubercular matter, but still more to the liquid contained in the bronchi around the tubercles. When these bodies have advanced to the third stage, the tubes become inflamed, and give rise to the mucous rhonchus. As soon as the cavity is of moderate size, the mucous rhonchus passes into gurgling—a sign of the greatest importance in the diagnosis of softened tubercles. It is constant, does not disappear for long periods, and can always, or nearly always, be reproduced by making the patient cough. As was remarked by Andral, gurgling is the pathognomonic sign of pulmonary cavities. The gurgling increases with the size of the cavity; but after the tubercular matter is entirely discharged, there are great variations in its intensity. If the walls of the cavity secrete much liquid, it continues; but if there be little secretion, the cavernous respiration is alone heard. Besides the gurgling indicative of the large cavity, mucous rhonchus and gurgling are often heard throughout a considerable extent of the lungs. In such cases, numerous small cavities are partially evacuated, but the rhonchus may occasionally arise from the simple accumulation of mucus in the bronchi, and much care is necessary to distinguish between these causes.

In very old cavities, the gurgling is much changed in character; sometimes it has a creaking sound, like that of new leather; at others, it is a very dry mucous rhonchus. These varieties all depend upon the consistence and quantity of the secretion into the cavity.

Cicatrization of tuberculous cavities sometimes occurs, and would probably be much more frequent, were

it not for the secondary crops of tubercles. In one or two instances I have traced the progress of these cavities, but I have not verified it by examination after death. In such cases, the cavernous or amphoric respiration becomes less intense, and is gradually replaced by a feeble respiratory murmur.

Of the conformation of the chest in phthisis.—Some of the peculiarities in the conformation of the chest of consumptives, have been long noted; such as the remarkable protrusion of the shoulders, and the contraction of the anterior part of the thorax, from the emaciation of the pectoral muscles. But these extreme deviations from the natural form, occur only in advanced stages of the disease. In the earlier periods, the chest is more contracted than usual, either from general emaciation, or from adhesions between the two surfaces of the pleura, near the tuberculous deposits. The contraction dependent upon emaciation, extends to the whole of the chest, but is most evident at the inferior part, where there are no large muscles. It increases with the progress of the disease. The adhesions from pleurisy are necessarily strongest at the summit of the lungs, where the tubercles are in greatest number; they are sometimes slight and cellular, but in a majority of cases are firm and cartilaginous. Sometimes they are so thick as to form a hard, cartilaginous cap, completely enclosing the lung, and increasing the dulness of the percussion. When the pleurisy has not been confined to the summit of a lung, the contraction is similar to that following the idiopathic disease, and is, therefore, of less importance in the diagnosis than when it is limited to the top of the lung, where simple pleurisy is rare. The local adhesions necessa-

rily increase the depth of the depressions above and below the clavicles; if one of them be much greater than the other, we infer that it is owing to adhesions, and not to mere emaciation.

OF THE EXPECTORATION IN PULMONARY CONSUMPTION.

In the earliest stage, there is rarely any expectoration. When passing into the second stage, the sputa consist merely of the thin whitish semi-transparent bronchial mucus. They retain this appearance until cavities begin to form. The sputa then become whitish, opaque, do not run together in masses, but are rounded, with irregular indented edges. Sometimes there are whitish or yellowish grains in the sputa, which are fragments of softened tubercles. The round sputa generally float in a thinner and more transparent liquid, which is chiefly the ordinary bronchial secretion. This variety of expectoration is called nummular, and is peculiar to phthisis. It almost always occurs during the progress of the disease, but sometimes is not developed until it is far advanced. The expectoration rarely retains this character until the death of the patient, but becomes more yellow, and has a dirty grayish tinge; the sputa run together, and are not mixed with the thinner liquid. The odour is nauseous, and in rare cases fœtid.

Hæmoptysis, or the spitting of blood, occurs in most of the cases of phthisis of adults. It comes on at various stages of the disease; sometimes, though rarely, it is the first symptom perceived by the patient, who is taken with spitting of blood while enjoying apparent health. Hæmoptysis is, however, most frequent during the progress of the first, or the beginning of the

second stage, after the cough and expectoration have begun. In the third stage, slight hæmoptysis (from a few streaks of blood to a spoonful), is not infrequent. Copious hæmoptysis, that is, from a spoonful to a pint or more of blood, is rare; but when it occurs, is much more fatal in this period than in any other. The spitting of blood, if in greater quantity than a spoonful, is a very sure diagnostic sign of phthisis, unless it should follow local injuries, or be connected with some derangement of the menstruation. I allude only to those cases in which the blood comes from the lungs, not the mouth or fauces. It is very true that some individuals who have had profuse hæmoptysis, do not die of consumption; but it is beyond doubt, that many of these persons are tuberculous, although the disease may have become stationary. It is proven, by direct observation, that hæmoptysis is very frequent in patients who are tuberculous, and that it is very rare in those who are not. The probability is, therefore, very great, that patients attacked with hæmoptysis (with exceptions just stated), are tuberculous.

The *cough* of consumptive patients is variable; at first it is dry, short, and very rare. Patients are frequently not aware of its existence; at other times they make an effort to suppress it, and thus conceal its existence from themselves. The cough becomes more loose and paroxysmal as the tubercles increase in size, and is both frequent and loose when there are cavities in the lungs. It is much more severe at night, or early in the morning, than at any other hour of the day.

Emaciation is an almost constant attendant upon phthisis, and however acute the case may be, it is sure to appear before the termination. When the emacia-

tion is not attended with loss of appetite, the sign is of much greater value. Nothing, however, is more irregular than the progress of emaciation; I have seen cases of phthisis with cavities, although the patients were stout muscular men.

Loss of muscular strength is very frequent, though not universal; it advances when the disease makes rapid progress, and seems stationary when the development of tubercles is suspended.

It is needless to enlarge upon those symptoms of phthisis which are usually found in its advanced stages; as hectic fever, night sweats, diarrhœa, and œdema of the feet. For more copious details, I must refer to systematic writers.

OF THE VARIETIES OF PHTHISIS.

Latent consumption is far from infrequent. In some subjects tubercles are developed, and pass through their different stages almost without fever or cough. The diagnosis must then be drawn from the physical signs, which are especially useful under such circumstances. The disease is most frequently latent in young children, and in persons far advanced in life.

Acute phthisis is not often indicated by decided physical signs. The tubercles are disseminated through a large portion of the pulmonary tissue, and the patient usually perishes before any of them attain a large size. The fever and prostration are more intense, and the emaciation more rapid in this form of disease than in any other. It is more frequent in women than in men.

The frequency of phthisis in children is remarkable. Like all the tuberculous diseases, it is most common in children who are badly fed, and deprived of a suffici-

ency of light and air. It is rare before the age of two years, but very frequent afterwards. The tubercles are more equally disseminated throughout the lungs than they are in adults, and are not often much larger in the upper lobes than in the lower. It is very common to find cavities and large tubercles in the lower lobe, while there are but few and small tubercles at the summit of the lungs. Cavities in the lungs are comparatively rare in children; they generally die before the tubercles soften. The tuberculous matter is more frequently infiltrated in the pulmonary tissue, as it is in the monkey tribe, and may invade a large portion of the organ. In the aged, phthisis is comparatively rare, and passes into a chronic form; it is often latent, but does differ in other respects from the phthisis of adults.

Of the complications of phthisis.—Tuberculous consumption does not seem subsequent upon other diseases, unless the patient has had an original predisposition to it. In such a case, any malady which has kept up a permanent febrile irritation, or deprived him of air and exercise, may give rise to phthisis. There is a class of diseases which form only apparent exceptions to the common rule, that consumption is not a secondary affection; these are those which depend upon deposits of the tuberculous matter in other organs than the lungs. It is now generally admitted, that all lesions whose common anatomical character is the secretion of tubercles, are essentially identical, and that the difference in their symptoms depends only upon the changes in the functions of the organ, produced by the continued presence of a foreign body. The causes which influence the deposit of tubercles in one organ, rather than in

another, are unknown; but they depend, to a certain extent, upon the age and sex of the patient. Tubercles in the glands are more common in children than in adults; those of the serous membranes are more frequent in the female than in the male sex. In adults, they are almost always found in the lungs when they exist in other organs of the body; the exceptions to this law do not exceed one in a hundred.* From the very constant and early deposit of tubercles at the summit of the lungs, an examination of the physical signs of these organs will often throw much light upon the tuberculous diseases of other viscera, and especially those of the serous membranes. On the other hand, a knowledge of the laws governing the deposit of tubercles in different organs of the body, will facilitate the diagnosis of obscure cases of pulmonary consumption. The chief of these laws (for which we are indebted to M. Louis), are as follows:—Chronic peritonitis, which does not follow the acute form, is always tuberculous. This law I have very often verified, both in Europe and in America, without finding an exception to it. Another is, that consecutive attacks of pleurisy, first on the one side, then upon the other, are caused by tubercles in the lungs, or pleuræ. To these conclusions, I may add one drawn from my own observations. When children or young adults are attacked with the disease of the membranes of the brain, known under the name of meningitis, or me-

* It has so happened that I met with one of these rare cases while writing this chapter. It was in a coloured woman, who had gray granulations, or tubercles in the pleuræ and the peritoneum, but not the slightest trace of them in the pulmonary tissue.

ningo-cephalitis, they have tubercular deposits in one or more of the organs of the body.

Tubercles are formed very frequently in the follicles of the intestines and the spleen; less often in the liver and kidneys. When they occur in the brain, they are generally attached to the meshes of the pia mater. Tubercles of the bronchial glands are more frequent in children than those of the lungs, and constitute a variety of phthisis, which will be afterwards noticed.

Besides the lesions of viscera which depend upon the development of tubercular matter in their substance, various organs may be inflamed or ulcerated during the progress of phthisis. The affections of the intestinal canal are very frequent during its course, but those of the trachea and larynx are almost peculiar to it. When the symptoms dependent upon the affection of the larynx are much more prominent than those of the lungs, the disease has often received a distinct name, and is then called laryngeal phthisis. It is now well ascertained, that all such cases at the same time present tubercles of the lungs, so that the disease is regarded as one of the varieties of phthisis.

Inflammation of the lungs frequently succeeds tubercles in these organs, but is not as necessary an attendant upon them as pleurisy, which is rarely absent, although there should be no tubercles in the serous membrane. The pleura is inflamed at the summit of the lungs, where they are most diseased, instead of the base, which is the seat of ordinary pleurisy. The adhesions which follow the inflammation are a source of safety to the patient, who would frequently perish from perforation of the pleura, if the cavity of this membrane was still preserved near the softened tubercles.

Diagnosis.—This is a much more complicated problem than that of any other pulmonary disease; not that there is any doubt in those instances which are accompanied by well marked physical signs, in addition to the general symptoms; but in a large number of cases of consumption, both these series of signs may fail, or be imperfectly developed. The progress of the disease will remove the doubt which often attends the early stage, but it is then too late to remedy the evil. Although the earliest development of tubercles cannot be certainly ascertained, we may decide with much probability whether the disease exist or not.

The early periods of phthisis may be confounded with simple pulmonary catarrh, with dyspepsia, and febrile diseases of various type, or may be completely latent. The points in which phthisis differs from chronic catarrh, are:—1st. Hereditary predisposition, which exerts an important influence in the production of phthisis. 2d. The age of the patients, which is rarely above thirty, if the disease be consumption. 3d. Sex—if the patient be a female, for catarrh is by far the most frequent in males. 4th. Occupation—phthisis is more frequent amongst those who are obliged to remain within doors, and especially those who work in constrained positions. 5th. Emaciation—a very important sign, especially if it be not attended with loss of appetite, which would account for it on other grounds. 6th. Enlargement of the ends of the fingers, and curving of the nails, which sometimes occurs at an early period of phthisis, and almost always is very perceptible toward its termination. 7th. The fever is sometimes intense, and entirely disproportioned to the extent of the local lesions; it is, therefore, a very im-

portant sign in the more acute forms of the disease, in which it is usually most considerable. The chronic varieties are not accompanied with fever; so that the absence of this symptom is not an important negative argument against the existence of tubercular disease. A peculiar sensibility to cold, rather than a distinct rigour, often attends the fever; and night sweats are not infrequent, even in the early stages of consumption, while they are rare in catarrh. 8th. The occurrence of chronic peritonitis, shown by flatulent distention of the bowels, constipation, and vague, inconstant darting pains through the abdomen, will remove all doubt which might remain as to the nature of the affection. The pleuritic pains in the sides, especially if alternating from one to the other, are also important signs of phthisis, and rarely occur in simple catarrh. Laryngitis, if chronic, is an almost unfailing evidence of consumption; it is indicated by hoarseness, or loss of the voice, and pain, or slight soreness at the larynx, increased by swallowing. It should not be confounded with simple inflammation of the uvula and tonsils, which may even proceed to ulceration, but can be readily detected by examination of the fauces. 9th. The expectoration in the early stage of phthisis consists merely of a little whitish mucus, and does not present the various aspects of catarrhal sputa. It was already mentioned, that the expectoration of large quantities of blood was almost pathognomonic of tubercles in the lungs.

When two or more of the general signs just mentioned are combined, they indicate the probable existence of phthisis, especially if they do not appear to be dependent upon other diseases. If the physical signs

are absent, it shows that the disease has not extended far enough to involve a considerable portion of the parenchyma of the lungs. The only exception to this rule is acute phthisis, when a multitude of gray granulations, or minute tubercles, may be scattered through the lungs, without giving rise to any material alteration of the respiration. When, in addition to the symptoms above mentioned, there is an increased depression above and below the clavicles, dulness of percussion in the same part, and rude or very feeble respiration, there can be no rational doubt of the existence of the first stage of phthisis. If the rational symptoms are very doubtful, the physical signs are less important, unless they be decided when the disease is clearly recognized, although it has assumed the latent form.

In all cases it must be recollected, that the diagnosis of consumption, in its early stages, is a complicated problem, which cannot be solved without a careful examination of both negative and positive signs. When no doubt is left as to the affection, the physician must be cautious in informing the patient of the nature of his disease; unless, at the same time, he explains to him that it is not far advanced, and may be checked by a combination of medical treatment, with the necessary hygienic means.

The second and third stages of phthisis are readily recognized by the general and physical signs detailed in the preceding pages. It is, therefore, scarcely necessary to recapitulate them here. Even in these cases, where the chances of cure are so slight, physical exploration is most useful, by showing the nature and stage of the disease. It may thus prevent an improper

course of treatment, and discourage the patient from undertaking those long journeys, which a vain hope of recovery often suggests. There cannot be too much caution used in advising him to leave the comforts of his home, at a time when he is least capable of severe exertion.

CHAPTER XII.

PULMONARY APOPLEXY, AND ŒDEMA OF THE LUNGS.

These lesions are classed together, because they are rather the sequelæ of different diseases of the lungs, than distinct affections. They, however, occur under very different circumstances; pulmonary apoplexy is usually connected with phthisis, and rarely proves fatal; but œdema of the lungs often precedes death at the close of various chronic diseases.

When blood is secreted from the mucous surface of the bronchi, no lesion of this membrane can be detected; the liquid is simply exhaled from its surface. But when the blood is poured out from the lining membrane of the smaller tubes, and the cellular tissue around them, there is often a deposit of it in the tissue of the lung, where it forms rounded masses, from a line to two or three inches in diameter. These masses are scattered throughout the lung, are of a dark brown, or blackish colour, and very smooth when incised; the consistence of the tissue is sensibly diminished, but not pulpy. Both the exhalation from the mucous membrane of the bronchi, and the deposit of blood in the pulmonary tissue, are frequent attendants upon phthisis; and tubercles, in greater or less number, are found scattered through the lungs. Sometimes the nodules

of coagulated blood are found after death, although none had been expectorated; but in most cases, copious hæmoptysis occurs. The hæmorrhage in itself is rarely dangerous, but is alarming from its importance as a symptom of phthisis, or in rare cases, of a disease of the heart.

The *physical signs* of pulmonary apoplexy are chiefly the mucous, or sub-crepitant rhonchus, which extends over the whole of one side of the chest, when the hæmorrhage has been considerable; but is limited to a small portion of a lung when there is little effusion of blood. The resonance, on percussion, is not perceptibly altered, unless the clot is very large, which is rarely the case. The rhonchus differs from that produced by the secretion of mucus; the bubbles are evidently formed of a thinner liquid, and break more quickly. The vesicular sound is sometimes entirely lost; at others, it is heard mingled with the rhonchi, but is always much feebler than natural. The sonorousness of the chest is diminished, if the effusion of blood be considerable; but, in most cases, it is not evidently altered.

A bellows sound of the heart frequently coincides with pulmonary hæmorrhage, whether the blood comes from the bronchial tubes or the vesicles. The impulse is at the same time greater than usual. These alterations in the sounds of the heart cease when the hæmoptysis is arrested.

PULMONARY ŒDEMA

Is the effusion of serum into the cellular texture of the lungs; when they are cut, an abundant spumous transparent liquid issues from them. They crepitate

and pit upon pressure, while their density is evidently increased. This lesion is very frequent in the aged, and is often the immediate cause of death at the termination of severe fevers. It also complicates some cases of general dropsy, but is scarcely regarded as an idiopathic disease.

The physical sign indicating œdema, is the presence of a loose and very abundant crepitant rhonchus, which extends to a large portion of the lungs. Its bubbles are larger than in the crepitus of pneumonia, but break more quickly, and do not extend from point to point, in long trains; they resemble much more nearly the sound produced by effervescing cider or champaigne. The crepitus is most abundant at the base of the lungs, but, if general, is usually a fatal sign. The sound, on percussion, is scarcely diminished.

CHAPTER XIII.

PLEURISY.

The pleuræ are more frequently inflamed than any other of the serous membranes. The inflammation is primitive, or secondary to other diseases, especially those of the pulmonary parenchyma. The anatomical phenomena, and the physical signs of idiopathic pleurisy, differ but slightly from those of the secondary disease, although the general symptoms, and the prognosis, may both be widely different.

Anatomical characters.—When inflammation of the pleura commences, the vessels beneath the serous membrane are very numerous, and form a net-work of a bright red colour, distinctly visible through the transparent membrane. When the membrane is detached, it is evident that the vessels are developed in the cellular tissue beneath, and not in the membrane itself, which is not perceptibly altered. If the disease continues, the secretion of serosity from the free surface of the serous coat is probably at first lessened, but is soon changed in character, and is replaced by two new products, which are usually found at the same time, but in different proportions. These are first, a liquid, not unlike the ordinary serous secretion of the membrane; and secondly, a soft albuminous matter, or plastic

lymph, deposited in the form of a pellicle upon the serous coat, or of flocculi, which sink to the bottom of the liquid. It is most probable that these secretions occur in every case of pleurisy, but in various proportions. In the slightest cases the liquid is so little abundant that it is not perceptible by our means of investigation; we can then only infer its existence from the analogy of severe cases. In a still more frequent variety, the secretion consists of coagulable lymph, without liquid. This form of pleurisy always exists when the inflammation follows a previous attack of the disease, which had passed through its stages, and terminated in close and extensive adhesions.

In the large majority of cases, the liquid secreted consists both of serum and lymph. The serum is whitish, or yellowish, never perfectly limpid; it follows the ordinary laws of gravity, and accumulates in the most dependent parts; its situation, therefore, varies with the different positions of the patient. For the same reason, it is most frequently accumulated at the base of the lungs and along the edge of the spinal column—parts which are nearest the centre of gravity when we are in a recumbent or sitting posture. The lymph also accumulates in greatest quantity at the lower part of the lungs, and the opposite parieties of the thorax. At the angle forming the lowest portion of the lung, it is sometimes so abundant as to form a thick yellow mass, inclosing the pulmonary tissue. When the pleurisy is preceded by a disease of the lungs, as tubercles or gangrene, the accumulation of lymph is greatest at the parts of the pleura which cover the diseased mass—so that in phthisis, the pleurisy, and consequent adhesions, are almost always

greatest at the summit of the lungs, where the tubercular matter is most abundant. The consistence of the lymph varies from that of a soft pulp to a firm semi-cartilaginous membrane, detached with difficulty from the pleura. It is not possible to distinguish the period of the disease, from the inspection of the anatomical secretions; but the false membrane is always less consistent, when newly formed, than in the later stages, although we are ignorant of the precise relation between the degree of the inflammation and the consistence of the lymph. The lymph is sometimes deposited as a thin uniform layer, or membrane; at other times, it is in irregular patches of various thickness, or it assumes a reticulated aspect, with cells not very unlike those of a honeycomb. The masses of lymph, lying loosely in the liquid, are generally less consistent than the layers covering the pleuræ. The membrane lines the whole cavity of the pleura when the inflammation is extensive and the effusion considerable; when the disease is less advanced, it is chiefly found at the lower part of the cavity, but upon both the costal and pulmonary surfaces, though it is usually thickest on the pulmonary pleura.

When the layer of lymph is detached from the pleura, the serous coat is of a reddish colour, owing to the numerous vascular ramifications beneath it. Its transparency is retained, although it is not always as perfect as in the normal state; if held against the light, there is a slight milky tint of the membrane. The apparent thickening is chiefly owing to the coating of coagulable lymph; a very slight but real increase of thickness of the membrane may be distinguished when the lymph has been carefully removed. The vascular

ramifications are of a bright red colour, and sometimes so numerous as to communicate a uniform redness to the membrane; the redness is generally proportioned to the quantity of lymph effused upon the serous coat. In patients much weakened by anterior diseases, the pleura, instead of being red, is of a semi-opaque white; in this case, the quantity of serum is unusually great, while the lymph is less abundant, and of less consistence.

The side of the chest affected is thrust outwards by the effused liquid, when it is considerable in quantity. The distension is first visible at the lower and posterior part of the thorax, near the angles of the ribs; it is less obvious in the axilla, and is perceived anteriorly in cases only of great effusion. The local alteration, in the conformation of the thorax, may frequently be recognized when little or no perceptible increase of the semi-circumference of the chest is detected. The thorax loses its preternatural fulness when the liquid begins to be absorbed; but when the effusion has been considerable, it never recovers its original conformation. The anterior surface is depressed, slightly concave, or flattened, instead of the natural convex surface; the posterior face is less convex than usual, and the intercostal spaces are not nearly so wide as in healthy subjects. In the axilla, the depression following the absorption of the liquid is less evident than elsewhere.

While the ribs are forced outwards the lung is compressed against the spine, by the gradual increase of the liquid. In proportion as the effused liquid is absorbed, the false membranes which cover the surface of the lung, and retain it against the spine, acquire additional consistence, and prevent it from regaining its former development. The lymph lining the costal

pleura becomes more dense and organized, approaches in appearance to cellular substance, and is supplied with vascular ramifications from the vessels of the serous membrane. The vessels are minute, but of bright redness, and are only visible when the adhesion between the serous coat and the false membrane has become intimate.

When the cure of pleurisy is nearly complete, the two surfaces of the membrane come in contact, and gradually adhere to each other. At first there is still sufficient motion for the surfaces roughened by the deposit of lymph to rub against each other; the friction then causes a peculiar creaking sound.* As the adhesion gradually becomes complete, the costal and pulmonary pleuræ are closely and permanently united.

State of the lungs in pleurisy.—The lungs in simple pleurisy are free from inflammation; but are not, strictly speaking, in a normal condition. When the pleurisy is limited to inflammation of the serous membrane, and deposit of lymph, the lungs are less fully expanded than is natural, from the pain felt by the patient during respiration; they, therefore, contain more solid substance, and less air, than if they were perfectly healthy. If there be a secretion of liquid, however small in quantity, some compression of the pulmonary parenchyma takes place, and the quantity of air received into the lung is less, while the proportion of solid matter is augmented. If the compression be very great, the lung is dense, has a leathery feel, and contains no air.

Physical signs of pleurisy.—In the earliest stage of

* See description of sounds.

the disease, the conformation of the chest is not perceptibly altered; but when the effusion is considerable, the form of the thorax is much changed. At first, dilation is perceived only in the lower posterior portion, where the intercostal spaces become more prominent, and the angles of the ribs are higher than in the healthy state. At this period, no perceptible difference exists in the semi-circumference of the two sides. When the effusion is greater, the dilatation extends to the axilla and anterior surface of the chest, and the intercostal spaces are decidedly protruded. The quantity of liquid is frequently so great as to increase the semi-circumference of the chest; so that the side affected may measure from one to three inches more than the other; there is very commonly a difference of from one to two inches. The thorax should be measured just below the nipple. The shoulder is raised when the liquid is abundant, and the nipple is higher than that of the healthy side. Should there be much effusion into the left side, the heart is thrust to the right of the sternum.

The general dilatation of the thorax is so peculiar to pleurisy, that if it be accompanied with pain, it is sufficient for a very sure diagnosis of the disease. The degree of distension of the chest indicates the progress of the disease, when it has reached its crisis; the prominence remains stationary for a considerable time; it begins to diminish when absorption commences, and as the cure advances, the ribs sink until the affected side is more depressed than the sound one. The progress of the absorption may be estimated by simple inspection and by measurement. The gradual sinking of the side does not terminate by a return to the nor-

mal form; the intercostal spaces are diminished, and the thorax becomes flattened instead of convex; there is, at the same time, a depression of the shoulder, nearly proportionate to its previous elevation.

Percussion.—When there is no effusion of liquid, the percussion yields as clear a sound as in health; but as soon as the effusion begins, the percussion necessarily becomes dull from the compression of the lung, and diminished volume of air. The dulness of sound is at first limited to the lowest part of the chest, and gradually ascends as the liquid insinuates itself between the lung and the wall of the chest. The flatness varies with the position of the patient, and consequent change in the level of the liquid. If, in cases where there is moderate effusion, the patient be placed upon his face, the posterior part of the chest, which had previously yielded an obscure sound, becomes sonorous. The variable line of the flatness is a good discriminating test between pleurisy and pneumonia; in the latter disease, the cause of the obscure sound is in the lung itself, and change of position produces no diminution of it. The dulness is at first only relative; but when the lung has been completely forced from the walls of the chest, or the whole of the air is expelled from it, it becomes perfect, or absolute. In cases where there is so much liquid that the lung is almost reduced to a membrane, which is closely applied to the spine, no resonance can be obtained on percussion, in any part of the thorax. In the large majority of cases, this complete flatness does not occur; there is still sound at the summit of the lung, where the liquid, from the laws of gravity, is least likely to compress the vesicles. In all cases a little sound may be obtained near the spine,

opposite the root of the lungs; this arises chiefly from the air contained in the bronchia, which are not easily compressed by the liquid.

Percussion affords the most important signs in the diagnosis of pleurisy; they are constant, easily recognized, and from the changes in the level of the flatness, the presence of a liquid may be distinguished from that of a solid body. The sonorousness does not entirely return when all the liquid is absorbed; a little obscurity remains for some weeks, in cases in which the effusion has been moderate; when it has been so abundant as to be followed by contraction of the thorax, the sound on percussion is always duller than natural.

Of the respiration.—As soon as pain is felt in the side, even when there is no effusion of liquid, the respiration is altered. The vesicular murmur is feebler than natural. The feebleness arises in part from the short inspiration which the pain produces, but still more from the comparative immobility of the ribs on the affected side. The movement of the thorax is impeded by the great pain produced by the act of inspiration. As the quantity of liquid increases, the respiration becomes more feeble, and gradually ceases as the lung is more and more compressed. When the lung is perfectly flattened, no trace of respiration can be heard, except along the spine, at the root of the lungs, where a feeble respiratory sound, with little vesicular expansion, may generally be detected. The respiration becomes stronger from below upwards, and corresponds very nearly with the flatness on percussion. In cases with moderate effusion of liquid, the respiration is weak at the lower part of the chest, and a little within

the scapulæ; but if there be much liquid, the vesicular murmur ceases at the lower posterior part of the chest, and in the axillæ, and becomes weak on the whole anterior surface.

Besides the diminished force of the respiration on the side affected, it sometimes becomes decidedly bronchial, and is so almost always near the root of the lungs. The greater distinctness of the bronchial respiration, in certain cases, seems to be owing to condensation of the tissue of the lung, which is at times greater than at others, and to the deposit of thick pseudo-membranous masses near the large bronchial tubes. When the bronchial respiration is strongly marked, there is much reason for suspecting the complication of pneumonia. It is always less loud in pleurisy than in pneumonia, and is not tubal; but it is analogous in other respects, and is best heard in the expiration and near the large bronchial tubes. The extent of the chest over which the bronchial respiration may be heard, is much more limited than in pneumonia, in which this sound is always produced when a local induration occurs around a bronchial tube; but as it is owing to no cases of pleurisy, a force extraneous to the lung which compresses it equally on all sides, and renders it less permeable to the air, it is yielded only by the part of the lung most favourable for it. The expression, bronchial respiration of pleurisy, may be used with propriety, to distinguish the less forcible variety occurring in this disease. The less degree of force does not destroy the distinguishing characters of bronchial respiration, which are always diminished force of vesicular expansion, and increase of the blowing sound, especially in the expiration.

Alterations of the voice.—In the early stages of pleurisy, there is no perceptible alteration in the resonance of the voice. When the liquid becomes more abundant, the condensation of the lung increases the resonance of the voice. It is not simple bronchophony, but from the interposition of a layer of liquid between the lung and the walls of the chest, it has a peculiar vibrating tone. This vibration of the voice is called egophony. It is a sign of secondary importance; is not always heard during the course of the disease, and disappears when the effusion is considerable. The cessation of the egophony is owing to the liquid compressing the lungs, so as to flatten the bronchia, and render them unsuitable for the transmission of sound. The most common seat of egophony is towards the inferior parts of the chest, on a line with the nipple, and extending from it to the spine; it varies in changing the position of the patient.

There are no rhonchi in simple pleurisy; they are heard only when the inflammation of the pleura is complicated with that of the bronchial membrane, or of the lungs.

Of the movement of the chest during respiration.—The movement of inspiration is short, and interrupted in the acute stage, while the expiration is slow and prolonged. But as the pain subsides, the respiration becomes more regular, but at the same time more frequent and more elevated than usual.

The dyspnœa arises from the diminished volume of the lung into which the air can pass. The motion of the chest is chiefly performed by the healthy side; that in which the effusion has occurred, expands less

completely in the early stages, and is almost passive when there is much liquid.

OF THE FUNCTIONAL SIGNS OF PLEURISY.

Decubitus generally on the back, but at the early stage of the disease, sometimes on the sound side. In the chronic form, the patient lies on the back, or more frequently on the side affected, in consequence of the weight of the liquid, which would impede the motion of the healthy lung, if the patient lay upon that side.

The pain is acute in the early stage, and referred, not to the spot where the inflammation is greatest, but to the anterior edge of the axilla, or below the nipple.

Cough short, dry, and very painful.

The expectoration is very little abundant, transparent, or a little whitish.

Pulse frequent and hard in the early stages; when the chronic stage has occurred, very various; in some patients perfectly natural; in others, always febrile.

Respiration frequent, especially when the effusion is abundant.

Skin dry and harsh, during the febrile stage.

Termination, when idiopathic, nearly always favourable; the exceptions are very rare.

Duration very various; recovery occurs in a few days, when there is little effusion; when the liquid is considerable, the disease lasts from one to three months.

VARIETIES OF PLEURISY.

(*a*) There is a very common form of pleurisy, which is at first accompanied by pain, but afterwards the only

symptoms experienced by the patient are some difficulty of breathing, a slight cough, and a little uneasy sensation about the chest, not amounting to actual suffering. Pleurisy may be still more completely latent, and be free from pain throughout its whole course; in this case, it can only be recognized by physical exploration, when the flatness on percussion, and the feeble respiration, will identify the disease.

(*b*) Chronic pleurisy may succeed the acute form, and is then recognized by the signs already described, as indicative of the effusion of liquid. The chances of confounding this variety with phthisis are so small, that it is hardly necessary to insist upon its signs, which are perfectly characteristic. The liquid is more purulent, and the false membranes are greatly increased in thickness and consistence. The lung is firmly attached to the spine by the strong membranes, which sometimes acquire the consistence of cartilage, and are perfectly organized. There is, also, a variety of pleurisy which seems essentially chronic, and cannot be traced from a precise origin; it generally depends upon the presence of tubercles in the lungs, and, if the case be examined with care, the evidences of tubercular disease will be found to have preceded those of pleurisy.

(*c*) Double pleurisy is nearly always dependent on tubercular disease of the lungs; sometimes it occurs as an idiopathic disease, and is then usually fatal.*

(*d*) The mortality of pleurisy is considerable when

* Two cases of this kind I witnessed last winter, in which there was double pleurisy and pericarditis. One was, besides, complicated with pneumonia.

the subjects of the disease are very young, or far advanced in life. In these cases the patients are in a situation similar to those exhausted by previous diseases. Many aged persons, who are supposed to die of old age, really perish of latent pleurisy. In children the disease is not rare, and sometimes proves mortal. In one case, I found the affected side dilated to at least twice its former dimensions; this patient perished of suffocation.

(*e*) Pleurisy sometimes alternates with rheumatism, and is then frequently confounded with pleurodynia, a mistake very easily made, unless the physical signs prevent the error.

(*f*) Pleurisy, consecutive to tubercles or pneumonia, is not to be classed with examples of the idiopathic disease. In this instance, it is not unfrequently mortal. The pleurisy of tuberculous patients is generally dry, with secretion of lymph, but not of liquid; but the effusion is not unfrequently as considerable as in idiopathic cases. The disease may then be easily recognized, although some tact is requisite to discover its tuberculous origin.

Diagnosis.—It is evident that if a patient offer the following symptoms—oppression, pain in the thorax, fever, flat sound on percussion, extending from below upwards, and the respiration is feeble or absent—that his disease must be pleurisy, and can be nothing else.

When the chest is dilated, the diagnosis becomes still more clear. If the pain and dyspnœa be not attended by any alteration of the percussion, or of the respiration, other than a slight weakness of the vesicular murmur, we may still form a diagnosis, which is

very probable, though not physically certain. It is then confirmed by the absence of the signs indicative of pneumonia, with which pleurisy might easily be confounded. Severe pleurodynia or rheumatic disease of the intercostal muscles, is much less common than it is usually thought to be; most of these cases, when carefully examined, prove to be examples of pleurisy, with little effusion of liquid.

CHAPTER XIV.

PNEUMO-THORAX.

The term pneumo-thorax is applied to a collection of gas in the cavity of the pleura. It seems that, under some circumstances, gas is secreted by the serous membrane, and, in others, there is probably a decomposition of the fluids contained in its cavity. Both cases are accidents of little importance, and are so rare, that their existence has been doubted. The common acceptation of the term pneumo-thorax, is now limited to the anatomical lesion, which consists in a perforation of the pleura, causing the cavity of the serous membrane to communicate with the external air through the bronchi.

It is not properly a disease, but an accident, which may be caused by any lesion of the lungs, producing suppuration or ulceration of these organs. The diseases which may give rise to it, are pneumonia, and gangrene of the lungs, as well as phthisis, but at least nineteen of twenty cases occur during the course of the latter affection. It is, therefore, an accidental lesion, almost peculiar to phthisis, and is caused by the softening of tuberculous matter near the pleura, and the consequent perforation of this membrane from ulceration. It would occur much

oftener if adhesions between the costal and pulmonary pleuræ did not so constantly take place, when the subjacent pulmonary tissue is diseased. The adhesions are, therefore, the safe-guard of tuberculous patients. Pneumo-thorax is about twice as frequent on the left as on the right ride; this difference is explained by the greater frequency of pleurisy on the right side. Perforation seldom occurs in lungs much infiltrated with tuberculous matter, but very frequently in those containing disseminated tubercles, too few in number to give rise to extensive pleurisy. The opening in the pleura is rarely large; sometimes it is a quarter of an inch in diameter, at others barely sufficient for the head of a pin to pass.

The immediate consequence of perforation, is the passage of air into the cavity of the pleura; the air is introduced during the inspiration, and cannot entirely escape in the expiration. Pain and dyspnœa immediately supervene; the efforts of inspiration are increased, and the volume of air becomes so great as to distend the intercostal spaces, and, at the same time, compress the pulmonary tissue. Should the lung which is not perforated be much diseased, the dyspnœa increases so rapidly as to cause the death of the patient. The last case of pneumo-thorax I witnessed, caused death in less than an hour—the dyspnœa becoming more and more imminent with each convulsive inspiration. The diameter of the perforation in this case was a quarter of an inch; the lung was compressed against the spine, and the intercostal spaces forcibly protruded. When a puncture was made through the intercostal muscles, the air was driven out by the contraction of

the chest, in a little stream, like that from a small blow-pipe. In the larger majority of cases, death does not ensue so speedily; inflammation of the pleura follows the introduction of air into its cavity, and the sero-purulent effusion of pleurisy increases the dyspnœa and pain. If the disease terminates favourably, the inflammation of the pleura, and consequently the effusion of liquid, increase, while the perforation is gradually closed by the lymph. When the consecutive pleurisy is cured, contraction of the chest follows, as in ordinary cases of inflammation of the pleura. As the lungs are generally much diseased before perforation occurs, the chance of a favourable termination is very small. Death is, in most cases, hastened, because the lung most capable of supporting respiration is suddenly compressed.

Physical signs of pneumo-thorax.—As soon as the air enters the cavity of the pleura, it presses upon the intercostal spaces, and distends the chest. Its conformation is necessarily altered: it is more rounded than before; and, if the quantity of air be large, is generally dilated throughout the affected side, nearly as it is in pleuritic effusions.

The percussion is much more sonorous than natural; its loudness is increased over the whole of the side; the sound is hollow, like that of an empty vessel, and totally different from the resonance of a healthy lung. The whole side of the chest does not offer a very loud sound, if a part of the lung is held down by old adhesions, when the resonance is natural in the corresponding part. When secondary pleurisy and consequent secretion of liquid occur, the percussion becomes flat at the lower part of the chest, but is still sonorous in the

upper portion. As the liquid increases, a dull sound gradually replaces the loud resonance, until it extends throughout the pleura. The respiration may be wanting, or it may be amphoric. If the communication with the bronchi be free, a perfect amphoric respiration is heard, with a sharper and more metallic sound than is produced by tuberculous cavities. The metallic tone is most distinct in the inspiration; sometimes it is feeble in the expiration; at other times entirely wanting. This diversity is owing to the various forms of the aperture through the pleura. It is sometimes valvular, and permits the ingress, but not the egress, of the air; at other times it is permanently open. The sharpness in the tone is owing to the hardness of the walls of the pleura, which are always more dense than the pulmonary tissue surrounding a cavity. There is never a distinct vesicular murmur. The metallic tinkling is very frequent, but is less constant and less important than the amphoric respiration. It may often be heard, after ceasing for a time, by making the patient cough—when the silvery sound, compared to that caused by the fall of a drop of liquid from the walls of the cavity, is very distinct. The resonance of the voice is amphoric, and is more loud and distinct than that arising from ordinary cavities, however large they may be. It is loudest near the large bronchi, and is most distinct in those cases in which the perforation is large and permanently open. When the gas is absorbed, and the opening is gradually closed, the amphoric resonance ceases entirely. The parts of the cavity farthest from the opening into the pleura, yield a more diffused and less metallic resonance.

The sound of the heart is heard much less loudly than usual; this is a sign of the more importance, because the perforation is most frequent on the left side. As the chest is filled with air which conducts the sound imperfectly, the heart is scarcely heard, even at the præcordial region.

The general signs of pneumo-thorax are sometimes characteristic. If a patient affected with a chronic disease of the lungs be suddenly seized with severe pain in one of the sides of the chest, obliging him to lie upon the painful part; dyspnœa, sometimes so great as to interrupt his speech, and compel him to assume a sitting or half recumbent posture, and a short, dry, suppressed cough, he very probably has pneumo-thorax, from perforation of the pleura. The pain and anxiety rather diminish than increase after the rupture occurs, and the patient rarely perishes of the immediate difficulty of breathing, induced by the large accumulation of gas.

Diagnosis.—In those cases of disease which have been observed from the beginning, or their early stages, the occurrence of pneumo-thorax may be known with entire certainty. The well-marked physical signs, with the dyspnœa and sudden pain, are absolutely peculiar to this lesion. The diagnosis may be a little more doubtful in cases in which all its elements are not present. Well-marked cases of pneumo-thorax may always be recognized; but mere emphysema, in subjects who are much emaciated, and so much exhausted as to render it difficult for them to distend the lungs, may be confounded with the former lesion. If the vesicular murmur is entirely absent, as it some-

times is in such cases, the problem is of very difficult solution. Examples of this kind are of rare occurrence, and are limited to those advanced stages of disease in which all the characteristic symptoms are more or less obscured. In the earlier stages of emphysema, the general conformation of the chest is altered, but the distension is not so great as in pneumo-thorax, nor is it as exactly limited to one side. Besides, if the dilatation be so considerable as to give rise to doubt, the progress of the symptoms of emphysema is so slow and gradual, as to present a strong contrast to the violent dyspnœa, caused by a large volume of gas in the pleura.

Very emaciated persons, whose lungs are little, if at all diseased, sometimes have a very sonorous thorax; but it is rather contracted than dilated. The increased sonorousness probably depends upon the diminution of the cellular substance of the lungs.

CHAPTER XV.

TUBERCLES OF THE BRONCHIAL GLANDS.

The bronchial glands may inflame and become infiltrated with pus; but this rarely happens unless there has been previous inflammation of the pulmonary tissue. They are frequently softened in diseases connected with a general vitiation of the fluids, as typhoid fever, and the exanthemata; but their most frequent lesion is the tuberculous degeneration.

Tubercles in the bronchial glands are rare in adults; but, in children, they are more frequently found in these glands than in any organ of the body. They are as often tuberculous in children as the lungs in adults, and are not unfrequently much diseased when the lungs are comparatively healthy, or even perfectly free from tubercles. The lesion is most frequent in those children who have been badly fed, and are habitually confined in close, ill-ventilated apartments.

When the deposition of tubercular matter in a bronchial gland begins, the tissue may either be more livid or more pale than natural. Throughout its texture are scattered one or more yellow points, of a substance evidently extraneous to the healthy tissue of the gland. As these points enlarge, the tissue is gradually compressed, and thrust aside, until it is limited to one ex-

tremity of the ganglion, where it forms a sort of membrane. At the same time the gland increases in size, and by the time all its original tissue has been absorbed, it sometimes attains the size of a pigeon's egg, or, in very rare cases, it may even be larger. The tuberculous deposit is rarely confined to a single gland, but usually extends to a number of those which surround the large bronchial tubes. The cyst which encloses the ganglion thickens as the gland enlarges; it resists long after the tubercular substance softens, but at last ulcerates, and allows the softened matter to be discharged through the opening into the nearest bronchial tube. These cavities differ from those arising from tubercles in the substance of the lungs, by the thickness of their cyst, and their position without the lung; but as a certain number of these glands are enclosed in its tissue, they then bear a much closer resemblance to ordinary cavities. In such cases, I have generally recognized them from their close contact with a bronchium.

Physical signs of tubercles in the bronchial glands.—After a very long and careful investigation of this subject, at the Childrens' Hospital of Paris, I could discover no test by which this lesion can be recognized. The cause of this difficulty is very obvious: the glands are deeply seated, are not in a sonorous part of the chest, and though they surround the bronchi, it is a very rare circumstance to see these tubes really so much compressed as to impede the passage of the air through them. It is not even commonly found, that the cylindrical form of the bronchi has been changed. In a few cases, I fancied that there was an obscurity on percussion, near the spine, with an unnatural feeble-

ness of respiration on one side of the chest; but these signs were doubtful, and rather derived from the knowledge I had of the frequency of the lesion, than clearly observed in the patient.

The functional signs are common to all the varieties of tubercular diseases. They are fever, emaciation, dryness and harshness of the skin, and night sweats. There is sometimes difficult respiration.

Dr. Selden, of Norfolk, communicated to me a singular case of tubercles in the bronchial glands. It was in a negro child, who was afflicted with difficulty of breathing, dilatation of one side of the thorax, and flat sound on percussion. The operation for empyema was practised, and a thin serous liquid was evacuated. It was found, on the death of the child, some weeks afterwards, that the vessels of the lung on the diseased side passed through a cluster of tuberculous glands, and were almost obliterated, so that the circulation was impeded, and serous effusion consequently occurred.

CHAPTER XVI.

OF THE HEART.

Of the exploration of the heart of a healthy individual. —It is well known that the heart is placed behind the extremity of the sternum, and a little to the left of it. The left ventricle is in advance of the right, which is behind the other, and covered by it, except a small portion of its right margin. The greater part of the pericardium is not in immediate contact with the walls of the chest; the lungs are protruded before the heart, and remove it from the cartilages of the ribs. The space not covered by the lungs is rarely more than an inch square, and corresponds to the anterior surface of the right ventricle; in a few individuals the whole heart is covered by the lungs. The pericardium is closely in contact with the muscular tissue of the heart, and in the normal state does not sensibly increase the dimensions of this organ.

The ventricles form the anterior and inferior two-thirds of the heart. The left is thicker and stronger than the right, and forms the point of the heart which strikes forcibly against the cartilages of the ribs. The cavity of the right is larger than that of the left. The auricles are placed at the upper part of the heart,

under the sternum, and near its junction with the third costal cartilage.

1. *Examination of the heart by percussion.*—As a portion of the pericardium, and consequently of the heart, is not covered by the lungs, percussion on the corresponding part of the chest must yield a dull sound, because there is no lung, and consequently no air beneath it. This space is about an inch square, or a very little larger, and begins at the middle of the sternum, but does not extend to the nipple. Its length, in a vertical line, is about two inches from the measured base of the chest along the sternum, but at its left margin it is less than an inch. The form of the space in which the sound is dull, is, therefore, nearly triangular; the longest side of the triangle being formed by the sternum. The degree of dulness varies; in corpulent subjects it is of course more marked than in those who are much emaciated. The resonance is perfectly sonorous in patients who are affected with emphysema, if it be far advanced; as the lungs, when expanded, completely cover the heart.

2. *Of the impulsion of the heart.*—In the normal state, the impulsion of the heart is felt opposite the cartilage of the fifth rib, in a space about an inch square. The stroke of the point of the heart may be distinctly perceived by applying the stethoscope, the hand, or the ear. The impulsion is greater in those individuals whose chests are contracted and thin, than it is in robust or corpulent persons. It is increased by violent exercise, mental agitation, and fever, and diminishes when these causes have been removed. Various affections, foreign to the heart itself, may increase the force of its pulsations; these are, rheumatism, chlorosis,

sometimes hysteria, and still more frequently the mental ailments classed under the general term hypochondriasis.

3. *Of the sounds of the heart.*—By placing the ear near the heart of a healthy individual, we find that each pulsation is composed of two distinct sounds, which are followed by an interval of repose. The first sound occupies about one-half the time of each pulsation; the second sound a fourth, and the interval of repose nearly as much. The first sound coincides with the contraction of the ventricles, and is loud and prolonged; the second accompanies their dilatation, and is sharp and clacking.

There is still some obscurity as to the causes of these sounds, although it has been, in a great measure, removed by the experiments of Messrs. D'Espine, Hope, Williams, and other observers. Several different theories have been proposed, which differ but little for practical purposes, as the physical signs of the lesions of the heart may be explained by either. All the experimenters agree that the first sound accompanies the contraction, and the second the dilatation of the ventricles, and that no sound is produced by the auricles, contrary to the opinion of Laennec, who ascribed the second sound to their contraction. The most probable theory is that which attributes the second, or sharp sound, to the motion of the valves, and the first to the muscular contraction of the ventricles. This theory, which was proposed by Dr. Williams, as a modification of the preceding opinions, is apparently unexceptionable in its explanation of the second sound; but it is not yet certain that the first is owing to muscular contraction.

4. *Of the extent of the chest in which these sounds are heard.*—This limit varies according to the dimensions of the chest and the thickness of its walls. In persons of moderate embonpoint, and well developed chest, the heart is scarcely heard, except at the præcordial region, or at the distance of an inch or two from it. If the action of the heart be excited by fever or other causes, its sound may be heard in a much greater extent, without indicating any organic alteration. In this case the intensity of the sound gradually becomes less, as the distance from the heart is greater. It is greatest at the præcordial region, then at the upper part of the anterior surface of the left side, then of the right, afterwards at the posterior surface of the chest, proceeding from the left to the right side.

If the lungs are indurated, the diseased portion conducts the sound of the heart much better than a healthy tissue. It is consequently heard to a greater distance than usual, and does not always follow the rule just mentioned, of the diminution of its loudness, as the distance from the heart increases. A careless observer may easily mistake the increased loudness of the sound the heart produced, by disease of the lungs, for an alteration of the organ.

5. *Of the modifications of the sounds of the heart.*—Besides the increase or diminution in the loudness of the two sounds yielded by the heart, they may be changed in character and tone.

The sounds may be distinct, and not differ very materially from the normal state, although their clearness and sharpness are lost. Such a condition frequently accompanies diseases of the heart, in which the bellows

or rasping sounds are habitually heard; but when these are suspended, a roughness in the murmur usually remains. A slight harshness and intermixture of the sounds often accompanies a state of functional derangement of the heart, without the least organic lesion.

The *bellows sound* resembles very closely the noise made by forcing a current of air steadily, and rather quickly, through the pipe of a large bellows. It may be heard in the systole or the diastole of the heart, but is vastly more frequent during the former. When it is permanent, it indicates, with great certainty, an organic disease of the heart; but a temporary bellows sound is very frequent in patients who have lost much blood by hæmorrhagies, or who are affected with functional disorder of the heart, arising from various causes.

The *rasping sound* is much harsher, and more hissing than the bellows sound; it is not unlike the noise made by a rasp. It is most frequent during the systole of the heart, and certainly indicates disease of the valves.

The *musical bellows sound* has a peculiar vibration, analogous to the sound produced by passing a wet finger along the edge of a glass. It is rare, and is rather heard in the arteries than in the heart.

CHAPTER XVII.

INFLAMMATION OF THE HEART AND ITS MEMBRANES.

Pericarditis.—The following anatomical changes are produced by inflammation of the pericardium.

The serous membrane is less transparent, and assumes a general reddish tinge, or is dotted with innumerable bright red points, from the development of vessels in the cellular tissue beneath it. Its secretion soon becomes more abundant than natural, and assumes the usual characters of the liquid secreted by inflamed serous tissues. It consists of two parts: one is coagulating lymph, which is deposited upon the surface of the pericardium, in the form of irregular granulations, or in uniform layers, like the false membranes of the pleura; the other is a serous fluid, intermixed with flocculi of pus or lymph, which give it a turbid appearance. As the inflammation advances, the liquid becomes more opaque and yellowish, and increases in quantity; the false membranes are thicker, and are irregular, rugous, or divided into a multitude of cells, like a honeycomb. The honeycomb appearance is owing to the constant motion of the heart, which separates the two layers of lymph from each other, before they are organized: they are thickest about the origin of the great vessels.

As the pericardium is distended by the liquid, it forces the lung aside, and comes immediately in contact with the walls of the chest; it expands on every side, but retains its pyriform shape. The proportion of liquid and lymph depends partly upon the intensity of the inflammation, and partly on peculiarities in the constitution of the patient. When there is little or no serum, the pericarditis is dry, and is analogous to a form of pleurisy already described. In very feeble patients, the effusion consists chiefly of thin liquid, and the membrane is pale, semi-opaque and wrinkled.

Physical signs.—In the natural state, the pericardium is covered by a portion of the lung, which extends over its whole surface, except its inferior extremity, and the margin below the sternum. There is sound on percussion, but it is a little less loud where the edge of the lung is thin, than it is in other parts of the chest. The pulsations of the heart, and the normal sounds of respiration, are both heard distinctly in the præcordial region. When the pericardium is inflamed, the effusion of liquid forces the lung from the place which it occupies before the heart; consequently the sound on percussion becomes dull, because a liquid yields a flat sound, instead of the gaseous resonance of the spongy tissue of the lungs.

At first there is only a moderate increase of the normal degree of obscurity; afterwards the sound becomes flat in the situation in which it is naturally dull, and obscure in the adjoining parts. In extreme cases, the flatness extends from the base of the chest to the third rib, and from the right margin of the sternum to the border of the axilla. Its form is always pyramidal—the apex of the pyramid being towards the upper part

of the thorax. The upper part of the left side of the thorax yields a dull sound, although the effusion does not extend so far; but by pressure from below upwards, it forces the lung into a smaller space, so that it contains less air than usual. As the disease advances and the effusion increases, the extent in which the percussion is dull becomes more considerable; but when it terminates favourably, the resonance rarely becomes as perfect as it is in a healthy chest. The thickening of the pericardium, and frequently adhesions between the two surfaces of the pleura nearest the heart, give rise to contractions of the chest, which prevent the full development of the lung.

The conformation of the chest, at the præcordial region, is altered when the effusion is very considerable. At first there is so slight a prominence that it can only be detected by a careful inspection of the space included between the cartilages of the fifth and seventh ribs; but when there is as much as a pint of liquid, the prominence is very distinct, and nearly six inches in length; it extends from the right side of the sternum beyond the left nipple.

The respiration is either very feeble or totally absent in the præcordial region, because the lung is forced aside. The pulsations of the heart are also very feeble, as the layer of liquid removes it from the ribs, and interposes a soft cushion, which impedes the transmission of sound, and totally destroys the impulsion. The sounds are usually unchanged in character, but there is sometimes a distinct bellows murmur masking the first sound.

When the pericarditis is dry, there is no preternatural prominence of the chest, and little dulness on

percussion. The dulness is slight, because the lung still retains its position before the heart, although there is a larger quantity of solid matter than natural, arising from the deposit of layers of lymph. In this variety there is often heard a creaking sound, not unlike the grating noise observed towards the termination of pleurisy. It is owing to the sudden separation of the two layers of false membrane from each other, by the contraction of the heart. It may be distinguished from the sound of pleurisy by its coincidence with the contraction of the heart, and not with the act of respiration. The creaking sound is occasionally heard towards the termination of pericarditis with effusion, as well as in the dry variety.

The functional signs of pericarditis, like those of pleurisy, are sometimes so well defined, that they perfectly characterize the disease, while in other cases they may be entirely absent. In most cases there is more or less pain at the præcordial region; sometimes it is lancinating, and very sharp, and increases during the act of inspiration. The dyspnœa may be extreme, and oblige the patient to lie upon his back, with his head high, or even sit erect. Œdema of the limbs occurs in the minority of cases. The pulse sometimes yields no indication of the disease; at others it is quick and small; in rarer cases it is small, feeble, and irregular. The irregularity of the pulse is a less important symptom than it was once thought to be. Like all functional signs, it may be absent during the whole course of a fatal case, and is very often wanting in milder varieties.

Diagnosis.—In cases of pericarditis with large effusion, there is no difficulty in recognizing the affection,

for the pyriform prominence of the præcordial region, the perfect flatness on percussion, and the absence of respiration, combined with the feeble impulsion of the heart, are pathagnomonic of the affection. The shape of the prominence is different from that which is observed in hypertrophy, and the flatness of percussion distinguishes pericarditis from emphysema. The functional signs may confirm the physical proof of the disease, although these are in themselves sufficient. When an effusion of liquid has occurred into the left pleura, the physical signs are less easily perceived, because they are confounded with those of pleurisy, if there be a sufficient quantity of liquid to cause dulness of sound throughout the whole left side of the chest. In such cases a careful history of the symptoms is necessary to prevent error. But if the effusion into the pleura be moderate, it will not encroach upon the præcordial region; so that the flatness and the prominence peculiar to pericarditis, may still be distinguished from the signs of pleurisy. The difficulty of diagnosis is scarcely felt when the disease has been treated from the commencement; it is consequently less in private than in hospital practice. If pericarditis succeeds rheumatism, its occurrence is more easily discovered than in idiopathic cases.

It is now well known that pericarditis is much more frequent and far less fatal than was once believed. The mortality is probably not greater than that of pneumonia, for it is common to meet with subjects dead of various diseases, who have recovered from inflammations of the pericardium, as is shown by old and well organized adhesions. On the other hand, well characterized cases of the disease may be traced

through their whole course, and finally terminate in recovery. For a most accurate and complete history of the pericarditis, and the means of recognizing it, the medical profession is indebted to Dr. Louis.

Endocarditis.—This term has been given to the inflammation of the internal membrane of the heart. This affection has been recently studied. M. Bouillaud described, in the first edition of his work, numerous cases in which the arteries and the internal membrane of the heart were reddened. The greater part of these cases were ascribed by him to an inflammation of the internal membrane of the arterial system; but a more extended observation has shown that redness is not a sufficient proof of inflammation; it may be produced by maceration of the vessels in blood, or by incipient putrefaction. Certain conditions of the fluids also favour its production. It is now generally conceded, that the anatomical proof of inflammation of the internal membrane of the heart is redness, alteration of its colour and thickness, with deposit of albuminous matter upon its surface.

As this affection is rare, and the diagnosis is extremely obscure, I will give some of the prominent symptoms noticed in the case of a young physician, whose body I examined at Paris, in the autumn of 1833.

He was twenty-seven years of age, had enjoyed good, but not robust health. About the beginning of October he perceived an œdema of his legs, which was not attended by dyspnœa or any other symptom. A slight diarrhœa, with anorexia, afterwards came on, but the swelling diminished; he was then taken with pain in the right iliac fossa. This subsided, and no prominent

symptoms appeared until thirty hours before death, when he suddenly felt an intense pain in the region of the heart, and great dyspnœa. These symptoms increased until they caused intolerable anguish. The intelligence of the patient was not affected during the whole course of the disease.

On examination after death, we found the external surface of the heart dotted with semi-opaque whitish granulations, less than a pin's head each; a few ounces of serum were contained in the pericardium, which was a little injected. The lining membrane of the left ventricle, of the semi-lunar valves, and of the aorta, in its whole course, was reddened, semi-transparent, and covered with opaque granulations. They were generally flattened, the largest not exceeding the size of a pin's head, and adhered with some tenacity to the membrane. The same appearance was presented by the iliac and carotid arteries. The vessels of the limbs were not examined. The other viscera were inspected with care, but presented no evidence of disease.

I have lately met with a similar case, but much more chronic, in which anasarca and ascites occurred, without any appreciable lesion being found after death, except redness, thickening and patches of delicate false membrane on the semi-lunar valves, and throughout the whole length of the aorta. M. Bizot, of Geneva, informed me that he had seen several similar cases, which will be described in the work he is now preparing upon the diseases of the arteries. The symptoms of these cases were so analogous to those above described, that he suspected the nature of the lesion before death.

Diagnosis.—It is obvious that there are no constant

physical signs of this disease. There may be a bellows sound when the thickening of the valves is sufficient to impede their functions; but in the majority of cases the diagnosis must be based upon the presence of œdema, dyspnœa, and palpitations, combined with the absence of the physical signs of pericarditis, or of an appreciable organic affection of the heart.

CHAPTER XVIII.

DISEASES OF THE VALVES OF THE HEART.

The valves may be diseased from vegetations and deposits of lymph upon the membrane covering them, or their form may be altered by a secretion of new matter into their fibrous tissue. This substance is either cartilaginous or bony.

When the semi-lunar valves are affected, the lesion usually begins at their central tubercle, which increases in size until it may attain the dimension of a large pea. As the lesion extends, the flexibility of the valves is diminished, and they either become rigid and fixed in such a position as to offer a permanent impediment to the passage of the blood through them, or they are shrivelled, and do not unfold themselves sufficiently to close the orifice when the blood has passed through it. In either case the harmony of the circulation is destroyed, and important functional disturbance is almost sure to ensue. Besides the symptoms caused by changes in the valves, the muscular texture of the heart rarely remains unaltered when their function is imperfectly performed, and hypertrophy or dilatation of this organ complicates the original lesion.

The left side of the heart much more frequently offers alterations of the valves than the right; they are also vastly more frequent in the aged than in the young or middle aged. Alterations of the valves of the left side of the heart, like those of the arteries, are almost necessary consequences of the progress of age, and are physiological changes, peculiar to advanced life. Patients of strong rheumatic or gouty diathesis, are especially subject to lesions of the valves of the heart, as well as to other affections of this organ. It was once imagined that venereal affections were a frequent cause of this lesion; but observation has shown that this idea is groundless.

The practical effects of diseases of the valves depend on obstruction to the passage of the blood, caused by their rigidity and fixed position, which diminish the orifice when it should be widely open; or, the valves are shortened and hardened, so that they are no longer capable of unfolding themselves, and closing accurately enough to prevent regurgitation of the blood. The first lesion diminishes the quantity of blood which passes through an orifice in a given time, and consequently the contraction of the heart becomes more forcible, in order to disburthen the cavities by a quicker motion of the fluid. It is more important than the simple dilatation of an orifice, as the disturbance to the circulation is greater, and the general symptoms become much more embarrassing. The regurgitation of the blood causes dilatation of the cavity into which it returns, and afterwards more powerful efforts of the muscular tissue. The lesion, to a certain extent, provides its own remedy; but after longer duration, ex-

tensive organic alterations of the heart occur, and effusions of serum take place into the serous cavities and the cellular tissue of the limbs. These consequences occur at an earlier stage, when the valves are permanently contracted.

Physical signs of lesions of the valves of the heart.— The physical signs of diseases of the valves are chiefly derived from morbid changes in the two sounds of the heart. Whatever theory is received as to the mechanism and origin of these sounds, the relation between the lesions of the valves and the morbid sound is the same in each hypothesis, and may be explained almost equally well. It must be recollected that one fact is totally independent of all theory, and is based upon direct observation; that is, that the first sound is produced during the systole, and the second during the diastole of the ventricles.

The side affected is most easily known by placing the ear at a little distance from the heart, when the natural sounds are heard near the healthy side, and the morbid near the diseased part. If the ear, or the stethoscope, be applied immediately over the heart, then the morbid sound, which is commonly loud, masks that of the pulsations of the healthy side. When the right side only is diseased, the natural sound may be heard at some point of the left side of the heart, at a little distance from it. If the right side be healthy, and the valves of the left are altered, then the best place for hearing the pulsations of the right side is at the epigastrium. If the morbid sounds of the heart are heard at both the right and left portions of the chest, we may infer that both sides of the heart are diseased, although

it may be the semi-lunar valves on one side, and the auriculo-ventricular on the other.*

The signs of the diseases of the valves are the bellows sound, the sawing or rasping sound, heard either during the systole, or the diastole, the purring of which may be felt by the hand, and the state of the pulse.

Contraction of the left auriculo-ventricular orifice.— When this orifice is contracted, it gives rise to a bellows, rasping or filing sound, during the diastole of the heart. This fact might have been known from the different theories of the heart; but it is besides confirmed by direct observation in all those cases in which care was taken to note the time of the heart's motion corresponding to the sound. Dr. Hope was the first to call attention to the fact, that contraction of the auriculo-ventricular orifice causes a small and intermittent pulse, more frequently than the contraction of the aortic valves. The reason of this fact is, that little blood passes into the ventricle from the auricle, and, therefore, the arterial pulsation is small.

Contraction of the right auriculo-ventricular orifice.— Morbid sound in place of the second sound of the heart, and coinciding both with theory and direct observation. The pulse is much less affected than if the mitral valve be altered.

Contraction of the aortic orifice.—Morbid alteration of the first sound, indicated both by theory and obser-

* For this test I am indebted to M. Littré, who has published an excellent article upon affections of the valves of the heart, and their signs. (See Dictionnaire de Médecine, tome viii, 2d edition.) I have translated from the same author, the analysis which follows, of the lesions of the valves of the heart, and their signs.

vation. In this case the feebleness and intermittence of the pulse are less frequent than if the mitral valve be contracted. It is not unusual to find a moderate degree of contraction of the aortic orifice in cases where the pulse had always been natural; but the pulse invariably becomes small and feeble when the contraction is considerable. The pulse may confirm the other signs, although these are sufficient to indicate the lesion, even when the pulse remains perfectly natural.

Contraction of the orifice of the pulmonary artery.—Bellows blast in the first sound; the pulse of the pulmonary artery, of course, cannot be felt.

With the contraction of each of these four orifices, there may co-exist a purring sensation, easily felt by the hand. This is always present when a rasping sound is heard, but not always when the contraction merely gives rise to a bellows murmur.

Dilatation of the mitral valve.—Bellows sound during the systole, proved both by observation and theory. The pulse is in general feeble and irregular, although the impulse of the heart is strong; at least, this was the case in the small number of cases observed by M. Littré.

Dilatation of the tricuspid valve.—Bellows murmur in place of the first sound of the heart.

Dilatation of the aortic valves.—This lesion and its symptoms have been well described by M. Corrigan, and afterwards by M. A. Guyot, in an inaugural thesis. It is characterized by three principal phenomena: 1. Absence of the second sound of the heart, which is replaced by a bellows blast, very audible at the heart

itself, in the ascending aorta, and in the sub-clavian and carotid arteries. 2. Visible pulsation in the arteries of the neck, of the head, and superior extremities. 3. By increased force, frequency, and vibration of the pulse. The force of the pulse and the visible pulsations of the arteries, are owing to the hypertrophy of the left ventricle, which accompanies the dilatation of the valves.

Dilatation of the pulmonary valves.—Bellows sound in place of the second sound of the heart. It originates in the heart, and is thence heard in the whole præcordial region, especially between the second and third left ribs.

It is evident from the preceding remarks, that if the morbid alteration has occurred in the first sound of the heart, there is a contraction of an arterial orifice, or dilatation of an auriculo-ventricular one. If the second sound be altered, there is a contraction of the auriculo-ventricular orifice, or a dilatation of the arterial valves. The last case is easily known by the bellows sound prolonged into the arteries during the diastole of the heart.

Diagnosis.—The diagnosis of diseases of the valves of the heart is plain enough, if attention be paid to the preceding analysis of their signs. But in practice, a difficulty very often occurs from a complication of several lesions of the heart, including more than one of its valves. We must then analyse the sound, and recollect that lesions of the valves of the left side are more frequent than those of the right. Hypertrophy and dilatation have their peculiar signs.

The general signs of diseases of the valves will also

facilitate their diagnosis. These are, œdema of the inferior extremities, and, to a less extent, of the cellular tissue of the rest of the body, puffiness of the face, dyspnœa, and, in more advanced stages, paleness and sallowness of the skin, arising from a diminution of the colouring matter in the blood.

CHAPTER XVIII.

HYPERTROPHY AND DILATATION OF THE HEART.

HYPERTROPHY is an increase of the muscular fibre of the heart: it is divided into three varieties, one of which is very frequent; the other two are extremely rare. It is more frequent on the left than on the right side of the heart, and is almost confined to the ventricles. The increase may be strictly limited to the fibres composing the middle and exterior parts of this organ, and its cavity may be unaltered; this is the case in simple hypertrophy. The enlargement may take place in the fibres composing the whole thickness of the heart, which thus increases upon its internal and external surface, and at the same time its cavity augments in size; this variety is called hypertrophy, with dilatation or active aneurism. It commonly attends diseases of the valves of the heart, especially those lesions of the semi-lunar valves of the aorta, which allow the blood to regurgitate into the cavity. The third form is that in which the muscular fibre is thickened upon the inner side of the heart, so as to diminish its cavity; this is also a rare lesion.

Physical signs.—There is one sign common to all the forms of hypertrophy of the heart; that is, an increase in the impulsion of the heart against the walls

of the thorax. If the increase in size be moderate, the impulsion is augmented at the point of the heart only; but if it be considerable, and extend to a large part of this organ, its whole mass seems to be lifted against the ribs, and raises the end of the stethoscope by a sort of undulating motion. The impulsion is not quick and abrupt, but gradual, and communicates to the ear the sensation of a large body slowly rising against the chest, rather than that of a short, quick stroke from a smaller one. In the most common variety, that is, hypertrophy with dilatation, the impulse is augmented in extent much more than in force. The strength of the impulsion against a single point of the thorax, is sometimes not greater than it is in a healthy heart; it may even be more feeble when the circulation is impeded in the few days that precede death. This temporary feebleness renders the diagnosis of such affections difficult, if the patient has not been examined at an earlier period.

The sound of the heart is diminished if the hypertrophy is simple, or if the cavity is not dilated. The increased thickness renders the sound less clear and sharp. Sometimes the sounds are nearly lost, or converted into an obscure purring; but this is rarely observed, unless the valves are at the same time materially diseased. The diminution of loudness is still more evident in the second than in the first sound.

In hypertrophy combined with dilatation, the sound is louder, at the same time that the impulse of the heart is increased. As valvular disease almost always complicates this variety, and is its most frequent exciting cause, we generally hear either the bellows or the rasping sound.

The percussion is always obscure over the heart if there be much hypertrophy; it is, however, less dull than where there is a large effusion into the pericardium. The obscurity extends in a lateral direction, and in the form of an oval, whose long diameter is nearly parallel to the cartilages of the ribs; it never assumes the pyramidal form peculiar to cases of pericarditis.

The functional signs of hypertrophy are limited to a preternatural force in the pulsations of the heart and arteries, in case there is no disease of the valves. A moderate degree of hypertrophy does not materially interfere with the functions of the different organs, although it is said to favour the development of cerebral diseases. But, as in a large majority of cases, the valves are more or less altered, a variety of symptoms occur to complicate those of simple enlargement. The alterations of the pulse, the œdema of the limbs, and the difficult respiration, all belong rather to the former than to the latter affection.

DILATATION OF THE HEART.

Writers on the diseases of the heart formerly considered dilatation, with thinning of the muscular parietes, as a frequent lesion. Were this the case, it would form an exception to the very general law, that dilated organs increase in thickness; but a more extended observation has shown that this exception did not exist. It is even doubtful whether the heart is ever dilated and thinned at the same time; it is certain that the lesion is at least extremely rare.

Dilatation and thickening of the heart constitute one of the varieties of hypertrophy already described,

and is, by far, the most frequent lesion of the muscular tissue. When the dilatation is great, and the thickening moderate, the disease usually arises from an obstruction to the passage of the blood through the valves; when the hypertrophy predominates, the primitive lesion is commonly dilatation of the valves.

Other organic lesions of the heart, as rupture of its parietes, ulcerations, true aneurism, and the fatty degeneration of the muscular tissue, are rather interesting as anatomical lesions, than as objects of clinical study. They occur so rarely, and are accompanied by symptoms which are so imperfectly known, that it is not necessary to describe them in this work. For a detailed description of them, the reader is referred to the systematic treatises on diseases of the heart.

Although the organic diseases of the heart are extremely frequent, they are less common than its functional derangement. The signs of functional disease are an uneasy sensation in the region of the heart, sometimes amounting to positive pain; palpitations, which are usually diminished by exercise; a quick, jerking impulsion, and increased loudness of sound, with frequency of the pulse. Patients who complain of these symptoms, are usually young persons of irritable nervous temperament, and are often subject to dyspepsia, chlorosis, or hysteria. At first sight, it might seem difficult to draw the distinction between the functional and the organic affections of the heart; but the former differ from the latter in many respects. Their symptoms are not permanent; they diminish by exercise, and are increased by the passions, or by mental agitation; there is no alteration of the sound on percussion, and the impulsion, though quick and

sharp, does not communicate to the ear the sensation of a large body, which seems to raise it up from the chest. A bellows sound may occasionally be heard when there is no organic lesion, but it is not permanent.

Aneurism of the thoracic aorta may be recognized, by physical exploration, at a comparatively early stage, but not until the artery is about twice its natural size. We then find a dull sound on percussion, at the upper part of the sternum, loud pulsation at the same situation, and a single sound, instead of the double beating of the heart. A bellows sound often accompanies this pulsation; it does not always originate in the artery, but may be conducted by it from the heart. Diseases of the heart may often be confounded with aneurism of the aorta, unless great attention be paid to the extent of the impulsion and the signs offered by percussion. Aneurism of the pulmonary artery cannot be distinguished by any certain signs, but its existence may be suspected by a careful examination of the positive and negative signs of cardiac diseases.

CHAPTER XIX.

OF THE METHOD OF ACQUIRING A KNOWLEDGE OF THE PHYSICAL SIGNS.

The sounds derived from auscultation and percussion, may be easily acquired by examining the most clearly marked specimens of each class, and then proceeding to the study of such signs as are less obvious. Such a method of study is especially necessary for those physicians who are well acquainted with the rational symptoms of disease, but have not easy access to large hospitals, in which the types of each sound may be pointed out by experienced auscultators. By selecting well-marked cases, and comparing the group of functional and physical signs presented by the patient, no doubt can be left upon the mind of the physician, as to the precise identity of the case before him. After establishing the nature of the disease, and recognizing the physical sign, it should be studied long and attentively enough, to leave in the mind of the physician a clear and permanent remembrance of it. The following classification of the sound includes each series, beginning with the most evident, and then passing to those which are more obscure.

1. Alterations of the Respiration.
   a. Strong bronchial or tubal respiration.—Cavernous respiration.
   b. Less perfect bronchial respiration.
   c. Rude respiration.
   d. Amphoric respiration.

2. Of the Moist Rhonchi.
   a. Mucous rhonchus.—Gurgling.
   b. Sub-crepitant rhonchus.
   c. Crepitant rhonchus.

3. Dry Rhonchi.
   a. Sonorous.
   b. Sibilant rhonchus.

4. Of the Voice.
   a. Bronchophony.
   b. Pectoriloquy.
   c. Increase of natural resonance.
   d. Egophony.

The alterations of the sonorousness on percussion are:

   a. Perfect flatness.
   b. Dulness of sound.
   c. Natural resonance.
   d. Increased sonorousness.
   e. Tympanitic resonance.

OF THE VARIETIES OF THE RESPIRATION.

To acquire the tubal respiration, a patient with pneumonia of some severity should be selected. About the sixth or eighth day of the disease, sometimes even at an earlier period, a pneumonic patient will present the following symptoms—cough, viscid and rust-coloured sputa, pain in the side, fever, great prostration. These symptoms occurring in a patient previously in good health, must indicate inflammation of the lungs, for they occur in no other disease. If the ear be then applied to the posterior part of the chest, between the scapulæ and the spine, strong bronchial respiration will be heard, in at least nineteen of twenty cases; the blowing sound will be very distinct in the expiration and the inspiration, but especially the former. A very moderate degree of attention will be sufficient to recognize this sign, and cases of pneumonia are so frequent, that all practitioners may readily meet with several in every winter and spring.

Cavernous respiration is not always constant, nor quite so strongly characterized as the tubal respiration of pneumonia, because the opening into a tuberculous cavity is not often as unobstructed as the large bronchia, at the root of the lungs. But if a patient be examined in an advanced stage of consumption, who has copious night sweats, loose cough of long duration, expectoration of puriform rounded or irregular masses, great emaciation, and other well known rational signs of pulmonary consumption, cavernous respiration is almost certainly heard at the upper part of one or both lungs. The respiration should be examined more than once, for the opening into the

cavity may be obstructed, or a loud gurgling may mask the cavernous respiration; but if the sign be sought on several patients at different times, especially after free expectoration, it cannot fail to be observed, and may then be compared with tubal respiration, which it closely resembles.

From these two varieties it is comparatively easy to pass to the examination of the less perfect bronchial respiration of pleurisy, and the early stages of pneumonia. The characters are the same, except that the degree of intensity and distinctness of the blowing sound is much less than in the tubal or in the cavernous respiration; it is also most easily recognized during the expiration. No difficulty exists in finding examples of the bronchial respiration of pleurisy, because the dilatation of the chest, and the absolute flatness on percussion, are characters so striking that the case is instantly known, and the signs of the respiration can then be studied at leisure. The chest should be examined at the seat of the large bronchia, opposite the root of the lungs, where there is the least compression of the pulmonary tissue.

The rude or imperfect bronchial respiration may be learned after the other varieties are known, by auscultating the upper and anterior part of the lung of patients who have a moderate pleuritic effusion on the same side. The compression of the pulmonary tissue in the upper part is slight, and the vesicular murmur is still heard, combined with a decided blowing sound, both in the inspiration and expiration. This variety is also heard in deep-seated inflammations of the lung, and in the early stage of phthisis. In the latter case,

a careful comparison of the sound heard at the summit of one or both lungs, with the characters of bronchial respiration on the one side, and the vesicular murmur on the other, will explain the sound. The rational signs of phthisis are here of particular necessity.

As the respiration at the upper part of the right lung of healthy individuals is always a little rude, it is important, while studying this variety of the respiration, to auscult individuals in good health, at that portion of the chest, and thus obtain a type of comparison between it and that more distinct variety produced by tuberculous masses at the summit of the lungs.

OF THE RHONCHI.

1. *Moist rhonchi.* (*a*) *Mucous rhonchus.*—It is easy to distinguish the mucous rhonchus by the strong bubbling or gurgling sound, caused by the passage of the air through a liquid. It is less easily found in bronchitis than in other affections, because the disease is usually of short duration, does not always present the mucous rhonchus, and rarely retains it during a long period. It is easy to observe the mucous râle in phthisis, when much advanced. The cavernous gurgling, which is only an exaggeration of the mucous rhonchus, may almost always be heard in such cases, and is easily known from the peculiar sound of a liquid agitated by the passage of air. Around and about this gurgling, there is generally a moist rhonchus, similar in sound, but a little less strong and less diffused, which is the ordinary mucous rhonchus. Another useful means of learning the mucous râle, is to examine patients affected with pneumonia, when the bronchial respiration has ceased, and the viscid or rusty

sputa are replaced by a puriform liquid; the mucous rhonchus is, in such cases, heard where the bronchial respiration had before been most distinct.

The crepitating rhonchus should be learned before a distinct idea can be formed of the sub-crepitating, which is intermediate between the crepitus and the mucous râles. A patient ill with pneumonia, presenting the bronchial respiration and symptoms described, page 176, should be directed to cough. During the inspiration following the effort of coughing, the ear should be passed, with attention, over the part of the chest where the bronchial respiration is found, and then around and above this place. The crepitant rhonchus, with its peculiar dry sound, will be heard in little trains, like the crackling produced by the firing of moist powder. The crepitus is generally distinct before the development of the strong bronchial respiration, but the type is less easily learned if other signs be not well developed. The sub-crepitating rhonchus may be studied in the same case of pneumonia which furnished the specimens of bronchial respiration and crepitus: it is heard when convalescence approaches, after the disappearance of the other sounds. In such cases, the expectoration is less viscid; it is mucous, or mucopuriform, but not purulent, as it is in such cases as terminate in suppuration.

2. *Dry rhonchi.*—These râles which are easily known from the precise and simple description of which they are susceptible, are heard very constantly in whooping-cough. When the paroxysms are frequent, children almost always offer both the sibilant and sonorous rhonchi, frequently combined with the mucous. All

these sounds are distinct, and can be heard at the same time, as well as the notes of a violin and flute played in concert.

OF THE VOICE.

I have placed in the same line strong bronchophony and pectoriloquy. These two sounds are so analogous, that either of them will serve for facilitating the knowledge of the other. The distinction between them consists in the exact limitation of perfect pectoriloquy, and the greater diffusion of the resonance of bronchophony. The intensity of the sound of tubal bronchophony is at least as great as pectoriloquy, and, in a large majority of cases, is decidedly greater. The distinction between the two sounds was not very clearly known to Laennec, who seems to have, in numerous cases, taken bronchophony for pectoriloquy.* Bronchophony is more easily learned than pectoriloquy, on account of their anatomical differences. The large bronchial tubes at the root of the lungs must always yield a strong resonance of the voice, if the pulmonary tissue around them be hardened. If the induration is perfect, the bronchophony is tubal; and, like perfect pectoriloquy, it seems to enter the ear of the observer. Pectoriloquy, on the other hand, requires a complete evacuation of the cavity, free communication with the bronchia, and moderate distance from the surface. The method of acquiring these two sounds is similar to that for the bronchial and cavernous respiration, as they originate in similar circumstances, and from the same anatomical

* This might be inferred from the work of Laennec; it is confirmed by the recollection of those who were familiar with the inventor of auscultation.

lesions. One variety of pectoriloquy is easily mistaken by a beginner; it is that produced by a very large cavern, in which the voice is lost, instead of being distinctly formed. In this case, an attentive examination of all the circumstances is requisite to prevent error.

Simple increase of the natural resonance of the voice, or imperfect bronchophony, may be recognized by familiarizing the ear with the resonance of a healthy chest, after studying tubal respiration. Patients offering the rational signs of consumption, not very far advanced, will present examples of this variety; the sound is especially marked at the upper and posterior part of the chest.

Egophony is less easily recognized than the other alterations of the voice; it should be studied after the alterations of the voice, just alluded to, are perfectly known. Then the thorax should be ausculted in individuals who present the following symptoms—flatness on percussion, diminishing from below upwards, moderate fever, cough, white, but not viscid expectoration, and pain in the side. Upon making them speak, egophony may be heard below the scapula; by strict attention, the vibrating, squeaking sound of the voice will be distinguished from the loud resonance of bronchophony. A variety of vibrating bronchophony, caused by the induration of the lung, complicated with effusion of liquid into the pleura, partakes of the characters of both these alterations of the voice.

Of percussion.—There is much difficulty in acquiring the manual dexterity necessary to percuss accurately. Whatever pleximeter may be used, the great secret of percussion is to tap with the ends, not the bulbs of the fingers, as quickly as possible, but not

forcibly. Forcible percussion annoys the patient, but does not render the sound clearer. The best example of entire absence of sound is chronic pleurisy, with large effusion; next to this is pneumonia, if it extend to a large portion of the lung. As pleurisy, with much effusion, is more rare than pneumonia, it may be necessary to select the latter disease, and at the same time that the strong bronchial respiration and bronchophony are developed, the percussion is perfectly flat.

There is no difficulty in finding a multitude of examples of dulness of sound: both pleurisy, pneumonia, and the different stages of phthisis afford good specimens. The same cases which offered the perfectly flat sound, will yield a dull one when the disease abates, and the gradual passage from the one to the other is then easily traced.

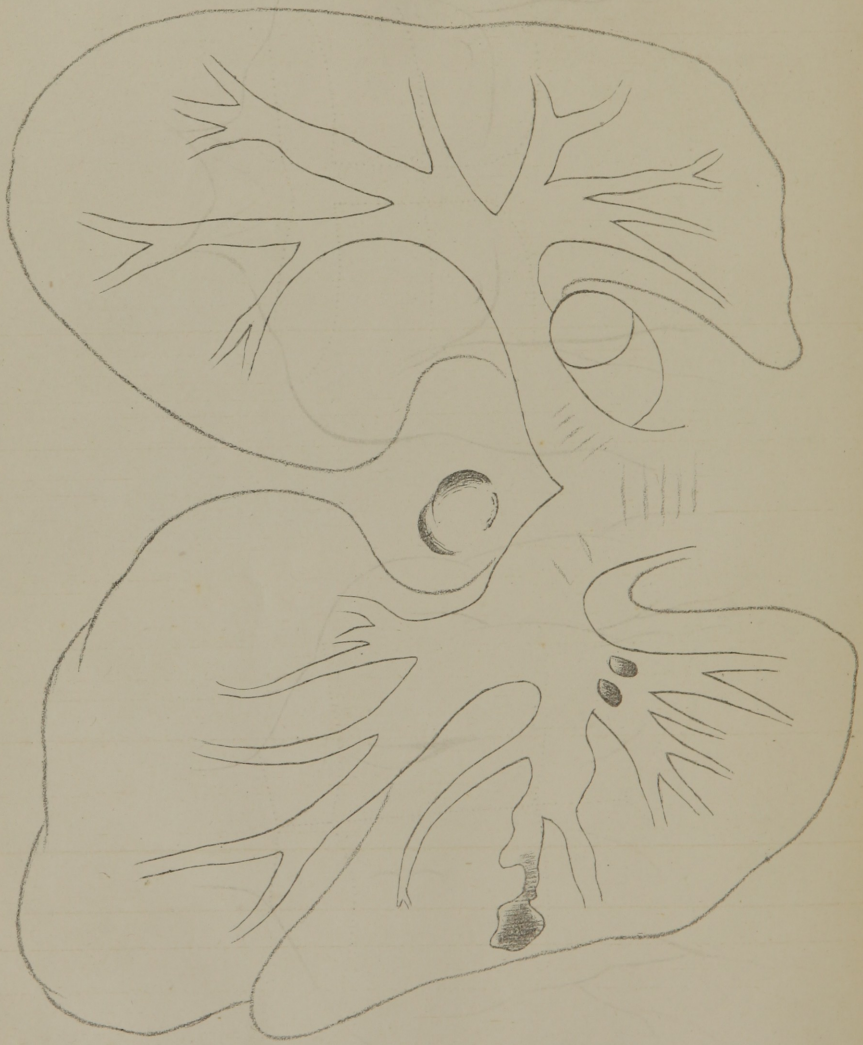
The natural sonorousness of the chest is, of course, found in all healthy subjects, but it is difficult to form a just idea of what it ought to be, unless patients with increased resonance of the thorax are occasionally observed.

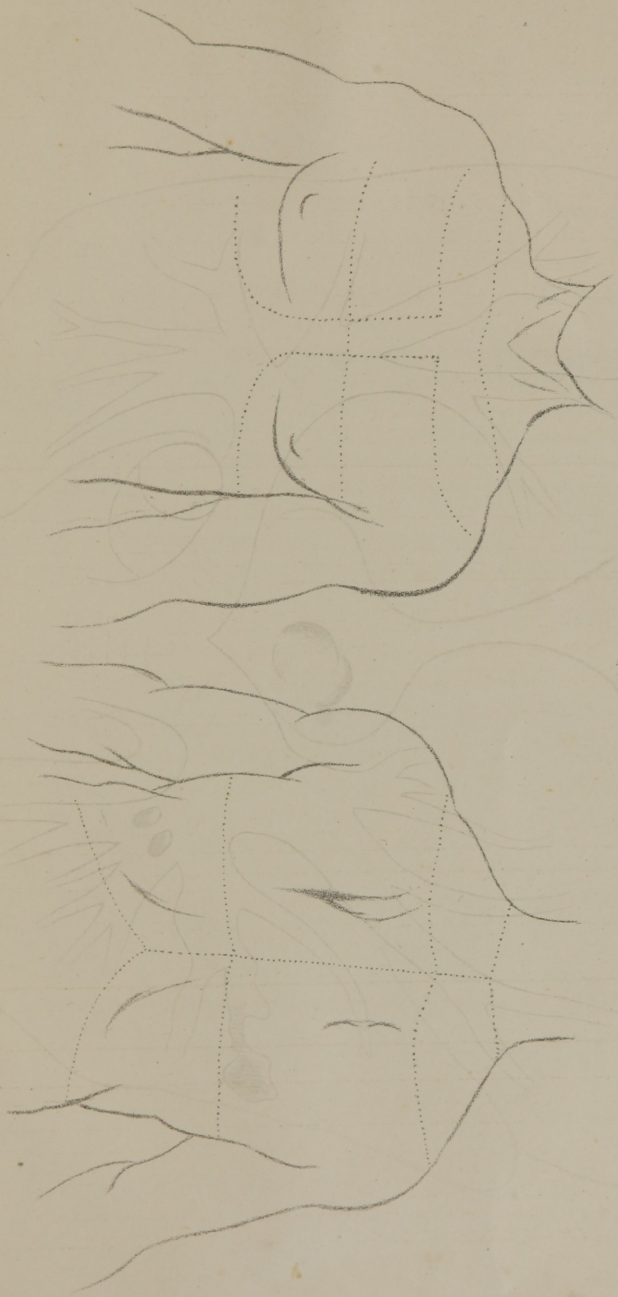
The best example of preternatural sonorousness of the chest, is to be sought in emphysema of the lungs. The functional signs united to the conformation of the chest are sufficient to characterize the advanced cases of the disease, in which the resonance is, of course, greatest. A patient past the middle period of life, who is subject to attacks of great dyspnœa, followed by the expectoration of watery frothy saliva, and who is habitually short breathed, with an unusual development and roundness of his chest, is surely emphysematous. Such a patient will offer a great increase of the natural resonance of the thorax, particularly at the prominent

portions. All persons emaciated by chronic dysentery, or diseases of other organs than the thoracic viscera, yield a loud sound on percussion, but never so loud as in emphysema.

The tympanitic resonance of pneumo-thorax is peculiar, and can only be confounded with that from enormous cavities. It is too rare for purposes of study, but when it occurs, a physician tolerably practised in auscultation, will have no difficulty in its diagnosis.

The signs indicating the various diseases of the heart, are usually well marked, but their relative value and precise connexion with the lesions, are not yet sufficiently ascertained for systematic analysis.





EXPLANATION OF THE PLATES.

PLATE I—indicates the division of the thorax into regions. These are three in number, on each side of the chest, but are unequal in extent. The upper regions are the common seat of the tuberculous deposit, and in that case they yield a duller sound on percussion than usual. In health, the sound is clear at the anterior part of the chest, but less sonorous posteriorly, on account of the large muscles of the scapula. The middle and inferior regions of the anterior surface, are the common seat of emphysema, when they yield a clearer sound than usual. The middle posterior portions yield an obscure sound when the lung is hepatized from pneumonia, or there is a very extensive tuberculous deposit. The inferior regions, including the lower part of the axillæ, are very sonorous naturally, but become dull when an effusion of serum or pus has been deposited in the cavity of the pleuræ.

PLATE II—represents a dissection of the larger bronchial tubes. They are opened at their posterior portion. It will be seen that the bronchi, which pass to the upper lobe of the right lung, are much shorter and larger than those of the left, which follow a circuitous course, beneath the arch of the aorta, as seen in the plate. Near the extremity of one of the bronchial tubes, on the right side, are two small dilatations, in one of which there were some fragments of tuberculous matter. These dilatations were evidently cicatrized cavities. In other respects, both lungs were perfectly sound, and the dissection of the bronchi, given in the plate, was afterwards repeated in a number of healthy lungs.

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