

A

PRACTICAL TREATISE

ON THE

DISEASES OF THE LUNGS.

Wm. Osler

BY THE SAME AUTHOR.

—•—
PREPARING.

A PRACTICAL TREATISE
ON
DISEASES OF THE HEART AND AORTA,
INCLUDING
THE PRINCIPLES OF PHYSICAL DIAGNOSIS.

*A new American from the third revised and much enlarged English Edition.
In One Octavo Volume.*



J. W. Welch

A

PRACTICAL TREATISE

ON THE

DISEASES OF THE LUNGS:

INCLUDING

THE PRINCIPLES OF PHYSICAL DIAGNOSIS.

BY

WALTER HAYLE WALSHE, M.D.,

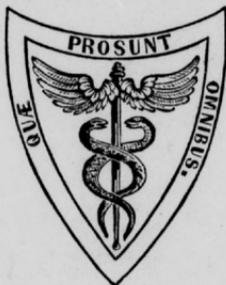
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CONSULTING PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION.

“Rerum ipsarum cognitio vera e rebus ipsis . . .”—JUL. SCALIGER.

A NEW AMERICAN

FROM THE

THIRD REVISED AND MUCH ENLARGED ENGLISH EDITION.



PHILADELPHIA:
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1860.

Handwritten scribble

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Respiratory

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1860

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TO

NEIL ARNOTT, M. D., F. R. S.,

PRE-EMINENT AMONG THOSE WHO HAVE SUCCESSFULLY APPLIED

THE PRINCIPLES OF PHYSICS

TO THE IMPROVEMENT OF HUMAN HEALTH AND THE

ALLEVIATION OF HUMAN SUFFERING,

This Volume

IS

ADMIRINGLY AND GRATEFULLY INSCRIBED.



ADVERTISEMENT TO THE THIRD EDITION.

THE present edition has been carefully revised and much enlarged, and may be said, in the main, to be re-written.

The theory of various acoustic phenomena has been examined afresh; and an attempt made to establish the practice of Percussion on a new and, as it is hoped, truer and more clinically-useful system than that hitherto adopted.

Descriptions of several diseases, previously omitted, are now introduced; the causes and mode of production of the more important affections, so far as they possess directly practical significance, are succinctly inquired into; an effort has been made to bring the description of anatomical characters to the level of the wants of the student as well as of the practical physician; and the diagnosis and prognosis of each complaint are more completely considered. The sections on treatment, and the Appendix (concerning the influence of climate on pulmonary disorders), have, especially, been largely extended.

Much as the Author would have desired to have printed the details of cases in support of the statements and opinions tendered, this has been found impracticable, without

inconveniently increasing the bulk, and altering the character of the volume. His regrets on this score are, however, lessened by his being enabled to refer to the original narratives in his case-books at University College Hospital—records which possess at least the signal advantage of having been set down at the bed-side at the moment of observation.

For the Index, the Author is indebted to the kindness of Mr. Samuel Bruce.

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ERRATA.

Page 45, line 17, *for joints read points.*

70, lines 8 and 9, *transpose latter and former.*



PART I.

PHYSICAL EXAMINATION OF THE LUNGS AND APPENDAGES.

. . . . "Who knows but that one may discover the works performed in the several offices and shops of a man's body, by the sounds they make, and thereby discover what instrument or engine is out of order.—R. HOOK, 1705.

INTRODUCTION—CLINICAL TOPOGRAPHY OF THE CHEST.

1. THE existence of disease involves that of anatomical change, not only in the part originally and chiefly affected, but also in the structures immediately adjoining. There are a few apparently pure dynamic diseases, forming doubtful exceptions to this proposition; but, admitting their reality, they are not of sufficiently great importance to affect the general truth.

2. The anatomical changes thus arising may or may not be capable of accurate discrimination during life. When they can be so discriminated, experience has shown that their detection is not so much accomplished by means of the vital functional derangements of the organs implicated, as by the aid of various alterations in the physical properties of those organs—as, for example, their density, their faculty of generating and of conducting sound, &c. So invariably do these alterations bear a certain and fixed relation to the physical nature of the anatomical conditions with which they are associated, that the discovery of the former is conclusive as to the existence of the latter. And not only the physical nature, but the precise limits and precise degree, of these conditions are disclosed by the alterations referred to, which, for these reasons, constitute their *Physical Signs*. Interpreted by the observer, and not by the patient, incapable, except in the rarest instances, of being feigned, dissembled, or even modified at will—estimable in degree and extent with almost mathematical precision—susceptible of indefinite refinement, physical signs like the whole class of objective phenomena of disease, are of immeasurably greater diagnostic, and considerably greater general clinical value than its subjective symptoms. Physical signs are, in fact, such accurate exponents of the physical nature, extent and degree of textural changes, that, although they convey no direct information as to the pathological nature of those changes, they may

fairly be regarded as instruments of pursuing morbid anatomy on the living body. But just as their significance is sure and precise, so is the difficulty of establishing their theory and mastering their practice positive and great; and hence it is that Physical Diagnosis has gradually acquired for itself the importance of a special art.

3. The means by which physical signs are discovered or elicited, are called *Physical Methods of Diagnosis*; and these methods vary with the textural properties, functional attributes, and peculiarities of site of the organs examined. The diseases of the organs of respiration are among those of which the physical *signs* are the most varied, most significant, best understood, and most readily ascertained. The *methods* employed for their detection are:—

I. INSPECTION; II. APPLICATION OF THE HAND; III. MENSURATION; IV. PERCUSSION; V. AUSCULTATION; VI. SUCCUSSION.

These methods are, as nearly as is possible, applied to the parts themselves of which we desire to ascertain the condition—to the external surface corresponding to them, when inapplicable to themselves. But the absence or presence of disease in the different thoracic organs, and, if it exist, its nature, may sometimes be indirectly inferred by employing these methods in—

VII. THE DETERMINATION OF THE SITUATION OF CONTIGUOUS PARTS AND ORGANS, which may consequently be considered an additional method of physical diagnosis.

4. All these methods agree in the general character of their direct and indirect objects. The *direct object* the physician has in view with all, is the just appreciation of the sensations they furnish, and these are nothing more than the physical signs already spoken of; the *indirect object*, the reference of these signs to the physical states upon which they depend.

But a deeper object, to which these are merely preparatory, remains behind—the determination of the pathological nature of those physical states. For this, familiarity with the laws of localization, alliance, progress, and reciprocal influences of thoracic diseases is indispensable. Physical signs, it cannot be too emphatically stated, reveal physical conditions alone; they give no direct insight into pathological nature.

5. With the view of localizing physical signs as precisely as possible, the surface of the chest has been divided into artificial regions; but as the assignment of limits to these regions is altogether arbitrary, it is not to be wondered that the boundaries adopted by different writers vary. Simplicity, as far as is compatible with the main object, should be especially aimed at in all such topographical arrangements; yet it scarcely appears possible, without a sacrifice of utility, to make the number of divisions less than in the following plan. They are designed to correspond, as far as is attainable, with important internal regions or outlines.

6. The chest is divided into anterior, lateral, and posterior regions. The *anterior* are called: supra-clavicular, clavicular, infra-clavicular,

mammary, infra-mammary, supra-sternal, upper sternal, and lower sternal. The *lateral* regions are: the axillary, and infra-axillary. The *posterior* group comprises: the upper scapular, the lower scapular, the infra-scapular, and the inter-scapular. Of these regions the supra, upper and lower sternal are single; all the rest are double.

7. The boundaries of these regions, and the more important structures and portions of organs corresponding to them, either within the chest or on its confines, may be stated as follows:—

8. *Supra-Clavicular*.—Above, a line drawn from the outer part of the clavicle to the upper rings of the trachea; below, the clavicle; inside, the edge of the trachea. Here is found the triangular apex

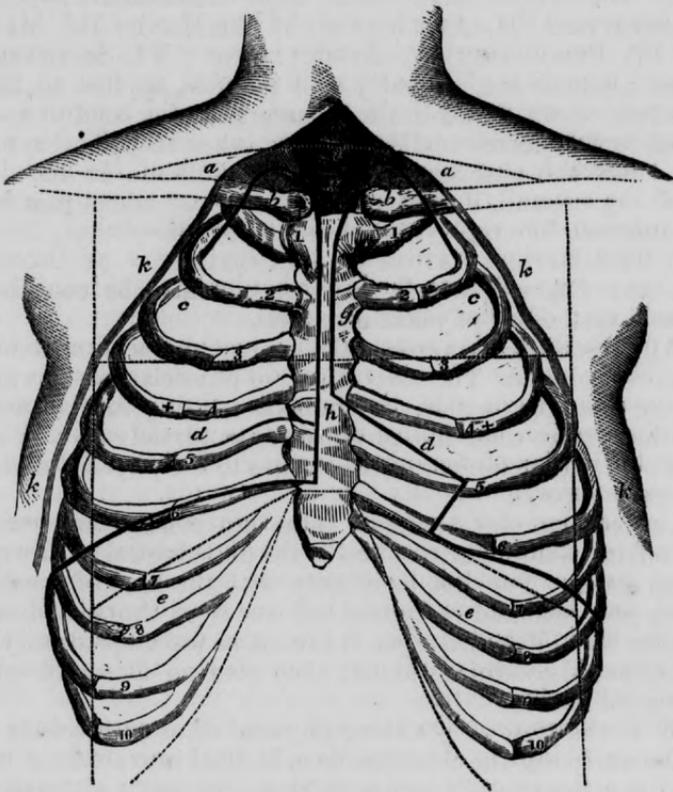


Diagram exhibiting the anterior regions of the chest, with their relationship to the ribs, and also the position of the edges of the lungs in calm (phrenic) inspiration. 1 to 10 inclusive, ribs; *a*, supra-clavicular region; *b*, clavicular region; *c*, infra-clavicular; *d*, mammary; *e*, infra-mammary; *f*, supra-sternal; *g*, upper sternal; *h*, lower sternal; *i*, trachea; *k*, integuments. The dotted lines indicate the boundaries of the various regions; the thick lines correspond to the outlines of the lungs, which rise to a maximum height of one inch and a quarter above the clavicle; + +, the nipples. Taken from an adult male, the trachea being tied after moderate insufflation of the lungs.

of the lung, sometimes reaching on the right side slightly higher than on the left (more rarely *vice versa*), with portions of the subcla-

vian and carotid arteries, and of the subclavian and jugular veins. The first rib contributes to form a sort of floor for the region.

9. *Clavicular*.—This region comprises the portion of the clavicle, behind which lung lies, or, as nearly as possible, the inner half of the bone. Beneath the bone lies on both sides lung-substance; on the right side, at the sternal articulation, the arteria innominata just reaches the inner confines of the region, while the subclavian artery crosses it at its outer edge; on the left side the carotid and subclavian arteries lie deeply, almost at right angles with the bone.

10. *Infra-Clavicular*.—Above, the clavicle; below, the lower border of the third rib; outside, a line falling vertically from the acromial angle;¹ inside, the edge of the sternum. Within these limits are placed the upper lobe of the lung, on both sides; on the right side, close to the sternal border of the region, lie the superior cava, and a portion of the arch of the aorta; on the left, the edge of the pulmonary artery. On the left side, the inferior border of this region corresponds to the base of the heart. The bifurcation of the trachea taking place behind the arch of the aorta, on the level of the second rib, the main bronchus on either side is found in this region—the right behind, the left a little below, the second costal cartilage.

11. *Mammary*.—Above, the lower border of the third rib; below, the sixth rib; outside, a vertical line continuous with the outer border of the infra-clavicular region; inside, the edge of the sternum. The contents of this region differ materially on the two sides. On the right side, the lung lies throughout immediately under the surface, extending downwards to the sixth rib, where the inferior border of the organ, turning off almost at right angles from the anterior, and gently sloping outwards, nearly corresponds to the lower edge of the region. The right wing of the diaphragm and the liver commonly rise to the fourth interspace. The fissure between the upper and middle lobes of the right lung passes obliquely upwards and backwards from about the fourth cartilage; that between the middle and lower, in the same direction from the fifth interspace. A portion of the right auricle and the upper and right angle of the right ventricle lie between the third and fifth ribs, close to the sternum. On the left side, the anterior edge of the lung passes obliquely downwards and outwards from about the level of the fourth cartilage, leaving a free space of variable size for the heart, and thus reaches the fifth rib; it then curves inwards and downwards to opposite the sixth rib or interspace, within the vertical line of the nipple—whence it passes, at first, nearly horizontally, outwards. The anterior point of division of the lobes of this lung lies about the fifth interspace, below the nipple. The left

¹ The "acromial angle" means the angle formed by the clavicle and the head of the humerus; the "sterno-clavicular angle," that resulting from the inclination of the clavicle and the sternum.

auricle and left ventricle, with a small portion of the right ventricle about the apex, lie within this region.

12. *Infra-Mammary*.—Above, a line slanting outwards from the sixth cartilage; below, a curved line corresponding to the edges of the false ribs; outside, the outer edge of the mammary region prolonged; inside, the sternum at its inferior angle. On the right side the liver, with the lung encroaching to a variable extent at its upper part during full inspiration, occupies this region. On the left side lie the stomach and anterior edge of the spleen, which rises as high as the sixth rib; in the inner part of the region there is generally a portion of the left lobe of the liver, lying in front of the stomach.

13. *Supra- or post-Sternal*.—A small region more or less hollow, bounded below by the notch of the sternum, and laterally by the sterno-mastoid muscles. The trachea fills it almost completely; it contains no lung; the innominate artery lies at its lower right angle; and in some persons the arch of the aorta reaches its lower border.

14. *Upper-Sternal*.—Corresponds to that portion of the sternum lying above the lower border of the third rib. Here are found the left, and a small portion of the right, innominate vein; the ascending and transverse portions of the aorta; the pulmonary artery, from its origin to its bifurcation; the aortic valves, near the lower border of the third left cartilage—the pulmonary a little higher than these, and quite at the left edge of the sternum; and the trachea, with its bifurcation on the level of the second ribs. The inner edges of the lungs, passing slantingly downwards, almost join on the middle line opposite the same ribs, when the organs are fully expanded—and lying immediately under the sternum, continue thus united as far as, and beyond, the lower edge of the region.

15. *Lower-Sternal*.—Corresponding to the remainder of the sternum, this region contains the main part of the right ventricle and a small part of the left; the line of union of the heart and liver, with the diaphragm intervening; the edge of the right lung descending vertically along the middle line, and, at its upper part, a small portion of the left lung; and inferiorly, and deeply-seated, a portion of the liver, and sometimes of the stomach. The tricuspid and mitral valves, the latter somewhat posterior to the former, lie at mid sternum opposite, or a little below the upper edge of the region.

16. *Axillary*.—Extending from the point of the axilla above to a line continuous with the lower border of the mammary region below, and in front from the posterior border of the infra-clavicular and mammary regions to the external edge of the scapula behind, this region corresponds to the upper lobes of the lungs, with, deeply-seated, the main bronchi.

17. *Infra-Axillary*.—Bounded above by the axillary region, an-

teriorly by the infra-mammary, posteriorly by the infra-scapular, and below by the edges of the false ribs, this region contains on both sides the lower edge of the lung sloping downwards from before to behind, with, on the right side, the liver, and, on the left, the spleen and stomach.

18. *Upper Scapular and Lower Scapular*.—Have the same boundaries as the fossæ of the scapula, and correspond to lung-substance.

19. *Infra-Scapular*.—Above, the inferior angle of the scapula and the seventh dorsal vertebra; below, the twelfth rib; outside, the posterior edge of the infra-axillary region; inside, the spine. Immediately underneath the surface, as far as the eleventh rib, lie the lungs; on the right side, the liver from the level of the rib just named to the lower edge of the region; on the left, the intestines, occupying some of the inner part of the region, and the spleen of the outer. Close to the spine, on each side, but somewhat more on the left than the right; a small portion of the kidney encroaches on this region, and along its inner edge, on the former side, runs the descending aorta.

20. *Inter-Scapular*.—Occupying the space lying between the inner edge of the scapula and the spines of the dorsal vertebræ from the second to the sixth; this region contains on both sides lung-substance, the main bronchi, and the bronchial glands. It also incloses, on the left side, the œsophagus, and, from the third or fourth vertebra downwards, the descending aorta. The bifurcation of the trachea takes place at the middle line, between the two regions, with some inclination, however, to the right side.

METHODS OF PHYSICAL DIAGNOSIS.

21. We propose here to give a general description of the various methods of physical diagnosis, and in the case of each method shall successively examine: Its nature; its direct or immediate object; the manner of practising it; the conditions which are discovered by its means in the healthy state; such deviations from the ordinary standard of these conditions as are, nevertheless, compatible with health; and, lastly, the deviations from that standard, which are actually morbid and constitute signs of disease.

SECTION I.—INSPECTION.

22. By inspection of the chest, as a method of physical diagnosis, is understood simply the ocular examination of its external surface; by inspection are ascertained the conditions of exterior *form* and *size* of the cavity, and of the *movements* of its walls. The *form* of the chest is to be considered in respect of its *general configuration*, and the *shape of its various parts*. The *size* of the cavity is less important considered as a whole than as composed of two divisions; the relative dimensions of these being the point of real consequence. The *movements* of the chest are *general* and *partial*: the *general* class

includes those of *expansion* and of *elevation*; the *partial* those of the *ribs* in respect of each other, and of the *intercostal planes*.

23. In order to insure correct results from inspection of the chest, the following precautions are to be observed: the light must be good; the surface fully exposed: the patient's muscles relaxed, and all physical restraint removed; and, above all, the plane on which he lies, stands, or sits, must be perfectly even. When the patient's state allows the observer the choice of the three postures just mentioned, the sitting ought generally to be selected. Inspection should be practised anteriorly, posteriorly, laterally, and from above downwards—in the latter direction particularly, as a means of roughly ascertaining the antero-posterior diameter of the chest. Under all circumstances, it is of the last importance that the two sides, both generally and in their various corresponding parts, be closely *compared*. This observation applies with the same force to all other methods of physical examination; without *comparison* of corresponding regions the utility of this kind of investigation would be very materially diminished. But in order that such comparison shall not be fallacious, it is essential that the observer should be fully alive to the numerous physical differences which naturally exist in corresponding parts of the two sides.

24. A. *Form*.—I. *In Health*.—The form of the chest of persons who have never had any affection of the thorax itself or its contents may be *regular*, or more or less *irregular*.

25. The adult male chest if *regularly* formed, resembles, when viewed anteriorly, and exclusive of everything except its own immediate integuments, a cone, having the narrow end uppermost; its transverse diameter obviously exceeding the antero-posterior; its two sides symmetrical, both generally and in their different parts; the supra-clavicular spaces very slightly depressed; the lower sternal region hollowed out in proportion to the stoutness of the individual; the infra-clavicular regions gently convex; the costal angles, formed by the union of the false ribs and middle line anteriorly, very nearly equal—that on the right side being slightly the more obtuse; the intercostal spaces visibly hollow both during inspiration and expiration, unless the individual be at all full in person; the lateral surfaces of the chest equally distant from the median plane—as likewise the nipples, which are on the same level, that of the fourth rib or fourth intercostal space; and the different regions of the chest, considered in themselves, regularly shaped. Posteriorly, the shoulders lie on the same level; the spine is either perfectly straight, or inclines very slightly to the right at mid-back; and the vertebral sulcus, moderately concave from above downwards, more or less deep according to the fatness or thinness of the individual.

26. But it is comparatively rare to find a chest having in all respects the characters now enumerated. Certain deviations of form, perfectly compatible with a healthy state, both of the thoracic

organs, and of the body generally, are of extremely common occurrence. It would follow, indeed, from the investigations of M. Woillez,¹ that the *regularly* formed chest, just described, exists in scarcely more than twenty per cent. of adult males, taken indiscriminately. The irregularities which render the chest non-symmetrical, while they are perfectly compatible with health, are by this author termed *physiological heteromorphisms*;² the title *pathological* being applied to those that are the manifest results of disease.³

27. It is obvious that the chief, almost the sole, clinical importance of these "physiological" departures from regular form consists in the chance of their being mistaken for alterations of shape dependent on disease. Their frequency indicates the necessity of acquaintance with them: in 197 cases, examined by M. Woillez, there existed 251 such heteromorphisms; 144 of these occurring in 111 persons who had had thoracic disease, 107 in 86 individuals who had all their lives been perfectly free from such disease.

28. Physiological heteromorphisms may be congenital or acquired, and general or partial. The *general* are those in which the natural relations of the different diameters of the chest are altered; the *partial* consist of local defects of symmetry, exercising no influence on the general shape of the thorax.

29. Again, certain local irregularities of form may be either of physiological or of pathological origin: disease may produce in one chest precisely the same alteration of shape that accidental circumstances, in no wise impairing health, effect in another. When a deviation of form, which may be thus either morbid or not, presents itself, its mode of origin can only be positively determined by the absence or presence of other signs denoting subjacent disease, or by the previous history of the individual showing that he has or has not suffered from pectoral complaints.

30. II. *In disease*.—Alterations of form and of position of the whole thoracic surface, or of its parts, if considered in regard of their *physical characters*, may be referred to the following species:—(α) Expansion and Bulging; (β) Retraction and Depression; (γ) Procidencia and Elevation; (δ) Curvature; (ε) Distortion.

31. (α) *Expansion* signifies a change of shape of the chest, in which one or both of its sides is generally prominent; *bulging*, a local or circumscribed expansion, the remainder of the thoracic surface being either in the natural state or affected with some other species of irregularity. Expansion of one side, produced by some

¹ Recherches Prat. sur l'Inspection et la Mensuration de la Poitrine. Paris, 1838.

² From ἕτερος other, and μορφή form.

³ Regularly formed chests are more common before than after the age of thirty, and in persons who follow sedentary pursuits or trades requiring little muscular exertion, or who have never labored under thoracic disease, than among persons in the converse conditions. The previous occurrence of such disease does not, of course, necessarily imply the existence of irregularity of form.

force acting from within outwards (the elasticity of the lung having been first destroyed), is best seen in cases of abundant pleuritic effusion, with or without pneumonia; in pneumothorax, hydro-pneumothorax, and general vesicular emphysema; less clearly in hypertrophy of the lung, intra-thoracic tumors, and extensive hæmothorax. Simple pneumonia and hydrothorax have not yet been proved to produce it; nor are any affections of the heart or great vessels capable, even as matter of theory, of doing so. Expansion of either side is never a physiological heteromorphism.

32. *Bulging* takes place to such extent as to arch, generally, the upper anterior surface, in rare instances of tuberculous excavation;¹ occurs at either base in pleuritic effusion and in pleuropneumonia; in emphysema appears above and below the clavicles, and has been observed to a very slight extent in those regions in cases of simple pneumonia of the apex; exhibits itself in various sites in cases of circumscribed pleurisy and intrathoracic tumor; in the right infra-axillary region in cases of enlarged liver, and in the left of enlarged spleen; in the mammary and lower sternal regions in pericardial effusion and hypertrophy of the heart, and in the upper and central parts of the chest in cases of aortic aneurism. But on the other hand, bulging frequently occurs as a natural condition in the following positions: the right back inferiorly; the left front inferiorly, with or without twisting forwards of the free edges of the ribs; the upper sternal region; the second costal cartilages, either or both; and the left sterno-mammary regions. Such non-morbid bulgings simulate those produced by pericardial effusion, aneurism of the aorta, pleuritic effusion, &c.

33. (β) *Retraction* and *depression* are the converse states of expansion and bulging: the former, a general sinking of the walls on one side; the latter, a similar condition limited to one spot or region. *Retraction* never exists without reduction of size of the lung, produced either by extrinsic pressure or by changes in its own substance. Now, pressure is essentially concerned in cases of pleuritic effusion; the lung, reduced to a small bulk by the pressure of accumulated fluid, deprived of its elasticity, and bound down by exudation-matter, is unable to resume its original volume on the removal of the fluid by absorption,—the side consequently yields inwards under the weight of the atmosphere. The exudation-matter aids materially, through its characteristic force of contraction, in producing this result, by diminishing the bulk of the lung, not, as might be supposed, by actually dragging the wall of the chest inwards. On the other hand, changes of the lung-substance, reducing its bulk, occur in tuberculous disease, the absorptive period of pneumonia, in cancerous and certain exudative infiltrations of the lung, and in collapse and atrophy of the organ consequent

¹ Sanders, U. C. H., Males, vol. xiv. p. 313; a huge cavity in the left lung, a small one in the right, with encroachment of the right lung on the region of the left.

on the inaction entailed by pressure on its main bronchus by enlarged glands, tumor, or aneurism.¹ *Depression* attends the same morbid states, when more limited in extent and influence. In estimating the clinical value of depression, the observer must remember that it sometimes occurs in the lower sternal region, and, symmetrically, in the inframammary regions, independently of disease.

34. (*γ*) *Procidencia* is that state in which the position of a part is lower than natural; *elevation*, that in which it is higher. Examples of *procidencia* are seen in the lowered position of the shoulder, of the ribs laterally, and of the nipple in chronic pleurisy with retraction. The shoulders are not always naturally on the same level, however; and the left nipple is, in healthy persons, frequently lower than the right. I once observed *elevation* of the shoulder on the same side as retraction of the parietes from chronic pleurisy.

35. (*δ*) *Curvature* signifies that deviation of the various axes of a part in which, notwithstanding, some degree of regularity of form is retained; *distortion*, a displacement of the same kind fundamentally, but one in which the deviations are so numerous and so considerable that all trace of regular shape is lost. The spine, sternum, clavicles, and ribs, are subject to the former of these displacements in connection with disease of the subjacent organs. Thus the dorsal spine becomes laterally curved in cases of chronic pleurisy with retraction; the ribs, in extreme cases of the same disease, undergo such torsion on their longitudinal axes that their upper edges become external; the sternum yields sideways under the pressure of intra-thoracic tumors, and the clavicle twists downwards and inwards in some cases of tuberculous destruction of the apex of the lungs. Some slight deviation of the dorsal spine to the right I have found to be more common than perfect straightness in male adults with sound chests; and the sternum sometimes naturally inclines to one side.

36. Here may be included the peculiar conformation called "pigeon-breast," characterized by flattening of the lateral regions, and prominence, with arching forwards, of the sternum. This is doubtless a congenital malformation in some cases; but it may also be an acquired deformity. As has been satisfactorily shown by Dupuytren² and Mr. Shaw,³ this alteration of form may be produced, especially in the flexible chest of childhood, by protracted difficulty of breathing, depending on obstruction in the upper air-passages. The principle of its production will be explained further on [54].

¹ I once met with a remarkable case, in which the girth of the right side only equalled 14 inches, while the left measured 15½ inches, there being no history of past pleurisy or acute disease of the right side. Congenital atelectasis, or intra-uterine pleurisy, suggested themselves in explanation; but, on further examination, the whole right side (face, head, limbs, and pelvis) was found to be notably smaller than its fellow. The patient, a male, aged about thirty, had been a seven months' child.

² Mémoires de Chirurgie.

³ Medical Gazette, 1842.

The pigeon-breast seriously perverts the natural relationship of the heart and lungs, and modifies both the heart's impulse and the mode of conduction of its sounds.

37. B. *Size*.—No practically useful rule can be laid down respecting the ratio of the natural visible dimensions of the thorax to those of the body generally; the proportion varies widely in different individuals enjoying robust health [1031].

38. There is no *visible* inequality of size in the two sides of a well-formed thorax. Numerous deviations from the natural relative dimensions of the different parts of the thorax occur in consequence of disease; but as they are always to be more accurately estimated by measurement than by inspection, and in some cases only to be ascertained at all by means of the former, the consideration of their different varieties is deferred to the section on **MENSURATION**.

39. C. *Movements*. I. *In health*.—(a) The *general* movements, or those in which the entire thorax is concerned, are of *expansion* and of *elevation*. In health these two kinds of movement are so intimately associated and agree so closely in proportional amount, that it is unnecessary to consider them separately: in certain states of disease they are very differently affected.

40. During *inspiration* the walls of the chest diverge from their central axis—the sternum and the anterior segment of the ribs passing somewhat forwards, the lateral outwards, and the posterior backwards, from that axis (*expansion-movement*). At the same time the anterior walls, and, with the exception of the three or four last ribs which are on the contrary depressed, the lateral walls, also, rise upwards (*elevation-movement*). In ordinary breathing these movements are in the direct ratio of the antero-posterior and transverse enlargement of the lungs—but not precisely so of their vertical enlargement, inasmuch as there is no constant proportion between costal and diaphragmatic movement. The rapidity, the energy, and the extent of the expansion and elevation-movements, bear a direct proportion to each other under all circumstances of health, unless volition interfere to pervert the natural order of things. On the other hand, the absolute amount of all three characters varies within sufficiently wide limits in different persons—but is found to increase, as a rule, in the direct ratio of the easy mobility of the framework of the chest (hence greater in youth than age), and the height of the individual.

41. During *expiration* the walls of the chest are restored to their previous condition by the converse movements of *retraction* and *depression*.

42. In each act of respiration the movements of expiration follow those of inspiration so closely, that no distinct pause is perceptible between them; when expansion and elevation cease retraction and depression appear to begin, precisely as the audible pulmonary sounds by which they are accompanied.

43. The *rate of motion*, though this be free from all jerking inequality of rhythm, differs perceptibly at different periods of the two acts: inspiration-movement begins slowly, quickens, slackens again; expiration-movement starts off rapidly, gradually slackening to its close.

44. If the entire time occupied by a respiratory act (that is, from the beginning of one inspiration to the beginning of the next) be represented by 10, the value of the duration of the inspiratory movement may be estimated approximately at 5, of the expiratory at 4, and of the pause between the expiratory and succeeding inspiratory movement at 1;—the period of thoracic motion being to that of rest, as 9 : 1. The motion at the close of expiration is so small in amount, and so slowly effected, that it is very difficult to fix accurately the instant at which the actual rest, dividing any two succeeding respiratory acts, commences; however, the ratio just given furnishes the mean of a number of observations, from which very extreme and apparently exceptional results were excluded: they were made by watching the movements of a small flat board, laid on either the superior thoracic or the lower thoracic and abdominal regions, according to the sex of the individual [49].

The ratio only holds in calm breathing; when respiration is hurried, the inspiratory act loses in relative duration: the easier the breathing, the longer the interval (in some individuals peculiarly so) between the end of expiration and the next inspiration. No observation can be trusted to, which is derived from the movements over a very limited area of surface.

45. In health, the *extent* and *frequency of repetition* of the movements of the thorax are in the direct ratio of the *duration* and *intensity* of the pulmonary respiration-sounds.

46. (b) The *partial* movements of the ribs on each other—movements, practically speaking, limited to special situations—are best appreciated by application of the hand.

47. In perfectly calm breathing the intercostal spaces continue visibly hollow, both during inspiration and expiration—more so during the former than the latter act. In the male this is most obvious in the infra-axillary regions; in the female in the infra-clavicular; in both sexes the fact can best be ascertained where the individual is thin. In forced breathing the deepening of the interspaces is still more marked in inspiration; whereas during expiration, they become more or less perfectly flat.

Further, the post-sternal hollow, and the supra-clavicular regions, seem to sink slightly inwards in calm inspiration, filling out again in expiration.

48. But the movements of the walls of the chest are not the only ones dependent on respiration which are of clinical importance. The enlargement of the lungs and descent of the diaphragm in inspiration, forces down the subjacent viscera, and causes protrusion of the abdominal walls, especially anteriorly; during expiration

these walls recede. Hence in *ordinary* or *calm* breathing, which is mainly effected by the descent of the arch of the diaphragm, the amount of abdominal is greater than that of thoracic expansion-movement, and the former commences sensibly before the latter.

49. There is a striking difference, however, in this point of view, between the sexes; and the statement just made applies in point of fact to the calm breathing of the male only. In the female the abdominal expansion is almost null, and always slightly posterior in time to the upper costal; neither do the lower ribs move notably; whereas the clavicles and infra-clavicular regions rise and fall with freedom. The adult male seems to the eye to breathe with the abdomen and the lower ribs from about the tenth to the sixth; the adult female with the upper third of the chest alone.

50. The cause of this difference in the sexes is not satisfactorily determined. It is yet a point *sub judice* whether, and to what proportional extent, the discrepancy of adult life prevails in infancy and early youth. I have examined a considerable number of female children, aged between four and ten years, who had never worn stays, or any substitute for these, and found in them the predominant infra-clavicular action of the adult. But the excess of upper movement is very positively less than among their seniors. On the other hand, Boerhaave,¹ one of the earliest observers of the difference in the respiratory action of the sexes, speaks as though the boy and girl of "one year old" breathe as distinctively, the one with the abdomen, the other with the chest, as the full-grown man and woman. *Per contra*, Beau and Maissiat affirm, that in earliest infancy, and often up to the third year, the respiration is abdominal in the female as well as in the male. It has appeared to me positive, that in earliest youth, when the pectoral and ventral modes of breathing first became obvious, the chest action in the female is more *general*, and less limited to the upper regions, than at a later period. *Age*, then, does seem to me to exercise an influence upon, or to be connected with, the typical breathing of the sexes.

Social position has no modifying power; the washerwoman and the peeress breathe exactly alike.

The *habit of forced breathing* is not without its effect on the calm action of both sexes. For instance, the extensive play of the upper regions in full-chested *soprani*, kept up in the exercise of their art for many hours daily, ends by increasing the amount of infra-clavicular movement in ordinary conversational breathing. It has appeared to me that, even in *tenor* singers, some perversion of the ordinary condition—some degree of unnatural infra-clavicular movement—may be detected in calm respiration.

But what influence does *dress* exercise? Looking at an adult female, and remembering her habit of drawing in the lower ribs by apparatus more or less unyielding, the inference would seem

¹ Prælect. Academ. § 623, tom. v. p. 144. Ed. Haller, Amst. 1744.

unavoidable that the reason why a woman does not breathe like a man is, that her mode of dress mechanically obstructs phrenic play. Certain mischiefs entailed by tight lacing we see positively in displacement of the liver; in misshapement of it, so that its height may be made to equal, nay to exceed, its breadth; in alterations of its texture, so that true lobular substance is replaced to a greater or less depth by induration-matter functionally useless. We see them exhibited in displacement of the heart; in narrowing of the lower intercostal spaces, &c. And if, from certain of the facts concerning age, just passed in review, we are forced to the admission, that the activity of infra-clavicular respiration-movement in the female is in the main designed by nature, and independent of extraneous influence, still I cannot help thinking that the great excess of that movement, and the limitation of breathing play to the upper thorax in the civilized adult female, are due in no small measure to the use of unyielding cases interfering with inferior costal and phrenic action. The agricultural female laborer, who knows not stays, breathes more like a male than the town female. Besides, during sleep, the conditions of pectoral and ventral action in the female are much less strikingly different from those in the male than in the waking state; the waist is relieved for a time from constriction. And further, the male and female dog breathe almost exactly alike, as do also the horse and mare; the action is abdominal and lower costal.

51. It would seem then that stays are in part productive of the peculiarity of adult female breathing, but certainly are not its sole cause. Boerhaave and his commentator, Haller, however, holding that the total sexual difference obtains from birth, looked upon the free upper costal action in the female as a pre-ordination to meet the difficulties of pregnancy. "Nisi hanc," says Boerhaave, "in fœminâ diversitatem natura fecisset, gravidæ perpetuâ dyspnœâ laboravissent, æque ac viri hydropici." But it seems here to be forgotten that, if the illustration be sound, ascitic females ought to escape dyspnœa. The final cause of the difference in the sexes is of less interest, however, than the mechanism by which it is actually worked out; but of this also nothing is known. Haller ascribes the predominant costal action in females to the greater flexibility of their bones and cartilages.¹ The upper interspaces are relatively wider in the female, the lower in the male; but is this effect or cause, or neither one nor the other? A most singular fact (if fact it actually be) is that, according to the assertion of Kuchenmeister, Fabius, and F. Arnold, the pregnant uterus exercises no influence on the breathing capacity [125*] of the individual.

52. But whatever be its cause, this sexual difference disappears in *forced* breathing; in both sexes the pectoral movement is, out of all proportion, greater than the abdominal; and even in the male the expansile action, if abrupt, commences superiorly.

¹ Op. cit. pp. 98, 145.

53. Various postures, which interfere with action in limited parts of the chest or abdomen, throw extra work on others, and so alter the mechanism of respiration. Thus, in calm breathing, the male, when lying on one side, exhibits extra costo-abdominal movement on the other; in the supine posture there is no perceptible movement in the perineum, while in lateral decumbency sufficient rise and fall takes place there to count the respirations by.

54. *In disease.*—(a) The general movements of simultaneous expansion and elevation are liable to *diminution*, either from consensual avoidance of pain, paralysis of the muscles concerned in producing them, or a material obstacle in the condition of the pleura or lung. Thus in pleurodynia, intercostal neuralgia, and at the onset of pleurisy, the first cause acts; in cerebral and in spinal paralysis, the second; while in cases of pneumothorax, pleurisy, and pneumonia, of obstruction of the main bronchus, of gaseous, liquid, or solid accumulation in the pleura, of consolidation and rarefaction of the lungs, the third. On the other hand, these movements *exceed* the healthy standard where a muscular effort is made to overcome some obstruction seated *low* in the chest, as in spasmodic asthma, and especially if the diaphragm be mechanically interfered with, as in pericarditis with copious effusion, or they may be *perverted*, if the *upper* air passages be obstructed, either from disease in themselves (œdema of the glottis; laryngitis, simple, œdematous, or croupal; tumors; foreign bodies, &c.), or in neighboring parts (enlarged tonsils; pharyngeal disease,¹ &c.), or from spasm of the glottis (as in epilepsy, hysteria,² laryngismus stridulus, pertussis, and chorea), the chest, instead of expanding during inspiration, will actually retract, especially below and at the sides, while the abdomen enlarges, from descent of the diaphragm, in proportion to the amount of obstruction. In many of these affections the rhythm of the movements becomes jerking and uneven. The more flexible and expansile any given chest is in health, the more marked will be this perversion where obstruction exists above the bifurcation of the trachea; it attains its maximum consequently in childhood. The explanation is easy. The small quantity of air inspired makes naturally to the nearest air tubes, those of the upper lobes, while none reaches the lower, though fall of the diaphragm has prepared these for its reception; the lower lobes collapse, and the inferior parts of the chest are consequently driven inwards by atmospheric pressure. This state of things becomes permanent where its cause is permanent, and thus is engendered in some cases the so-called pigeon-breast [36]. Instead of this bilateral perversion, the phenomenon will be unilateral, and flattening of one side, with lateral curvature of the dorsal spine, having its convexity towards the

¹ Constable, U. C. H., Females, vol. ix. p. 97. Cancerous ulcerated opening between œsophagus and trachea. Two days before death base of chest expanded, apices sank in, in inspiration. Yet the apices proved sound, the bases congested.

² Spicer, U. C. H., Females, vol. ii. p. 147, Jan. 1847.

healthy side, ensue, if the obstruction affect the main bronchus on one side only; or it will be still more limited if a bronchus of second or third calibre be alone affected. Now, whenever any cause seriously impairs the expansion movement of one side only, the expansion of the other is liable to increase, and similar deficiency of action, limited to a part of one side, may be made up by excess on the rest of that side; the law is the same as for the audible phenomena of respiration. It holds good, too, where the obstruction is parietal, as in general cancerous infiltration of the wall of either side of the thorax.¹

55. Want of power in the respiratory muscles, whether from debility or from paralysis, will impair the chest-motions, and entail flattening of the corresponding side.²

56. In the tetanic spasm, whether from disease or from strychnia, the walls are fixed.

57. (b) The relation of the movement of expansion to that of elevation may change completely; the former, for example, being almost totally suppressed, while the latter becomes even peculiarly obvious. When the lung-substance is more or less impermeable, either locally or generally, and either from disease within itself or pressure from without (as in cases of tubercle, pneumonia, pleurisy, pleuritic and pericardial adhesion, intra-thoracic tumors or aneurism), this kind of perversion in movement will exist, either locally or generally, according to its cause. It is especially marked on forced inspiration; volition may drag the thorax upwards, but cannot expand impermeable texture. In vesicular emphysema, while the elevation movements are carried to an extreme point, there may be no expansion at all, nay, even slight retraction at the base, during inspiration.

58. (c) The *rhythm* of the *respiratory act* is likewise subject to change; the duration of the expiratory movement may become considerably greater than that of the inspiratory. This is observed whenever physical obstruction exists in any part of the passages, from the nares downwards, to the exit of air from the lungs; and also where, as in vesicular emphysema, the elasticity of the lung is destroyed. In the latter affection the expiratory movement may be two-and-a-half times as long as the inspiratory.

59. (d) The proportion naturally subsisting between the extent and frequency of the *movement of elevation* on the one hand, and the duration and intensity of the *respiration sounds* on the other, may be altogether perverted: the former may be greatly increased in amount, while the latter have undergone remarkable diminution.

¹ I have seen the chest wall so fixed by infiltrated scirrhus, that the strongest effort of the will failed in producing any appreciable expansion of the affected side.

² The experiments of Stromeyer ("Ueber paralysie der Inspirations Muskeln, Casper's Wochenschrift, 1837") show that the division of the posterior thoracic nerve in the rabbit will suffice to reduce the measurement of the corresponding side of the thorax by five or six lines in less than three weeks.

This state of things constitutes one of the most remarkable features of diseases, where spasm affects the bronchial tubes or glottis, and obstructions of physical character exist in the larynx, trachea, or larger bronchi. The inspiratory action is abrupt and short, the expiratory prolonged.

60. (e) Again, the relationship of the thoracic and abdominal movements may change completely. Thus all conditions interfering, either dynamically or physically, with the movements of the diaphragm, while they impair these, give excess of energy to the thoracic class. Inflammation of the diaphragm, or of the serous membranes coating it, great fluid effusion in the pericardium, solid, fluid, and gaseous accumulations in the abdomen, pervert in this manner the natural order of things. On the other hand, the diaphragmatic movements may be increased by certain irritations of the phrenic nerves in pleurodynia, intercostal neuralgia, the painful periods of pleurisy, in diseases or injury of the spinal cord below the phrenic nerves, and when compared with the amount of expansion movement of the thorax, in obstructive diseases, functional or mechanical, of the air passages.

61. In the natural state the costal angles are nearly equal, the left being slightly the more acute of the two. All affections contracting either side of the chest to the exclusion of the other increase the acuteness of the costal angle on the former, as chronic tuberculation, chronic pneumonia, chronic pleurisy with retracted side, cirrhosis, &c. All affections augmenting the positive bulk of either lung widen the costal angle on the affected side, as rapid and general hepatization, and acute general tuberculous infiltration.¹ The more fully the base of the lung is implicated in the disease, the more obvious will be the effect. Where the costal angle is narrowed, its costal limb is depressed; where the former is widened, the latter is raised.

62. In estimating the thoracic movement of calm breathing in disease, the sex of the patient must always be borne in mind. An amount of infra-clavicular expansion, ample for a male, would be below par for a female; the converse is true of infra-axillary action. Various morbid states pervert the natural sexual condition, giving the female the free lower action of the male thorax, the male the upper mobility of the female thorax.²

63. The intercostal spaces are widened by fluid and gaseous collections in the pleura; by intra-thoracic tumors and aneurism; by certain kinds of enlargement of the heart; by hydropericarditis;

¹ Hodson, U. C. H., Males, vol. ix. p. 17. In this case of combined acute tuberculation and pneumonia, while increase of bulk existed inferiorly, diminution by interstitial contraction had set in superiorly.

² I have seen this in Cholera Asiatica. Cotten, U. C. H., Males, vol. xi. pp. 57, 58, ætatis 17. During the algide period this lad breathed costally and superiorly, exactly as a woman; two days later, the choleraic hue having disappeared, the breathing had become abdominal and inferior costal. The perversion is evidently connected with collapse of the lungs.

by extensive plastic infiltration of the lung when sudden and in the acute state. Fluid in the pleura or pericardium may, in addition, cause bulging of the intercostal planes, irrespectively of the nature of that fluid, whether purulent, serous, or bloody, though a less quantity of purulent than of other fluid will suffice for the purpose. The conditions of bulging will be more fully considered with the history of Pleurisy.

64. The interspaces undergo narrowing in the absorption-period of pleurisy and pericarditis, and in all affections causing marked contraction of the lungs.

65. The normal respiration-movement of the intercostal planes may, in disease, be diminished, annulled, increased, or perverted.

66. During the painful periods of pleurisy, in pleurodynia, in intercostal neuralgia, in herpes zoster of the chest-wall, the action of the intercostal muscles is controlled, nay, suspended sometimes, by so-called consensualism. In hemiplegia the action may be very slight. So far the mechanism is nervous; but mechanical interference may be caused by solid masses distending the side of the thorax, and by fluid accumulations, provided they be sufficiently copious to entail bulging of the interspaces.¹ Quantity of fluid is, however, not the only element to be considered, for accumulation sufficiently great to destroy pulmonary percussion-tone up to the spine of the scapula (and consequently to compress the lung seriously), will not put a complete stop to intercostal action. Nay more, under such circumstances the movement may be actually greater in the infra-axillary spaces on the diseased than on the healthy side. In pneumothorax, too, with very notable bulging, the superjacent interspaces may play freely.²

Increase of intercostal movement takes place in the paroxysm of asthma.

The intercostal movements are liable also to perversion: the spaces may bulge beyond the level of the ribs during expiration; they may bulge too in inspiration: and this in different parts of the same chest at once tuberculous and emphysematous.

67. If fluid be accumulated in sufficient quantity in the pleural sac to cause marked bulging of the interspaces, an undulatory movement caused by respiration may sometimes be seen. If, in addition, the costal plane be perforated, and a fluid collection in the walls of the thorax communicate at all freely with another in the pleura, an inspiratory fall and an expiratory rise of the former are distinctly visible.

¹ Mediastinal tumor, with solid infiltration of the lung, will not annul intercostal movement, even though the lung adhere to the side, unless a distending influence be exercised on the chest-wall by the mass.

² Reilly, U. C. H., Males, vol. xvi. p. 168. Action as great on the side of the pneumothorax as on the healthy side.

SECTION II.—APPLICATION OF THE HAND.

68. By application of the hand and palpation, are meant the acts of laying the hand on, and feeling, the external surface of the chest. The object of these acts is to ascertain the *form* of the different regions of the thorax (little or no information can be derived from them regarding the *general* conformation of the cavity); the state of the *general*, and especially of the *partial*, *movements* of the walls; the amount of *vibration* communicated to the hand from those walls, and the existence or absence of *fluctuation* within the chest.

69. In employing this method of diagnosis, the palmar surface of the fingers and hand should be laid gently and evenly on the surface. If the object be to investigate the form or movements of the thorax, this is the only precaution, in addition to those recommended for the proper performance of inspection, which it is necessary to observe; if the thoracic vibration be the subject of examination, it is advisable to place the patient in the horizontal posture.

70. Application of the hand is less useful than inspection in ascertaining the amount of *general movement*, taken as a whole, existing in any given thorax; but it is greatly more effectual in *locally* distinguishing *expansion* from *elevation-movement*, and in analyzing the *partial* costal movements.

Thus in chronic pleurisy with retracted side a good deal of elevation-movement may be felt during inspiration, while the total absence of any action tending to fill out or expand the hand laid on the surface is readily ascertained. The same state of things may constantly be established in the infra-clavicular regions, when the apex of the lung is consolidated. In this case, and also in empyema, the thoracic walls, above and below the clavicle, may fall in during inspiration and expand during expiration, while the elevation-movement pursues its natural course and rhythm.

71. In the normal state, calm inspiration causes divergence of the lower ribs, and convergence (as originally shown by Haller, and recently by Dr. Sibson) of the upper; while an intermediate set from the fourth to the seventh, undergoes scarcely any change of relative position. Expiration produces the converse effects. The amount of alteration is greatest superiorly in women, inferiorly in men; and in both sexes greater anteriorly and laterally than posteriorly. Forced breathing widens and narrows the interspaces proportionately more; the convergence of the infra-axillary ribs in the male during extreme expiration is particularly remarkable.

In the lower interspaces of the male, it is easy enough, by placing the thumb or a finger on their surface, to follow these movements. But it is very difficult to detect the inspiratory convergence in the upper spaces. When a finger is placed in an upper intercostal space, and the thinner the subject of the observation the better, it

seems to be compressed by the adjacent ribs during expiration, and relieved of all pressure during inspiration—just, though not to the same amount, as in the lower interspaces. There is, however, some fallacy here; for I have found, by performing artificial respiration, after the removal of the integuments, on the dead male subject, that the upper ribs do actually converge during that movement. The amount of approximation, even in persons with wide intercostal spaces, appears to me not to exceed one-sixteenth or one-twelfth of an inch at the outer edge of the costal cartilages.¹

72. Allied in mechanism to the expansion-movements, these diverging-movements may nevertheless be affected differently from the former in disease. Thus, in cases of chronic pleurisy, with contracted side, the elevation-movement may, during inspiration, be still perceptible in the infra-axillary region, and the expansion-movement be absolutely null, while the ribs actually converge. This inspiratory convergence of the ribs has appeared to me indicative of subjacent pulmonary consolidation and pleuritic *agglutination* combined.

73. *Vocal vibration, or fremitus.* If the hand be applied to the surface of the chest of a healthy individual, while speaking, a vibratile tremor is perceived by the fingers. This vibration, delicate under all circumstances and readily deadened by too forcible pressure of the hand, is, generally speaking, in the direct ratio of the graveness, coarseness of quality, and loudness of the speaking voice, and hence, as a rule, more marked in adults than in children, in males than in females. It is often altogether deficient, indeed, in females and children. *Cæteris paribus* it is more intense in long-chested than in short-chested persons; and markedly so in thin than in fat people; unless as deepening the voice and either lessening or increasing fulness of person, age appears to have no influence upon its amount. The vibration is scarcely affected by tension or relaxation of the muscles over which the hand is laid; in the great majority of cases it is stronger in recumbency than in the sitting posture (in twenty-two trials, sixteen times greater lying than sitting, four times equal, twice more marked in the sitting than the lying posture). It is greatly more marked when some sounds are uttered than others, and hence the importance, in delicate comparative trials, of making the person examined repeat the same word or words.²

¹ In H. Young, *ætat.* 40 (carcinoma of ileum and ileo-vesical fistula), U. C. H., Females, vol. vii. pp. 130; approximation of the second and third left cartilages was noticed on full inspiration. The left lung was healthy, weighing 13.75 oz.; but there were old general adhesions. Also case of Moore, U. C. H., Males, vol. viii. p. 390.

² In singing, the fremitus is much more marked when the voice is bass, baritone, or contralto, than when tenor or soprano; and it accompanies the lower notes of any given register to a much greater amount than the upper; it may be absolutely null on a high note, though most loudly sounded, while it is well marked with a low note of the same voice softly uttered. From a few trials I find that the fremitus

The intensity of fremitus, all conditions being favorable to its production, may be such as to throw a large arm-chair or sofa, against which the speaker leans, into strong vibration.

74. As a general truth, the intensity of the fremitus is considerably greater on the right side of the chest than the left,—the greatest amount of this excess existing in the infra-clavicular, infra-scapular, and inter-scapular regions. Exceptional regions are the right infra-axillary and infra-mammary, where the presence of the liver interrupts the vibrations, and throws into comparative prominence the naturally weak fremitus in the corresponding regions on the left side: the difference would be greater, were it not for the presence of the spleen in the latter position. Where the heart is uncovered by the lung, vibration is totally absent, and the right edge of that space may be traced by its abrupt cessation there; but over the left lung there is naturally so little vibration, that modifications of the sign can scarcely be used with confidence for making out the left edge of the space. The lower border of the right lung may be traced by the abrupt cessation of all fremitus immediately below it.

The fremitus is intensely marked over the larynx and trachea, stronger at the sternal than the humeral halves of the infra-clavicular regions, generally faintly manifest on the right clavicle, and imperceptible at the top of the sternum.

75. The natural vocal fremitus is susceptible, *in disease*, of *increase* or *diminution*. As in the case of other signs, the existing amount of change is most effectually ascertained by comparison of the two sides of the chest; but in making this comparison, the observer must carefully bear in mind the great differences naturally existing on these two sides.

76. Unnatural density of the pulmonary texture, produced by solid infiltration, *unless this be carried to an extreme amount*, intensifies vocal vibration—as in tuberculous or plastic infiltration, acute or chronic: pneumonia of the left base posteriorly will thus raise the fremitus above the standard of the right base in health.¹ Pulmonary apoplexy and œdema act, within my experience, in the same way, but to a slight amount. In dilatation of the bronchi the increased calibre of the vibrating tubes, as well as adjacent consolidation, commonly tend to the same result. In pleuritic effusion occupying the lower part of the side, the infra-clavicular region may furnish fremitus in excess.

77. When the lung-substance is removed to a distance from the chest-wall by gaseous or liquid accumulation in the pleura, as in

tus ceases with soprano and mezzo-soprano voices between *f* and *a* on the lines. Baritones either retain the fremitus through their whole register, or lose it about their upper *f*. The supra-laryngeal register of all voices is without fremitus.

¹ In cases of universal and very dense acute tuberculous infiltration the fremitus may be strong superiorly near the large tubes, less distinct inferiorly. Hodson, U. C. H., Males, vol. ix. p. 17.

pneumothorax and in pleural effusions, dropsical, hemorrhagic, or inflammatory, the fremitus is, as a rule, annulled. Unfortunately, however, the fremitus is, in some cases, retained at the right base, even when a considerable amount of fluid exists in the pleura. Sometimes explicable by solid adhesions conveying the vibrations from the lung to the chest wall, in other instances the anomaly does not admit of explanation. The theories of unison-resonance, echo, and consonance [433], do not fairly meet the difficulty. The influence of solid accumulation, either in the lung or pleura, varies according to circumstances: *very extensive* lung-infiltration, whether fibrino-plastic, pseudo-fibrous, carcinomatous, or other, deadens the vibration, especially if the infiltrated parts be distant from the larger bronchi, and the voice feeble;¹ extra-pulmonary tumors and aneurisms produce the same effect. But if the other circumstances, such as the strength and graveness of the voice, be favorable, aneurisms, tumors, and cancerous infiltrations will not, even when of tolerable size, annihilate fremitus, if they be in close connection with the larger bronchi. It is commonly said that in vesicular emphysema the vibration is impaired; I have not found this habitual, and in some cases its intensity is above the range of health. Neither do I believe, as has been affirmed, that plugging of the bronchial tubes with muco-pus deadens fremitus; during the closing hours of senile asphyxiating bronchitis, the chest-wall may vibrate forcibly, both with voice and cough.

78. Vocal fremitus and audible vocal resonance bear no uniform relationship to each other, either in health or disease: for though, when the voice is grave, and low notes are sounded, they both increase and decrease equably, under the converse circumstances audible resonance may be powerful, while the fremitus is feeble or null.

As a general rule, sounds of high pitch give *relatively* most audible resonance, sounds of low pitch most fremitus. But the exceptions to this rule in the acoustics of the chest are numerous. An individual with gruff voice of low register, may have powerful bronchophony in a spot where the fremitus is next to null;² *à fortiori* may this be the case, if the voice be high-pitched.

79. The act of coughing produces a vibration similar to, but less marked than, the vocal. This vibration (*tussive fremitus*) suffers the same kinds of modification in disease, but is valueless clinically, unless in cases of aphonia.

80. Certain rhonchi throw the bronchial tubes into vibration sufficiently strong to be felt on the surface of the chest (*rhonchal fremitus*); the sibilant, sonorous, and mucous, have all this property. The cavernous rhonchus, produced in excavations of the lung near

¹ Jennings, U. C. H., *Females*, vol. xv. p. 65. Mediastinal cancer encroaching on and infiltrating right lung—in the right axilla, the fremitus null—at the left front well marked.

² Crowhurst (right pleuritic effusion), U. C. H., *Males*, vol. ix. p. 142.

the surface, may be accompanied with marked fremitus, and without fluctuation being perceptible to the finger. Stridulous respiration even, such as that attending aneurismal pressure on the trachea, may produce very distinct fremitus, greater in inspiration than in expiration.

81. In the natural state of the pleura, the gliding motion of its costal and pulmonary laminae upon each other gives rise to no vibration perceptible by the hand applied to the surface. Nor is it usual, even in cases where audible friction-phenomena exist, to discover such vibration: in some instances, however, it may be detected; and the sensation conveyed (*friction fremitus*), though distinctly somewhat vibratile, nevertheless possesses more of a simply rubbing character, just as might be anticipated from a consideration of its cause—the collision of plastic matter on the pleural surfaces. In point of intensity it varies greatly; in some cases perceptible, even in ordinary breathing, to the patient himself—in others it is only evolved by forced inspiration, and only to be caught occasionally. Accompanying either the inspiration or expiration-movement, it is more commonly associated with the former. I have met with it to a higher degree at the absorption-period, than at the outset, of the pleurisy.

82. A pulsatile movement of the lung, attended with a quasi-tremor on the surface of the chest, and synchronous with the systole of the heart, has been noticed, originally by Dr. Graves, in some rare instances of pneumonia and intra-thoracic cancer. Here, too, may be included the impulse of intra-pleural pulsating empyema [882].

83. Palpation may also be used for the detection of fluids contained either in the lungs or pleura. The sensation is that of ordinary fluctuation, commonly attended with a certain degree of vibratile tremor. Its existence may be ascertained, either by the movements of the fingers used by surgeons for detecting fluid in an abscess (*simple fluctuation*); or succussion of the chest may be required (*fluctuation by succussion*); or percussion of the surface, be necessary to produce it ("*peripheric*" *fluctuation*); or it may occur through the influence of respiration as an attendant on cavernous rhonchi (*rhonchal fluctuation*): in this latter case vibration may be more distinctly felt than in the others. The "*peripheric*" species, described by Dr. C. Tarral, is to be detected by giving a quick sharp fillip in an intercostal space, perpendicular to the surface, when a sensation of fluctuation will be transmitted to a finger of the other hand firmly applied to the surface in the same space, at a short distance from the point percussed.¹ Simple fluctuation is producible, where the intercostal spaces are much bulged out by pleuritic effusion; peripheric fluctuation in the same cases, but most perfectly where air and fluid co-exist in the pleura; fluctuation by succussion

¹ Sometimes a more satisfactory result may be obtained by striking the ribs.

in cases of hydro-pneumothorax and of large excavation in the lung.

84. Application of the hand to the surface, below the clavicles in the female, below the epigastrium in the male, is the readiest way of ascertaining the frequency of respiration.

85. The absolute frequency of respiration in health averages in the waking adult twenty per minute; greatest at birth, it decreases quinquennially to the age of thirty, and between this period and the fiftieth year again increases somewhat.¹ Respiration is slightly increased in frequency by fulness of the stomach; the act is less frequent in the male than the female, and in both sexes in the lying than in the sitting, and in the sitting than in the standing postures.

86. In disease the absolute frequency may arise to eighty, and even upwards, and wholly excluding moribund persons, may fall to eight.

87. The ratio of the respiration to the pulse is more important, in pulmonary diagnosis, than the absolute frequency of either. In the adult the natural ratio lies between 1 : 4 and 1 : 4.5. The less frequent the pulse absolutely, the higher the ratio of the respiration; a pulse of sixty will relatively give a larger number of respirations, than one of eighty. The influence of posture is relatively greater on respiration than on the pulse; hence the ratio varies in the same individual in the three chief postures.

88. In disease the pulse-respiration ratio is subject to remarkable perversions, which are sometimes of signal use in diagnosis. The extreme ratios which have fallen under my own notice are pulse to respiration as 9 : 1 in chorea,² and as 1 : 1.25 in pneumonia.³ These perversions may be maintained, whether the pulse be, absolutely considered, frequent or not. In hysteria I have known the ratio range from 5 : 1 to 1.8 : 1.

SECTION III.—MENSURATION.

89. The object of measuring the chest is twofold: First, to ascertain, more accurately than can be done by inspection and application of the hand, the comparative bulk of the two sides, the relative positions of their different parts, and, in some few instances, the distances between those parts and certain fixed points beyond the limits of the thorax (*measurements in rest*); secondly, to estimate with precision the amount of expansion and retraction of the chest accompanying inspiration and expiration (*measurements in motion*).

¹ Quetelet. Sur l'Homme, t. ii. p. 91, 1836.

² Case of Carpenter, Clin. Lect., loc. cit., Lancet, January, 1849.

³ Styles, U. C. H., Males, vol. x. p. 306; on eighteenth day, of left pneumonia. "Pulse 56, heart same; respiration 60 to 70, twice counted; no subjective sense of dyspnoea."

§ I.—MENSURATION IN REST.

90. A complete system of mensuration in rest, would comprise the following admeasurements:—

A. GENERAL.—(a) Circular. 1. *On the level of the sixth cartilage*; 2. Midway between the nipples and clavicles. (b) Transverse; 3. From the point of one acromion to that of the other; 4. In the axillæ; 5. At the base of the chest. (c) Antero-posterior. 6. *Under the clavicles*; 7. At the base of the chest. (d) Vertical. 8. *From the clavicle to the most dependent point of ribs.*

B. PARTIAL.—(a) Horizontal. 1. *From the nipple to the middle line of the sternum.* (b) Vertical. 2. From the middle of the sternal notch to the nipple; 3. From the nipple to the antero-superior spine of the ileum; 4. From the most dependent point of the twelfth rib to the same spine.

91. But these different kinds of measurement are not all of equal importance, especially in the present state of knowledge, either because some of them really convey information of very secondary value, or because they have not as yet been sufficiently practised to render the physician familiar with the indications derivable from them. The measurements which it is of real consequence for the student to understand, and in all doubtful cases to practise, are distinguished by Italics; at the same time, it would be a mistake to imagine that all the others may not occasionally furnish more or less useful information, either confirmatory or corrective of results otherwise obtained.

92. A. GENERAL MEASUREMENTS.—(a) *Circular (1), on the level of the sixth costo-sternal joint.*—Circular measurement of the chest, as commonly performed with a *single* graduated tape passed round the thorax, from the middle line anteriorly, is a troublesome process, requiring the patient to be raised to the sitting posture, and the co-operation of two persons. Besides, the difficulty of ascertaining the precise point of the measure corresponding to the spine, renders the process inaccurate. These difficulties have been removed by a very simple plan, suggested, I believe, by Dr. Hare, that of joining together *two* such tapes at the commencement of their scales, and fixing them, as the patient reclines, at their line of union, to the spine; each side of the chest has thus its separate measure. By padding the inner surface of both measures, close to their line of junction, a sort of saddle is made, which readily fixes itself to the spinous processes.

93. The circular width of the chest varies so widely in healthy individuals, that there is little practical utility in attempting to fix its mean value. I have known it in the adult male so high, on the level of the sixth cartilage, as forty-four inches, and so low as twenty-seven [1031]. Perhaps thirty-three inches may be named as the fairest adult average; but the width varies with age, long

after the height has become stationary, gradually increasing from the age of sixteen to sixty: so that the mean being thirty inches from the age of sixteen to twenty, it is thirty-four from that of fifty-one to sixty. The circumference increases, but not in any fixed proportion, with the robustness, stoutness, and height of individuals. The female circumference is, absolutely and relatively, less than the male.

94. According to M. Woillez, the circumference is greatest in persons following trades that require active exertion of the whole frame, but not of the upper extremities in particular. Far from this, were his number of cases sufficient for the final decision of the question, the latter class of artisans must be held to have the lowest average circumference of thorax. But the absolute measurement is of less importance than might appear, for width is not an index of expansile power; on the contrary, the statical and dynamical conditions may, in fat people especially, be inversely as each other.

95. The relationship of pectoral to abdominal circumference varies with age: in infancy and childhood the latter is greater than the former. In the young male adult (less so in the female), the chest exceeds the abdomen in width. In cases of abdominal obesity the natural ratio becomes perverted.

96. Certain definite relationships exist between the girth of the chest on the one hand, and the width of the shoulders, the distance between the nipples and the antero-posterior diameter on the other (Brent); but as their perversions do not furnish any precise diagnostic inferences, it is unnecessary to describe them.

97. The two sides of the chest are of unequal semi-circumference in about five-sixths of healthy adults; a mean excess of about half an inch existing on the right side in right-handed individuals;¹ in left-handed persons the left side sometimes measures more than, or more frequently the same as, the right. These propositions hold true of both sexes; but the difference is slightly greater in males than females. As in infancy and youth the two sides scarcely differ, it seems probable the non-symmetry of the adult chest depends on the excess of use of the right side. I have not traced any special influence of trade on these measurements; but accidental circumstances, unconnected with disease of the thoracic organs, are liable to modify their ratio. Thus, distension of the stomach with flatus or food may equalize the measurement, for the time it lasts, on the two sides; and I am inclined to believe, that the deficiency of motion, kept up by fractured ribs in some cases for a very lengthened period, perhaps for a life-time, may in the end diminish the dimensions of the side—the lung probably, just as in cases where its expansion and retraction are interfered with by pressure of a tumor

¹ This excess becomes the more remarkable, when the frequency of slight convexity of the dorsal spine to the right, in health, is considered.

on a main bronchus, collapsing and becoming more or less atrophic, while the thoracic walls fall in proportionally.¹

98. The most important *morbid conditions* of circular dimensions are *increase* or *diminution of width* of either side, as compared with the other. They occur respectively in the same diseases, already enumerated under these heads, as morbid expansion and retraction [31, 33].

99. *Of circular width midway between the nipple and clavicle* little has been ascertained: the scapulæ prevent the real measures from being taken, and in some persons raise the circumference here above that on the level of the sixth cartilage. As far as is now known, the ratio of the upper and lower circumferences does not appear to me sufficiently constant to be trusted to clinically. It is matter of general belief that the size of the upper part of the chest, compared with that of the base, is greater in proportion as the muscular and osseous systems, especially the latter, are strongly developed, and the constitution of the individual free from the taint of predisposition to phthisis. Though not prepared to say positively whether the excess of width, existing at the lower part of the chest on the right side, holds in the upper regions also, I am inclined, from a limited number of observations, to believe that it does, though to a less amount than inferiorly.

100. (*b*) *Transverse*.—Respecting mensuration of the transverse diameters of the chest, I have no precise information to offer. It should be made with a pair of callipers, and there can be little question that diagnostic data of importance might occasionally be derived from its employment. It would, however, in the greater number of cases, do little more than confirm the results of inspection; for diminution of the transverse diameter, in respect of the antero-posterior, the change which, it may be presumed, would most frequently present itself, is one of those alterations of shape which most readily attract the eye.

101. (*c*) *Antero-posterior*.—A pair of common steel callipers is the simplest instrument for determining the antero-posterior diameter of the chest. The absolute maximum measurement varies widely; the extremes I have actually noted in males of middle height, free from chest-disease, being eight and twelve inches. The difficulties, in comparing the diameters of the two sides, are to apply the blades of the callipers with exactly the same force, and (a far from easy task, on account of the slope of the surface of the chest) to exactly corresponding points on both sides.

102. In measuring the antero-posterior diameter of the apex of the chest on either side, the extremity of one blade should be placed

¹ Case of Bassett (U. C. H., Males, vol. ii. p. 214); the right side (the man being right-handed and free from pulmonary disease, capable of explaining the fact) measured opposite the sixth costo-sternal joint $16\frac{3}{4}$ inches, the left $18\frac{3}{4}$ inches: he had old fractured ribs on the right side. Compare this clinical fact with the result of Stromeier's experiments on division of the posterior thoracic nerve [55].

immediately under the centre of the clavicle, the other upon the corresponding point of the spine of the scapula—the equi-distance of both extremities from the middle line being at the same time carefully insured. The diameter of the right side in this situation, as also over the sixth rib, will be found, in the greater number of healthy persons, to exceed that of the left (possibly as a compensation for the relatively less height of the right lung), but by so very small an amount that, where an excess at all marked is detected on that side, the physiological disparity may be ignored. In other words, an excess of even a fourth of an inch on the right side furnishes sufficient evidence of morbid depression or diminished diameter on the left; though the existence of a similar excess on the left side will be still more strongly conclusive of contraction on the right.

103. The *morbid states* discoverable by the measurement now described are, *diminution* and *increase* of the antero-posterior diameter. The latter change occurs in pleurisy with effusion, pneumonia, hypertrophy of the lung, emphysema, intra-thoracic tumor and aneurism, various cardiac affections, acute general tubercularization of a lung, and possibly chronic tuberculous disease of the apex, at its earliest period [1848]. Diminution, on the other hand, arises in the more advanced stages of tubercle, in simple chronic consolidation, in the absorption-period of pleurisy with retraction, and in cases of prolonged mechanical obstruction to the entry of air through the larynx or main bronchi.

104. (*d*) *Vertical*.—The vertical measurement of the chest has hitherto been only practised in front; measured with a tape, the distance between the centre of the clavicle and the most dependent point of the corresponding ribs is found to be very closely the same on both sides.

105. This distance is liable to be *increased* in cases of solid, liquid, or gaseous accumulation in the chest; to be *diminished* in chronic pleurisy with retraction. But though elevation of the diaphragm, with consequent diminished vertical height of the thoracic cavity on either side, and also the converse states, are not uncommon, changes of the measures on the *surface* are rare.

106. B. PARTIAL MEASUREMENT.—(*a*) *Horizontal*. *From the nipple to the middle line*. The nipples are equidistant from the middle line in the healthy adult male. The distance between either of them and that line is liable in disease to increase, and more frequently to decrease. Hypertrophy of the heart, pericardial effusion, mediastinal tumors and aneurisms in certain situations increase it, though not often seriously; on the other hand, diminution in cases of retraction after pleurisy, varying in amount from a quarter of an inch to an inch and a quarter, may be detected.

107. (*b*) *Vertical*. *From the middle of the notch of the sternum to the nipple*.—These points are equidistant on the two sides in chests of perfectly regular form. We have already seen, however, that

normally the left nipple sometimes lies lower than the right; hence the space comprised between the nipple and the clavicle on that side may be greater than on the other, independently of the influence of disease.

108. The only *morbid variation* observed in this measurement is *increase*, and it is obvious, from what has just been said, that this sign will have more value on the right than the left side. And mensuration is less useful in respect of this sign than inspection; for, on account of the flattening of the surface, which commonly co-exists with lowered position of the nipple from disease, the superficial measurement undergoes a diminution which may more than compensate for the increase produced by the latter cause. In a remarkable example of this apparent contradiction between the results of inspection and mensuration, although the left nipple was manifestly lower than the right, the distance between the former and its corresponding sterno-clavicular joint was only $5\frac{1}{2}$ inches, while that between the same joints on the right side was $6\frac{1}{4}$ inches.¹ It is to be supposed that such will usually be the result of mensuration, where the retraction after pleurisy affects more especially the antero-posterior diameter.

109. The distances comprised between the *nipple and the antero-superior spine of the ileum*, and between the *most dependent point of the twelfth rib and the same process*, are equal on the two sides in health. They undergo *diminution* on either side in cases of marked retraction of the chest; and, probably, *increase* in those of expansion.

§ II.—MENSURATION IN MOVEMENT.

110. There are two plans for submitting to measurement the influence of respiration on the dimensions of the chest; the one estimates the amount of antero-posterior movement, the other the amount of circular expansion and retraction attending the act.

111. The former measurement, which may be roughly made at the apex of the chest by placing the thumb on the spine of the scapula, and the index finger beneath the clavicle, is effected with much greater precision by an instrument of very ingenious construction, named by its inventor, Dr. Sibson,² the "Chest Measurer." In principle a callipers, of which one branch is movable, this instrument is capable, by means of an index and dial fixed to its movable branch, of indicating any change in the antero-posterior diameter of the chest or abdomen, even to the one-hundredth part of an inch, and has enabled Dr. Sibson to establish the following, among numerous other, propositions concerning the respiratory movements in health. In the robust male the forward movement of the sternum and of the seven upper ribs ranges from one-fiftieth

¹ Cyclopædia of Surgery, article *Empyema*, p. 102.

² Med.-Chir. Trans., vol. xxxi. p. 353. A modification of the instrument has been proposed by Dr. Quain.

to one-fourteenth of an inch in ordinary inspiration, and from half an inch to two inches during deep inspiration.¹ On the five lower ribs the ordinary movement is less, and the forced movement greater, than over the upper seven. The movement is somewhat less on the left side than the right, below the second rib. The ordinary abdominal movement is about a quarter of an inch, the extreme ranging from half an inch to an inch and a half.

112. Unless the expansibility of the chest be directly as the forward motion of the anterior parts of the ribs, the indications of the "Chest-Measurer" do not accurately express variations in the amount of the former. This is seen in health. The instrument shows, according to its inventor, that the forward motion is in the male greatest, during calm breathing, superiorly—least inferiorly; while, during forced breathing, the lower ribs play relatively more than the upper; now the eye and circular measurement teach us that the exact reverse is the truth in regard of the really important clinical fact—expansile action [48, 49, 52]. Again, when the costal cartilages are stiffened by age or precocious ossification, the expansion may be greater materially than in the ratio of forward costal motion: the converse state of things will exist in youth. In disease, too, the forward motion of the chest, and its lateral expansion, may be very differently affected: in a case of large excavation under the left, and consolidation with small excavations under the right, clavicle, the lower part of the sternum and adjoining cartilages *receded* visibly during inspiration, yet a fair amount of *circular expansion* was produced by the act.² The deceptive influence of the torsion-movement of the ribs (which will apparently increase or decrease the amount of their forward motion, according as the movable rack is fixed near their lower or upper edge) must be borne in mind; the very delicacy of the instrument might otherwise mar its utility. But in localizing with precision deficiency or excess of antero-posterior motion, and in estimating changes from day to day in the amount of either, the indications of the "Chest-Measurer" are greatly superior in perfection, it need scarcely be added, to those furnished by application of the hand.

113. The amount of inspiratory expansion and expiratory retraction of the chest and abdomen is measurable by the double tape already mentioned.³—Applied closely, but not tightly, to the chest, on the level of the sixth cartilage, the tape shows that the expan-

¹ Haller, estimating the effects of a moderate inspiration, found the forward movement of the sternum, superiorly, $2\frac{1}{2}$ lines, inferiorly from 3 to 8 lines.

² Green, U. C. H., Females, vol. v. p. 146, July, 1850. The same phenomenon sometimes occurs in pleuritic effusion also.

³ Mr. Henry Thompson, of University College, has suggested a very simple addition to the tape-measure, whereby the absolute and relative expansion of the two sides of the chest may be ascertained during *one* and the same respiration. The more ordinary plan requires two; and as no two respirations are probably precisely equal, Mr. Thompson's instrument, which may be had of Coxeter, Grafton Street, obviates a source of fallacy.

sion accompanying ordinary calm inspiration in health is very slight, averaging about a quarter of an inch in the healthy male adult, with a circumference of thirty-three inches: this amount is, practically speaking, shared equally by the two sides. In forced inspiration the circumference is increased from the medium or tranquil state by from one and a half to three inches, and is somewhat greater on the right than on the left side—the deficiency on the latter mainly depending on the heart. The total circular difference between forced inspiration and forced expiration ranges between two and a half and five inches; this is estimated by taking admeasurements at the moments the patient has been made first to fill, and then to empty, the chest to the fullest possible amount. At the same time the difference in the respective extremes on the two sides is seen. But the same amount of difference may exist between extreme inspiration and extreme expiration on the two sides, and yet be very differently produced: it may, on one side, depend in the main on great expansion above, and on the other on great retraction below, the *medium state*; in other words, inspiration may be free to excess on the former, expiration on the latter, side. In health, however, such want of harmony in the expiratory and inspiratory efficiency on the two sides is never met with, except to the very slightest calculable amount, and is probably traceable to the difficulty of the observation.

114. The chest-play is remarkably under the influence of posture; least in decumbency, it increases successively, chiefly in its inspiratory division, in the sitting and standing postures—very much in the ratio of the increasing frequency of respiration.

115. Forced breathing has scarcely any influence in expanding the abdomen; in a healthy male adult, now under observation, five feet six inches in height, in whom, while standing, extreme expiration gives a circumference opposite the sixth cartilage of $29\frac{1}{2}$ inches, and extreme inspiration one of 34 inches (a very rare amount of thoracic play, especially with so low a stature), the abdominal inspiratory expansion equals only a quarter of an inch.

116. *In disease*, mensuration ascertains with accuracy the amount of deficiency of expansion on both sides, and on one side as compared with the other, the mere existence of which deficiency is more or less readily ascertained by the sight and touch. The Section on Inspection [54] may therefore be referred to for a list of the affections in which deficient expansion is to be estimated by measure.

117. The variations from the healthy standard thus discoverable are sufficiently striking. In chronic empyema, for instance, the total difference between the fullest expiration and the fullest inspiration on the affected side may scarcely reach one-sixteenth of an inch; while the other side, especially if time has elapsed for its lung to grow hypertrophous, may have a play, as I have actually witnessed, of nearly two and a half inches, an amount reaching the limits of health for both sides united. Hemiplegia will materially

lower the respiratory play on the affected side; thus in two cases elsewhere described,¹ the range of motion on the paralyzed side equalled in each about a quarter of an inch, while that on the non-affected side measured in one instance three-quarters of an inch, and in the other an inch. Again, paraplegia, if reaching as far upwards as the chest wall, will cause a sensible diminution in the circular measurement in the male at the base during inspiration, and an equal increase during expiration.² Precisely the same perversion may be occasionally established in cases of obstruction of the upper air-passages.³ The principle at work in both cases has already been explained [39].

118. When the respiration play of both sides combined does not reach two and a half inches, disease impeding respiration in all probability exists; and when the total amount being equal to or exceeding a healthy average, the shares of the two sides are notably unequal, disease exists, impairing the play of one side and exaggerating that of the other.

119. But the measured range between forced expiration and forced inspiration may be the same on the two sides, and yet the accompanying change of volume of the two lungs be very different in kind. On the one side the play may be chiefly effected by the ready inspiratory expansion of the lung; on the other, by the great efficiency of expiratory contraction. In the former case the lung maintains its relative efficiency by its power of taking in beyond its medium quantity of air; in the latter by its power of expressing air, which in ordinary breathing stagnates within it; in the former case expansibility, in the latter elasticity, predominates. Here are two very different conditions of lung most important to be distinguished, and which have hitherto never been made the subject of clinical study. The difficulty of the study is, it is true, extreme, from the nicety required in fixing the standard of comparison, namely, the medium or tranquil measurement of the chest. My observations on this matter are as yet too limited to justify me in announcing general conclusions; but they prove to me that with care the inquiry may become rich in results. It seems almost a matter of necessity that, as the difference of power in the two cases directly bears on different portions of respiratory air, the influence on the oxygenating process must vary in each. Where the expiratory force is in excess, the "supplementary" air [122], where the inspiratory action predominates, the "complementary" air must be severally most affected.

120. The forced breathing of health expands the chest in both sexes and at all ages out of all proportion with the abdomen. In the forced breathing of diseases seriously affecting thoracic expansion, the diaphragm on the contrary assumes unusual energy, de-

¹ Clinical Lectures, *Lancet*, March 17, 1849.

² Cozens, U. C. H., *Males (acute myelitis)*, vol. xvi. p. 267.

³ Sams, U. C. H., *Males (chronic obstructive laryngitis)*, vol. xvi. p. 272.

scends more than natural, and expands the abdomen in excess. Severe pleurodynia will suffice to transpose the respiration movements in this way; I have known the pain attending herpes zoster [66] do so to a slight extent. Where local rheumatism affects the parietes of both the abdomen and chest, it is curious to observe the medium state of modification in the relationship of abdominal and thoracic expansion in forced breathing; the pectoral expansion is relatively somewhat less, the abdominal somewhat more, than the healthy average.¹

§ III.—MENSURATION OF CAPACITY FOR AIR.

121. Although the results of mensuration in movement may be taken as fair indices of the relative amounts of air circulating in the lungs of different individuals, and of the same individual at different times, it is plain they give no idea of absolute amounts. But direct attempts have been made, with the help of various instruments, to fix the entire volume of air admitted into the lungs under varying conditions of health and of disease.

122. Now the air habitually present in, or capable of being introduced by respiration into, the lungs, is divisible into various quantities. First, there is a volume of air which remains in the cells even after the complete collapse of the lungs in the dead body, and which cannot, by ordinary means at least, be artificially expressed from their tissue, though thoroughly removable by the influence of certain diseases, especially those causing fluid pressure on the pleural surface of the lung; this may be called *persistent* air. Secondly, a volume which, though collapse expels it after death, cannot be expressed from the lungs during life by the strongest expiratory effort; this may be termed *residual* air.² Thirdly, the volume of air which can be expelled by a forced, after an ordinary, expiration, may be termed *supplementary*. Fourthly, the *breath*, or *tidal*³ air, that which in flux and reflux passes to and fro in calm breathing. Fifthly, the volume which can be inhaled by a forced, after an ordi-

¹ Farrett, U. C. H., Males, vol. vi. Nov. 1850.

² In some cases of cholera Asiatica expression of the residual volume seems to be effected *in actu mortis*, and there is a tendency to this result for some time before death.

³ I here adopt, for the most part, the terms devised by Mr. Jeffreys ("Statics of the Chest," Lond. 1843). The distinction made in the text between persistent and residual air has not, so far as I know, been hitherto recognized; but it is evidently real. Of course it is the volume only, not the actual same air, that is persistent: the fact of such persistence shows the vital importance of the law of diffusion of gases (in the inverse ratio of the square roots of their densities) as unravelled by Mr. Graham; were it not for that diffusion, scarcely any fresh air, at least with the existing mechanics of respiration, could reach the air-cells for the purposes of blood-ventilation. In this statement I do not even by inference mean to express an opinion on the vexed question, whether the actual interchange of elements of the air and blood takes place in obedience to the law of diffusion, or, as Vierordt and others maintain, to that of absorption, of gases. It would, however, certainly appear that the presence of moisture is fatal to the activity of the former law.

nary, inspiration, and may be given the name *complementary*. The persistent, residual, and supplementary airs together, may be styled *stagnant* air; while the sum of the supplementary, tidal, and complementary quantities, may be named *total breathing volume*. Tabularly they would stand thus:—

$$\text{Stagnant} = \left\{ \begin{array}{l} \text{Persistent} \\ \text{Residual} \\ \text{Supplementary} \\ \text{Tidal} \\ \text{Complementary} \end{array} \right\} = \text{Total breathing volume.}$$

123. The earlier attempts at estimating these volumes, either singly or in combination, varied so ludicrously, that to obtain physiological standards seemed hopeless. Healthy types proving unattainable, the application of pulmometry to the clinical study of disease could not, in spite of the efforts of Kentish and Herbst, prove successful. And yet these observers, more acute than their predecessors, recognized the influence of various collateral conditions on the breathing volumes. Others have since done so even more fully; still, the most perfect results are, it is to be feared, only approximatively true.

124. Thus M. Bourgery,¹ investigating what he terms the “measure of respiration,” which proves to be the compound of the tidal and complementary airs, or the amount expelled by a forced expiration after an ordinary inspiration, finds this volume deeply influenced by age, sex, and leanness, or the reverse, of person. Health and vigor of body do not compensate for youth and thinness. The function reaches its maximum at the age of thirty;² at this period a forced inspiration will add to the stagnant air 2.5 to 4.3 litres in the male, from 1.1 to 2.2 litres in the female.³ The boy of fifteen can inspire 2 litres, the man of eighty but 1.35, a significant measure, I may observe, of the incapacitating influence of senile atrophy of the pulmonary parenchyma.

125. Dr. Hutchinson,⁴ in turn studying by means of his valuable instrument, the Spirometer, the quantity of air which may be expelled from the chest by the fullest possible expiration, succeeding

¹ Mém. de l'Acad. des Sciences, Janv. 1843.

² If this be true (and subsequent researches seem to confirm the statement), the discovery lends incidental support to the notion that no *fixed* ratio holds between the breathing volume and the girth of the chest; for, as before stated [93], the circular width increases with advancing years.

³ The influence of sex was, however, originally ascertained by Thackrah, who showed that “while healthy men inhale by the pulmometer 200 cubic inches and upwards, women rarely exceed 100, and often do not reach that amount.” (Effects of Arts, &c., 2d edit. p. 181. 1832.)

⁴ Med.-Chir. Trans. vol. xxix. 1846. A simple spirometer, tolerably accurate in its measurements, and easily carried in the pocket, has recently been invented by Coxeter, of Grafton Street, and is sold at a small price. The objection, raised to Hutchinson's spirometer as a perfectly accurate measurer, by Dr. E. Smith and others, on the ground of its mechanical imperfections, is well founded; but as comparative not absolute results are wanted, mathematical precision in the indications does not (in clinical practice at least) seem absolutely requisite.

the fullest possible inspiration (that is, the sum of the supplementary, tidal, and complementary airs, or the total breathing-volume), affirms that the physical conditions dominating all others, which influence breathing, are stature¹ and weight. His experiments lead to the inference, that the total breathing-volume (or "vital capacity") varies in a definite and calculable ratio with the height of the individual: that the mean for the male, at the height of 5 feet being 174 cubic inches, it increases, at 60° Fah., with every inch of stature between 5 and 6 feet, by eight additional cubic inches.

The experiments of Dr. Hutchinson have been repeated on a large scale in this country, in various parts of Germany and in the United States; and the clear formal result of the entire series is that while the *rule* is subject to numerous exceptions, the alleged *law* has no real existence. Dr. Pepper,² in illustration of the wide interval between extremes in healthy persons, gives the two following instances: height 6 feet, vital capacity equal 151 cubic inches; height 5 feet 10½ inches, vital capacity equal 202½ inches. Such enormous differences as these (and they are by no means of very uncommon occurrence) thoroughly warrant the incredulity of Fabius and others as to the reality of any precise ratio at all existing between stature and breathing capacity.

125*. Conscientious and well-designed attempts have been made (those of F. Arnold³ holding the foremost place among them) to prepare more trustworthy standards by including, as elements influencing the result, various other conditions besides mere stature. Nearer approximations to the truth have thus been obtained beyond a doubt. But, even thus improved, can these physiological results be applied with confidence in thoracic diagnosis? I apprehend not. For M. Bourgery's mean general standards for sex, age, and varying leanness of person, and Dr. Hutchinson's, as modified by Arnold, for stature &c., being *argumenti gratiâ* admitted, the question arises, what precise or even approximative oscillations above and below those standards are compatible with health? Now not only can no positive reply at the present day be given, but such is the intricacy of the problem, it seems unlikely ever to be furnished. Conceive the complexity of the case when as conditions independent of thoracic disease positively affecting vital capacity (and there may, for aught I know, be many more) must be enumerated the following: age, sex, amount of corpulence, strength, posture of the

¹ Kentish, the inventor of the pulmometer, first drew attention to the influence of height on breathing-volume ("Account of Baths, &c., with a Description of a Pulmometer," pp. 87, 91, 116, London, 1814); more recently Herbst categorically insisted on its importance (Ueber die capacitât der Lungen für Luft im gesunden und kranken Zustande, Meckel's Archiv. 1828, pp. 98, 101). But neither of these observers, wiser probably than some of their successors, attempted to deduce a precise ratio between capacity and height.

² Amer. Journ. of Med. Sciences, April 1853, quoted by Flint, On the Respiratory Organs, p. 45.

³ Ueber die Athmungsgrösse des Menschen, Heidelb. 1855.

body, circumference of the thorax,¹ height of the thorax, height of the body, weight of the body,² mobility of the chest-walls, relation between the depth of the chest and the stature, the relation between the outer girth and the internal area of the thorax, the class of the individual in society,³ the trade or occupation, sedentary habits or the reverse, the mode of dress, the habitual attitude, habitual nutritious feeding or the reverse, the amount of food in the stomach at the time of experiment,⁴ fulness or emptiness of the bowels,⁵ and the congested or non-congested, healthy or diseased, state of the abdominal organs generally.

126. The calculation has, no doubt, been offered for Dr. Hutchinson's results, that a deficiency of 16 per 100 is suspicious, but may possibly arise from physiological peculiarity—that beyond this, the deficiency is morbid. But in clinical practice it turns out, that the *general* standard of height, even with this correction, is often valueless—that the *individual* healthy standard often varies far too widely on either side of the general one. So much so, that a great fall may have taken place, from disease, in the breathing volume of an individual, at a time when he expels a quantity of air above the average standard of men of his height: according to the general standard he is more than healthy, he is extra-capacious; according to his own, he is diseased. For certainty of observation, the individual standard is required; the present man must be compared with the past man, and not with other men. And even in this limited application of the spirometer, there are serious difficulties; a slight variation in general vigor at the different periods (the influence of strength is very notable) will of necessity modify the results.

127. I am disposed to believe that any fall below the general average, is a surer indication of disease, than the maintenance of that average, or even of a slight excess, is of health.⁶ But of what

¹ The paradoxical notion that width of chest had nothing to do with vital capacity has been disproved by Arnold; common sense showed it must be an error.

² It is difficult to see *à priori* why a man should breathe in the direct ratio of his weight. I feel convinced it will be found the simple reason heavy people breathe most is, that greater weight is generally associated with greater height,—weight being an accidental coincidence of the supposed real governing element, height.

³ Arnold found that the upper classes generally have a smaller vital capacity than the humbler orders. Occasionally trade seems, according to the results of this observer, to exercise a singularly dominant influence.

⁴ The decrease in the respiratory capacity after a meal varies, according to Winter, from 80 to 200 cubic centimètres.

⁵ Fabius found that his man-servant increased 250 cubic centimètres in the "vital capacity" of the lungs after the use of an ounce of lenitive electuary (Arnold, *loc. cit.*, p. 96).

⁶ I have known a patient with cavities in his lungs expel considerably more air than that indicated for his height in the scale of health. He was only 5 feet 4 inches tall: I have not observed this with persons of good height; though with such persons, on account of the presumed influence of length of chest, it might *à priori* be particularly expected.

disease? Obviously of any disease, whether situated in the lungs and appendages, the heart or great vessels, the abdomen, the encephalon or cord, the vagus, phrenic or intercostal nerves, which interferes on vital or mechanical principles with the expansion or retraction of the lungs. The spirometer indicates when the lungs receive an insufficient supply of air, but gives no inkling of the cause of the deficiency—unless observation should prove (what is utterly improbable, not to say impossible) that special scales of reduction of breathing volume obtain in particular diseases. The spirometer, too, tells nothing of the distribution of the air inspired—in this view clinically inferior even to semicircular and antero-posterior mensuration, which point out the side and the region receiving too much or too little air.

128. For these and other reasons the spirometer affords no help, where, the presence of pulmonary disease being certain, its nature remains an insoluble problem by other methods of physical diagnosis. The weight of the allegation that a fall of breathing-volume, eventually traced to tuberculization, has been detected at a time when no ordinary physical sign of pulmonary disease existed, will be elsewhere considered.

129. On the other hand, where the object is to ascertain roughly and rapidly the pulmonary soundness of a body of men, as in the instance of recruits, the indications of the spirometer may, with practice on the part of the observer, be accepted as significant.

130. But it must not be forgotten that the practical sources of fallacy in the use of this instrument are numerous. Some persons cannot be taught to inspire properly; others to use all the air they actually inhale; some from simple indolence and indifference fail to "blow" an amount they are well capable of; others stimulated to extra laborious effort, in the hope of proving themselves in more robust health than they really feel, mark higher in the scale than many with more capacious lungs; some by habit learn, after a time, to utilize the total volume, a great part of which in early trials was lost (just as persons endowed with even the humblest vocal faculty acquire by practice greatly increased power of sustaining notes); while others, with equal habit are, from mere stupidity, as bad "blowers" at last as at first.

131. Would the variations of the tidal air furnish clinical data of greater importance than those of the total breathing volume? Possibly; no proof exists at least that because an individual can under an effort take in a surprising quantity of air he therefore habitually circulates and consumes the volume necessary for the maintenance of health. Mr. Jeffreys has calculated that in the healthy adult male this quantity oscillates between 16 and 40, and averages 26 cubic inches; and Vierordt found the amount in his own person ranged between 10.8 and 42.6 cubic inches.¹ The wide range

¹ Vide his article *Respiration*, in Wagner's *Handwörterbuch*, p. 835, 1844.

compatible with health points to the infinite difficulty, it is to be feared the impossibility, of obtaining serviceable results in disease.

132. It follows from this variation in the amount of the tidal air that a like variation must exist in the quantum of lung substance brought into play in ordinary breathing. The extremes of that variation are unknown; the mean amount habitually utilized is small, and probably does not exceed one-fourth of the total pulmonary mass.¹

133. The muscular force of expiration is considerably greater in the forced breathing of health than that of inspiration, in about the ratio of 8.03 : 5.68 according to Valentin. Of their relative power in calm breathing we know nothing by actual experiment; but calm inspiration being essentially a muscular effort, calm expiration in the main a mechanical result of the cessation of that effort, there is more waste of power in the former than in the latter act.

134. The inspiratory power sometimes exceeds the expiratory in disease [119].

SECTION IV.—PERCUSSION.

135. The act of striking the external surface of the chest for purposes of diagnosis is called Percussion; its immediate object is to determine the density of subjacent parts. Inferentially, the process serves to establish any increase or diminution of the quantity of air naturally contained within the thorax, as well as the site and area within which the change has occurred. Statically it tests, both in regard of different individuals compared with each other and of the same individual at different periods and under varying conditions, the quantity of stagnant air,—dynamically the amount of tidal and complementary air, any given lungs contain or receive. It indicates also the presence of air, of fluid, and of solid substances in unnatural localities within the thorax.

136. Percussion ascertains the existence and amount of variations in density of the chest by: (a) The nature of the sound elicited by percussion; (b) The degree of resistance, or combined elasticity and tension, of the part percussed.

137. (a) *Percussion-sound*.—English writers, as a body, have hitherto employed only two terms to indicate the varying characters of thoracic percussion-sounds, namely, dulness and clearness. Though, in deference to established usage, I have in writing retained these terms, their inaccuracy and inadequacy have long compelled me to relinquish them in clinical teaching. They are

¹ I base this statement on the following rough experiment. Ascertain what force of action with the bellows, introduced post mortem into the trachea, produces a somewhat greater amount of play in a given chest than that taking place in the calm breathing of life. Then remove the chest wall sufficiently to bring the lungs into view, inflate with the same force as before, and it will be seen scarcely a fifth of the lung-substance comes into action; some allowance must be made for the changed relations of atmospheric pressure caused by cutting away the chest wall.

inaccurate: first, because dulness and clearness are not terms opposed to each other, either in the common signification of the words or in an acoustic sense; secondly, because dulness and clearness¹ are not admitted among the properties of sound by acoustic philosophers;² and, thirdly, because it is demonstrable that the words have been conventionally adopted to represent conditions which, assumed to be simple, are in reality made up of several elements, capable of separate analysis. Besides the use of the term clear often leads into error. High-pitched resonance with hard quality possesses a considerable share of what is conventionally called clearness, and clearness is held always to indicate health. Now this form of clearness is often found at a tuberculized apex [199], while the other lung, relatively, or it may be, practically speaking, wholly free from tubercle, retains the deeper and less clear tone of normal resonance. Possessed by the notion that clearness is the unfailing index of health, the observer takes the really diseased for the sounder organ of the two.

138. Separation of the elements alluded to will lead us to a truer, and hence, though it may seem more complicated, a really more practical distinction of percussion-sounds than that commonly employed.³ Care will be taken, in the description of morbid states of percussion, to point out how the old terms stand related to those which it will be proposed to substitute for them [194].

139. There is no abstract reason why the human chest, when struck, should not give forth sounds possessed in various degrees of the several properties of sonorous bodies in general. But, as matter of experience, the acoustic properties of thoracic percussion-sounds, which are clinically serviceable, prove to be *amount* (or *intensity*) of *resonance*, *pitch*, *quality*, and *duration*. These properties

¹ The word clear applied to sounds, strictly speaking, means pure. The notes of an instrument are said to be clear when they are heard singly and purely uninterfered with by any extraneous vibrations; the tones of the human voice when free from huskiness or any other superadded character impairing their singleness. Now, in this sense, no sound elicited from the chest by percussion can be called clear; and, what is yet more important, several of its morbid tones, furnished in disease, have more of so-called clearness than the resonance of the healthy thorax.

² Hence there is this curious contradiction in the works of various writers on physical diagnosis, who preface their volumes with inquiries into the theory of Acoustics, that no such properties as dulness or clearness are ascribed to Sound in general, and yet dull and clear sounds are perpetually spoken of in subsequent descriptions. Again, dull sound is used as synonymous with "little" sound or "no" sound. This is sometimes, but not always, correct. There is, in point of fact, as intense noise in many so-called dull as clear sounds; it is not in *intensity* that the difference which impresses the ear consists, but in *duration* and in *pitch*, and sometimes in *quality*; so long as they both last, one may be as intense as the other.

³ The division of percussion-sounds into *full* and *empty*, made by Skoda, seems to me inadmissible (independently of the confusion produced by the use of the word *empty* in a sense wholly different from that it commonly bears) on grounds extremely well set forth by M. Aran in his translation (p. 37) of that author's treatise.

vary with the density, tension, and certain other physical conditions of the textures and materials furnishing the sounds.

140. *Amount (or Intensity) of Resonance.*—All wet animal textures in a state of relaxation, with the exception of bone and cartilage, which possess a well-toned resonance, furnish a toneless sound, or rather a mere noise, under percussion. The viscera are indeed, practically speaking, almost non-sonorous in themselves, the proper substances of the liver, spleen, kidney, heart, and lung, from which the air has been artificially expressed, do not appreciably differ in regard of this property; all of them are deficient in the molecular elasticity required for continuous and toned sonorousness. Hence the resonance of the lungs, of which we speak clinically, depends not on their proper tissue, but on the air they contain, and on the construction of the case in which they are contained. The quantity of bone and cartilage entering into the composition of that case, its hollowness, and the thinness of its walls, in comparison with the extent of its cavity, all conduce to the freedom of sonorous vibration. So, again, equal portions of heart-substance and of liver substance, when similarly percussed, and under similar surrounding conditions, will give out sounds short, abrupt, and toneless, to ordinary ears undistinguishable from each other. But if a left ventricle, *unopened*, be percussed lying on a plane surface, its sound will be found more intense, of longer duration, and of lower pitch than that of an equal thickness of liver-substance; the air inclosed in the ventricle explains the difference. *A fortiori* will the properties of the sound emitted by these two organs *in situ* variously differ.¹

141. *Pitch.*—The percussion-sounds of the chest vary very perceptibly in pitch in its different parts—being notably higher over the heart and liver, for instance, than in the infra-clavicular or infra-scapular regions. In diseased states it is easy to produce a series of notes in ascending or descending scales, by striking parts in various conditions of consolidation and rarefaction. The greater the quantity of air, the lower the pitch; the normal pulmonary pitch lies therefore somewhere between that of, for instance, dense hepatization on the one hand, and well marked emphysema on the other—nearer the latter than the former. Habit alone will familiarize the ear with the normal type.

142. As a single property of percussion-sound, pitch seems to me unquestionably the most reliable guide.²

¹ M. Piorry maintains there is a specific difference in the intrinsic percussion-sound of the actual substance of the different viscera; M. Skoda as confidently affirms there is none. Absolute truth lies, I believe, with Piorry. As every kind of solid material, wooden, metallic, &c., has its distinctive resonance, so too must animal tissues of different molecular compositions possess theirs; but the vibratile qualities of those tissues are so imperfect that the differences between their sounds may practically be ignored; in fact they are, as I have admitted above, inappreciable. The point of real clinical interest is the resonance of the viscera *in situ*.

² This conviction has been gradually growing on me since I first suggested the probable connection between so-called dulness and clearness and modifications of

143. *Quality*.—The quality of *timbre* of the sound emitted by the chest immediately over healthy lung-substance is not easily described; the usual statement, that it is a “good clear” sound, manifestly gives no distinct notion of its nature. It conveys the ideas of softness to a marked, and of hollowness to a slight, degree; but it is in fact *sui generis*, and to be learned only by experience. The nearest similitude is probably that of Avenbrugger, who likened the normal chest-resonance over lung to the sound of a drum covered with coarse woollen cloth: it might be called muffled-drum-like.¹ Fortunately this *pulmonary* quality* is sufficiently marked and peculiar to render the morbid variations easily appreciable.

144. *Duration*.—Difference of the duration of the sounds emitted by bodies of different kinds under percussion may be illustrated—if examples of the familiar fact be required—by the prolonged ringing *tone* produced by striking a gong, and the short abrupt *noise* similarly yielded by a mass of putty. The disparity in these two instances is considerably greater than any observable in percussing the human body, but less degrees can readily be conceived; that existing between the sounds emitted by the thigh and the cranium exemplifies one of those degrees.

145. The duration of the percussion-sound varies also very distinctly in different parts of the chest; perceptibly longer, for instance, at the upper part of the sternum than over the heart.

146. As in the case of all sonorous bodies, so with the different portions of the chest, a certain relationship subsists between the four properties of sound on which we have just commented. The note in the infra-clavicular region being of a certain intensity, pitch, duration and quality, that over the centre of the heart-region will relatively lose somewhat in intensity, rise notably in pitch, lessen in duration, and grow harder in quality. As a rule, to which the exceptions are very few, the greater the mass of subjacent air in the chest, the greater will prove the intensity, the lower the pitch, the longer the duration, the softer the quality of the percussion-note.

147. (*b*) *Degree of Resistance*.—When percussing a chest imme-

pitch, in 1843 (*Physical Diagnosis of Diseases of the Lungs*, p. 170). Skoda, I am aware, takes a very different view; according to him changes of pitch “are of the least practical worth” (2d edit. p. 19). On the other hand, Dr. Austin Flint (*Sur les Variations du Ton, &c.*, Paris, 1854) has recognized their importance, and submitted them to serious study. M. Woillez, too (*Archives de Médecine*, 1855), deserves particular mention in connection with this subject. But I cannot help dissenting from this excellent observer in his exclusion of *quality* from the essential attributes of percussion-sounds; this exclusion it is that leads him into the error, as I conceive it, of looking upon the variety of sound I have called *wooden*, and in certain cases even the *hollow*, as nothing more than peculiarities of high-pitched resonance (*loc. cit.* p. 281). The pitch may be precisely the same of a *wooden* percussion-sound over an indurated apex as of the so-called *dull* sound over a certain thickness of pleural fluid.

¹ In conformity with this it may be observed that morbid tympanitic quality (say that of pneumothorax) signifies nothing more than exaggerated normal resonance. This opinion I have always held; nor can I discover on what grounds M. Aran, in his translation of Skoda (p. 14, note) ascribes to me a different notion.

diately over lung perfectly free from all disease, the observer is conscious of a slight yielding motion on the part of the walls, accompanied with a sensation of elasticity. It is impossible to fix a standard of this elasticity, but the reality of its existence may at once be ascertained by percussing comparatively the anterior part of the thorax and the thigh; in the latter situation a sensation of dead unyielding resistance is experienced. The amount of resistance is increased by all conditions raising the pitch, shortening the duration, and hardening the quality of the percussion-sound.

148. *Manipulation.*—Considered in respect of the manner of manipulating, percussion is either *immediate* or *mediate*.

149. *Immediate* percussion, the invention of Avenbrugger, is performed by striking the surface of the chest with the tips of the four fingers of the right hand, united into a point on a level with each other, the ball of the thumb being placed firmly against the index-finger opposite the articulation of the second with the third phalanx, so as to support and give firmness to the fingers. The hand being thus prepared, the points of the fingers are brought perpendicularly down upon the surface with a sharp and quick stroke, which is found to produce a sound varying in properties with the condition of the subjacent parts. Immediate percussion may also be performed by striking the chest with the palmar surface of the fingers: others tap the surface lightly with the small end of the stethoscope; but patients always dislike this, and it may be productive of serious pain.

150. Immediate percussion has, however, almost completely fallen into disuse, less in consequence of the positive objections to its employment than of the invention in mediate percussion of a plan, if not more ready in its application, much more satisfactory in its results. There are, nevertheless, a few circumstances under which immediate percussion may still be had recourse to with advantage. Thus, in cases where extensive and notable difference between the two sides exists, rapidly striking them with the palmar surface of the hand will leave no doubt as to the fact; indeed it will disclose the amount, though not the superficial extent, of the alteration of sound, almost as satisfactory as the more delicate process of mediate percussion. In cases of hepatization and of pleuritic effusion, where it may be inconvenient to submit the patient to a lengthened examination, this method, therefore, has its utility. Again, it will be found that directly tapping the clavicles and spines of the scapulæ with the points of one or more fingers, or with the bent knuckle of the index-finger, conveys as correct information as mediate percussion of those parts.

151. The distinctive character of *mediate* percussion, for the invention of which we are indebted to M. Piorry, is that some solid body, interposed between the chest and percussing agent, receives the direct impulse of the latter. In mediate percussion, or, as I shall in future call it, simply, percussion, there are two chief things

to be considered—the material interposed, and the agent used for striking it.

152. The material interposed, termed a pleximeter (πληξίς, percussion, and μέτρον, a measure), may be of different kinds. That employed by M. Piorry is a thin, circular, or oval plate of ivory, about an inch and a half in diameter, and provided with two prominences or handles, fixed at right angles to its plane surface, and at nearly opposite points of its circumference; these enable the observer to hold it steadily, and apply it evenly and firmly to the surface. Innumerable have been the modifications of this, and the varieties of new pleximeters, proposed from time to time; of these, a finger of the left hand (Skerrett?) and a flat piece of India-rubber (Louis), are in my mind decidedly the best. The index or middle finger, on account of their always being within reach, on account of the accuracy with which they may be fitted, as it were, to the various depressions on the surface, and on account of the absence of parade in their employment, will no doubt always continue the pleximeters in most common use. They have, in these points of view, an unquestionable superiority over M. Piorry's plate of ivory. The India-rubber pleximeter may, however, be defended: there is nothing pompous in its appearance, and by a little management it may be accurately applied, even in the intercostal spaces of the thinnest persons. It has, besides, this positive advantage, that it saves the finger of the operator—no trifling matter, where a very large number of patients are to be examined. And its use implies a saving of pain not only to the operator, but also to the patient, as I ascertained some years ago by a considerable series of comparative trials. I have known females with cutaneous hyperæsthesia bear percussion without murmur in this way, who resolutely refused to allow it, the finger being used for a pleximeter. The only objection I have ever heard urged against the India-rubber is, that it deadens the sound. This, which would be a valid argument if a single point only of the chest were to be percussed, and a direct inference drawn from the result, has in reality not a particle of force; because inferences are invariably drawn from the comparison of different parts.

153. Whatever pleximeter be employed, it should be placed in accurate and firm contact with the surface; for this reason it appears advisable to apply the palmar, and not the dorsal, surface of the finger to the chest, when this is the pleximeter used. No extrinsic condition modifies the sound so much as the amount of force with which the pleximeter is applied to the surface; and the finger with its dorsal surface turned to the chest is, in this point of view, comparatively unmanageable. The validity of this objection is, however, not universally felt; M. Louis, among others, very frequently percusses in this way, and Dr. Stokes appears to prefer it. It is certainly, in some cases, easier to apply the dorsal than the palmar surface of the finger uniformly to the part of the chest under exa-

mination; but this advantage has always seemed to me much more than counterbalanced by the disadvantage just insisted on.

154. The finger may be applied parallel to the ribs, or at various angles with them. The former way of placing it is the more common; and, as a general rule, is the more correct, for by it only can the finger be fitted, in thin persons especially, to the irregularities of the surface. But it is sometimes both convenient and advantageous to vary the direction of the finger; and, as it is next to impossible to place the finger uniformly and equably against the surface in the neighborhood of the right acromial angle, if it be applied horizontally, fixing it at a variable angle with the ribs becomes a matter of necessity. To obviate the difficulty referred to, some persons stand behind the patient while percussing the upper anterior regions: but when this plan is followed, it becomes as difficult to fix the finger on the left side, as on the right when the physician stands in the usual way in front of the patient; the position is besides open to several other manifest objections.

155. Useful information may sometimes be obtained by using the four fingers of the left hand, laid firmly and closely on the surface, as a pleximeter. When the anatomical cause of variation of sound is considerable in extent, but slight in degree, there is an obvious advantage in including a space of some size under the pleximeter.

156. Whatever be the pleximeter used, the fingers are commonly employed as the percussing agent. The various hammers and accompanying apparatus, invented in this country and abroad, some of them of an appearance to terrify a timid patient, do not seem to me to possess any kind of superiority to the fingers, and labor under the serious disadvantage of depriving the observer of the indications furnished by the sensation of resistance of the parts percussed. The clinical supremacy of the fingers has never been a moment threatened by any of these elaborate inventions; and it appears consequently unnecessary to describe them.¹ Generally speaking, the index and median fingers, having their points placed upon exactly the same level, and supported, or not, by the thumb with its ball laid upon the outer surface of the former, opposite the articulation of its second and third phalanges, make the best instrument for striking with. But the index finger alone may be used, especially when gentle percussion only is required, and generally, therefore, in the case of children. Under some circumstances three fingers form a useful modification; or the knuckle of the index finger—that is, the joint of the first and second phalanges—may be used with good effect; in percussing the larynx, the most convenient plan is to fillip with the median finger.

157. When the four fingers of the left hand are used as the

¹ However, some practised observers prefer the hammer; and, on the principle of *audi alteram partem*, I would refer the reader to a valuable paper by Dr. Hughes Bennett, in the Edinburgh Monthly Journal, Oct. 1850.

pleximeter, those of the right form the best agent for percussing with. If precision be desirable, the tips of the fingers should be used to strike; in rough examinations the palmar surface of the right-hand fingers, held in firm extension, may be lightly tapped against the dorsum of the left hand.

158. In the case last referred to, the percussing fingers are made to fall horizontally, the more accurately so the better, upon the surface struck; under all other circumstances, it is of essential importance that the points of the fingers fall perpendicularly upon the pleximeter. The least variation in this respect is liable to be attended with a difference in the sound elicited.

159. In the act of percussing, *the movement should spring from the wrist only*, the forearm and arm being held perfectly motionless. The pain which beginners cause the patient in many cases, and the uncertainty of the results obtained, in a great degree depend upon ignorance of the real value, or neglect, of this rule: the awkwardness of striking from the elbow, or even the shoulder, as is often done, is a matter of less moment; though an observant patient will scarcely fail to be impressed unfavorably by it, when he finds himself rather pushed about than percussed. But the essential advantages of this mode of percussing are the nicety with which the force of the blow may be regulated, and hence made precisely equal in any two places it is the object to compare; and the great comparative ease of keeping the percussing fingers at *the same angle* in striking repeatedly the same or different spots. Were this point of manipulation generally attended to, it would be infinitely less common, than it now is, to hear a new and different sound elicited by each of a number of successive blows upon the same place; a variation, the mere possibility of which constitutes a serious drawback to the utility of percussion as it is too frequently practised.

160. The force used in striking should never be great, absolutely considered; but it may be made to vary from the most gentle, to a smart tap, according to the object in view. Generally speaking, gentle percussion is advisable, when we desire to ascertain the amount of density of superficial parts; forcible, when deep-seated tissues are the subject of investigation. Corresponding regions of the chest, which yield sounds of the same resonance and duration when gently struck, may yield sounds materially differing in these respects if forcibly percussed, and *vice versâ*; it is therefore obvious, that both modes should be employed in every instance where accuracy of diagnosis is aimed at.

161. The blow should be quickly and lightly given, the fingers being withdrawn, or at least all pressure removed, the moment their impulse has been effectually communicated to the surface struck; the vibrations of the surface are thus impeded to the least possible amount. To this precept there is but one exception: in eliciting a particular modification of special character of the sound (*cracked-metal character*), the successful production of which depends mate-

rially on the manner of striking, it is advisable to give the impulse slowly and heavily, and allow the fingers to press forcibly on the part for some moments after it has been given.

162. In the state of health the posture of the patient (except in so far as it may interfere with the act of striking on the part of the physician, or alter the tension of the patient's own muscles, or the relative position of the subcutaneous tissues) does not *directly* affect the results of percussion of the surface, wherever this corresponds to lung-substance. In other words, ordinary (as distinguished from artificial [163]) changes of posture have no notable influence in modifying the relationship of the lungs and their containing walls to each other, or in altering the amount of air they contain, or are capable of containing. But as variation of attitude very sensibly alters the position of the heart, either in a downward, forward, or sideward direction, and also of the liver, the posture of the patient must always be taken into consideration in estimating the results of pulmonary percussion near the cardiac and hepatic regions.

163. The posture of a patient undergoing percussion should, where circumstances admit of this, be the sitting or the standing. The difficulty of placing the patient perfectly level in bed (and if he be not so placed, the sound on either side is extremely liable to be modified), together with the constrained positions the physician is obliged to place himself in, in order to get at different parts of the chest, constitute so many objections to the recumbent posture.

While the anterior regions are under examination, the patient must hold his head erect, and allow his arms to hang loosely by his sides; his hands may be clasped across the head, to facilitate percussion of the lateral regions; and he should cross his arms pretty tightly in front, and bend his head slightly forwards while the back is examined.¹

164. Where muscle of any thickness covers the part examined, it should be in a relaxed state, so as to facilitate as far as possible the close approximation of the pleximeter to the proper wall of the chest. The converse is the case when immediate percussion is employed; for the obvious reason that a flaccid mass of muscle, in itself non-vibratile, must, besides, interfere with the transmission of sound from the subjacent parts.

165. It is scarcely necessary to insist upon the importance of observing, as far as possible, the same conditions, when percussing the two sides of the chest comparatively. Nor must it be forgotten, that in doubtful cases, the observation should be repeated many times and in various postures—more especially, if the patient be in bed, the percussion should be performed several times from the right and left sides of the bed alternately. On the other hand, it is of essential consequence in some cases, for instance, in percussing

¹ Vide a paper by Dr. Corson, of New York (Med. Times, May 14, 1859), recommending a variety of other postures.

the heart, that not only the posture of the trunk be unchanged during examination, but that the limbs be kept perfectly quiet.

§ I.—PERCUSSION IN HEALTH.

166. The properties of the percussion-sound of the healthy thorax vary materially in its different regions. The main clue to these differences has already [146] been pointed out in the varying proportions of air and solid material falling within the influence of the blow struck. The greater the body of healthy lung beneath any spot (because hence the greater the relative quantity of inclosed air), the lower will be the pitch, the longer the duration, and the softer the quality of the sound that spot emits under percussion. The only exceptions to this rule arise from the difference in physical constitution of the chest-wall itself in its different parts, illustrations of which modifying influence will appear as we proceed. Hence it is, too, that individual chests have their individual resonance, scarcely any two possessing exactly the same relative amounts of lung-substance and solid material in their walls.

167. *Anterior Regions.*—It is necessary to assume a standard of comparison for the sounds in different localities, and that of the infra clavicular regions may be used for this purpose. Here the resonance is of considerable intensity, true pulmonary quality and pitch, and sufficiently prolonged to have a distinctly appreciable duration, while the parietal resistance is moderate, and the elasticity marked. The pitch is slightly lower at the acromial than the sterno-clavicular angle [10], gradually rising from the former to the latter spot, and lower also at the second space than the first rib.

168. In the right mammary region, even at the upper edge, the pitch rises perceptibly, though slightly, on firm percussion; while at and below the fourth interspace, though pulmonary resonance may be elicited by a gentle tap, very perceptible elevation of pitch, with slightly increased resistance and diminished mass of tone, is caused, if the blow be firm, by the presence of the liver behind the shelving border of the lung; at the sternal edge of this region the heart in the majority of persons produces similar effects on the sound and resistance. In the inner part of the corresponding left region the mass of the heart plays a precisely similar part, greater only in degree, in modifying the percussion-note, extending its influence as far outwards as, or, with a firmly-given blow, beyond the nipple.

169. The resonance of the right infra-mammary region, in consequence of the presence of the liver beneath the surface, is high-pitched, brief, hard in quality (if the hepatic tissue be indurated the quality may be wooden), and accompanied with strong sense of resistance. The left lobe of the liver also exercises a similar influence on the inner part of the left corresponding region, while the outer portion is in like manner affected by the spleen, and the inter-

mediate space gives either an amphoric and ringing or a tympanitic note from the subjacent stomach, if that viscus be empty; a short toneless noise if it be full of food. On deep inspiration a certain amount of lung encroaches in front of the liver superiorly, and may be discovered by very gentle percussion; even in expiration some lung-substance may be similarly detected in the left region, unless the stomach happens to be greatly distended.

170. Both clavicles towards their sternal ends give a peculiar sound of mixed pulmonary and osteal characters, rendered somewhat tubular too by the immediate vicinity of the trachea; about the centre of the bone the tubular and osteal characters become less, the pulmonary more marked, the pitch falling perceptibly. Towards the humeral end of the bone the note again rises in pitch, and its quality becomes hard but non-tubular.

171. In the supra-clavicular regions, at their outer part, the resonance has much the characters of the first interspace; the pulmonary quality, especially in females and young males, is quite as obvious as below. The pitch rises at their inner part, where a slightly ringing and tubular quality is also elicited, unless the blow be directed so as to avoid the trachea completely. The grave-toned resonance of this region may, in moderately thin persons, be retained even a little behind the anterior edge of the trapezius muscle. On the other hand, in individuals free from thoracic disease, but either naturally very thin or emaciated from any disease, the outer part of this region often gives resonance of wooden quality under percussion, and is very resistant; the first rib forms, as it were, the floor of the region, and its proper osteal tone comes out modified by the intervening soft parts.

172. The supra-sternal region gives distinctly tubular resonance if the percussion be made at right angles with the surface; a mixture of osteal sound is detected if the impulse be given even to a slight degree in a downward direction; the proximity of the trachea and sternum explains this. In the upper sternal region the resonance is of the same mixed quality as on the adjoining end of the clavicle as far downwards as the second rib; here, at the point of convergence of the inner borders of the lungs, especially at the moment the organs are distended by inspiration, purer pulmonary tone may be elicited by gentle percussion. But occasionally, from excess of cellulo-fatty substance at the top of the mediastinum, the percussion-sound may be hard in quality and high-pitched here, a peculiarity which sometimes proves a source of serious clinical difficulty.¹

173. From the third rib downwards the resonance is of complex character. The heart and liver, with the intervening diaphragm, give a toneless sound, modified, however, by the peculiar bone-

¹ It may simulate, according to circumstances, the abnormal note of pericardial effusion, aneurism, or tumor, as will hereafter be fully shown.

resonance of the sternum itself. If the stomach be in the condition to yield either an amphoric or a tympanic note, one or other of these qualities may be detected, modifying still further the intrinsic sound of the solid organs. This region further presents one of the most difficult practical problems in the art of percussion, that of defining the line of union of the heart and liver. Now, although there are cases where, to a practised ear and finger, the differences in the pitch of the sound and resistance of the two organs (the former being lower and the latter less over the heart than the liver) will effectually mark out the continuous edge of each of them, instances of the kind are not the most usual, obviously because, one of the organs somewhat overlapping the other, the percussion-note there must be a resultant of that furnished by the substance of both. These characters failing, the line of demarcation may in many persons be traced by making gentle and forcible percussion alternately, while the patient holds his mouth widely open; the special amphoric quality of the stomach-note may then be detected between, and only between, these two organs; this I have repeatedly proved on the dead subject. But even this test will, sometimes from solid or fluid accumulation in the stomach, sometimes from unusual position of the viscera, wholly fail; the line can then only be found by uniting hypothetically the lowest point of the heart's impulse with the apex of the angle formed by the union of the upper free edge of the liver with the right free edge of the heart.

174. *Posterior Regions*.—The supra-spinous fossa (in spite of the mass of muscular substance filling it, and the imperfect apposition of the bony stratum of the scapula with the chest-wall beneath) gives a note in healthy persons, even though they be fat, by no means deficient in the graveness, the body of tone and soft quality characteristic of normal pulmonary resonance. In thin females, especially, the note is sometimes very strikingly pulmonary.

The lower scapular region, while less resonant and higher pitched than the upper, and resisting to a marked degree the impulse of the fingers, has some faint pulmonary character in both respects; the spine of the bone, on mediate percussion especially, gives a high-pitched osteal sound. The inter-scapular region holds an intermediate place in point of resonance between the upper and lower scapular.

175. The entire of both infra-scapular regions, especially in inspiration, gives a well-toned pulmonary note on gentle percussion as far as the eleventh interspace downwards. But forcible percussion on the right side brings out the high pitched, hard, hepatic sound from the lower edge of the region, as high as the ninth or even eighth rib, the amount of these characters gradually decreasing in the upward direction.¹ On the left side the spleen, if large,

¹ The blow must really be forcible, however, to bring out liver-note so high as this.

or the stomach and intestines, modify the percussion-sound of the lung, at the lower part of the region. Speaking roughly, it is certain, the extreme right posterior base is less resonant, and its tone slightly higher pitched, than the left. The influence of the kidneys, when of natural size, is practically null.

176. *Lateral Regions.*—The axillary region is highly resonant in its upper part, giving in many persons a sound graver, softer, louder, and of greater duration than the infra-clavicular region. On the right side the sound loses in amount and rises in pitch on strong percussion at the fourth interspace, and acquiring the same characters at the sixth rib, as in the infra-mammary region in front [173], retains them thenceforth to the lower border of the infra-axillary region. Below the sixth rib on the left side, though pulmonary resonance may still be elicited by gentle percussion, the spleen and stomach modify in their respective ways the quality of the sound.

177. Lastly, the sound elicited from the larynx and trachea (which is best obtained by flipping with the right middle finger one of the fingers of the left hand applied firmly to the surface, the patient's head being thrown back, and the tissues of the neck thus brought into a state of tension) is notably higher pitched than the pulmonary, loud, of considerable duration, and has a distinct hollowness in its quality,—is in fact tubular. These characters arise from the form of the tube and the quantity of cartilage in its walls. The resistance is greater under the fingers, in proportion to the mass of sound, than it would prove over healthy lungs.

178. The properties of the sound elicited by gentle and by forcible percussion differ to a slight or to a marked degree in all regions of the chest independently of difference in the density of the structures beneath. When strong percussion is used, the percussing fingers, by a sort of mechanical necessity, are allowed to rest on the surface for a moment; and thus a muffled character is given to the sound from interference with the vibrations of the chest-walls. Hence, force in the blow, instead of intensifying, weakens the sound and lessens its duration. Again, wherever an organ of greater density than the lung lies at some depth from the surface, the intervening space being occupied by pulmonary tissue, the sound will be raised in pitch and lessened in amount, by striking heavily, its duration diminished, and the sense of resistance increased: by employing force, the impulse is made to reach the deep-seated organ. For this reason a decrease in amount of tone and rise in pitch may, as we have seen, be sooner detected by strong than by gentle percussion, in passing from above downwards in the right lateral and anterior regions; the influence of the liver is thus brought into play at a higher point of the chest. On the same principle the precise extent of the heart overlapped by the lung may be defined by alternately using some force, and by merely tapping the surface.

179. The sound is louder and of harder quality on the ribs than the intercostal spaces; this is especially true in thin persons—the osteal note mixes with the pulmonary, and also raises the pitch of the resulting compound sound. So, too, the tone is harder in quality and higher in pitch, as a rule, over the angles of the ribs posteriorly, than in the vertebral groove.

180. A rising gradation of pitch from grave to acute, changing at irregular intervals, it is true, may be traced in the antero-lateral regions, as follows: stomach region (the graver the more that organ is distended with gas); the axillary region; the second interspace; the post-clavicular region; the third space; the fourth space; the mid-top of the sternum; the clavicle; the centre of the cardiac region; the liver.

181. The acts of inspiration and expiration modify the results of pulmonary percussion in three different manners: *a*, by altering the volume of the lungs; *b*, by altering their density; *c*, by altering the position of the heart and abdominal viscera.

182. *a*. At the close of an ordinary expiration the right lung extends downwards as far as the sixth rib in front and the eighth laterally. The lower edge of the left organ sloping abruptly outwards and downwards from the middle line on the level of the fourth cartilage, again turns inwards a little, and then passes outwards, reaching laterally the eighth rib or interspace. From numerous trials on the dead subject, where no cause existed to modify materially the volume of the lungs, I infer that in expiration the lungs are from one to one and a half inches apart on the level of the second cartilage, and four and a half inches apart on the level of the fifth. From their lateral aspect the lower edges curve downwards and backwards, reaching the ninth interspace or tenth rib, especially close to the spine.

183. During full inspiration the lungs extend downwards in all directions materially further than the limits just mentioned; their inferior edge is then carried about an intercostal space and a half lower than after ordinary expiration; whereas, by forced expiration that edge is sensibly raised. The play of the lower border of the right lung on the vertical line of the nipple may range between the fifth and the seventh ribs or interspaces—a distance averaging in chests of medium height about three inches. In the measure of this distance (determined by gentle percussion and by vocal fremitus) we have an excellent test of the “total breathing-volume” [122] of the right lung. So, too, the breathing play of the anterior margin of the left lung may be determined by its varying amount of encroachment on the area of the heart’s superficial dulness in inspiration and expiration.

184. It is obvious, from these facts, that the *superficial extent* of surface, from which pulmonary percussion-sound may be elicited, will vary with the precise moment of the respiratory act at which the observation is made.

185. *b.* In regions of the chest, say the infra-clavicular and axillary, where a large body of lung lies beneath, a sensible difference in density attends the entry or exit of the "total breathing volume" [122] from the part. At the end of forced expiration the percussion-note is higher in pitch, harder in quality, shorter in duration, and inferior in mass of tone to that produced at the end of full inspiration. The sense of resistance increases, at the same time, the more complete the expiratory emptying of the lungs. Nay, even in the ordinary movement of the tidal air [122] differences the same in kind, though greatly less in degree, may be occasionally caught, where the lungs are thoroughly sound.

186. *c.* The fall in position of the dense spleen and liver attending inspiration, replaced as they are by expanding lung, tends during that act to increase the amount of pulmonary character in the percussion-sound in the lower regions of the thorax; the influence of the similar locomotion of the stomach and intestines will vary with the filled or empty state of those viscera. The heart pushed downwards and inwards, and receding somewhat from the chest-wall during inspiration, where its place is taken by the inflated lung, gives its peculiar high pitch and relatively hard resonance within a smaller area and lower in site during that act than in expiration.

187. In consequence of this triple influence of the respiratory movements on the results of percussion, it is advisable, under all circumstances, and absolutely necessary in delicate cases, that the act of respiration be at the same stage of progress, when the two sides of the chest are percussed comparatively. The end of a full inspiration is in such instances the fittest moment for striking; as, by desiring the patient to hold his breath, we may then be certain of having both lungs in the same state for a short while.

§ II.—VARIATIONS FROM THE STANDARD OF PULMONARY PERCUSSION COMPATIBLE WITH A HEALTHY STATE OF THE LUNGS AND PLEURA.

188. The sound yielded by the chest of different individuals varies in characters. In some instances this is explicable, in others not so. As a general rule, the thinner the walls, the greater the mass of tone, the graver the pitch, and the more pulmonary the quality of the percussion note; in all these attributes the note improves in persons whose thoracic walls emaciate independently of pulmonary disease. On the other hand unusual laxity of the ligamentous structures of the thorax renders the walls unfavorable to vibration. But, making all allowance for these conditions, there will still remain instances in which the chest is unusually well or ill-sounding, without its being possible to assign any satisfactory cause for the peculiarity. The real existence of such cases, however inexplicable at present, should always be borne in mind by the clinical observer.

189. Sex has its influence: the sound is relatively more pulmonary

in all its attributes in females in the upper regions, especially the supra-clavicular, as contrasted with the lower, than in males. The relative amounts of movement of the tidal air superiorly and inferiorly in the two sexes, give a satisfactory clue to the difference [49].

190. The sound varies, too, with period of life. From the age of four or five to fifteen the pitch is grave, the duration marked, the quality soft, resistance slight; the walls are flexible, elastic, and commonly not much loaded with soft textures. The ossification of the cartilages, desiccation of the ligaments, and general stiffness of the thorax in old age impairs the freedom of vibration, and *pro tanto* lessens the resonance: but the excess of hardness in the chest-wall thus induced tends to raise the pitch and annul the healthy softness of quality of the percussion note. These latter effects would probably be much more generally observed, were it not for the counteracting influence of senile atrophy of the parenchyma of the lung and wasting of the external soft parts.

191. Marked deformity of the chest, congenital or acquired, modifies the resonance over lung, healthy in itself. Lateral curvature of the spine will destroy the pulmonary quality in the direction where it bears. Many of the physiological deviations from symmetry, described by M. Woillez [31—35], also variously influence the percussion results—their general tendency being to raise the pitch and harden the quality of the sound. The existence of broken ribs, too, lessening freedom of motion on the affected side, and hence lessening the quantity of air in proportion to the pulmonary substance beneath, induces the effects on the percussion-note entailed by increase of density [146]—a fact showing that slight diminution of resonance does not, after an injury of the kind, positively prove the existence of pulmonary congestion.

192. Numerous differences in the results of percussion of corresponding points of the two sides of the chest have been noticed, and traced to an obvious cause, the presence of texture and organs of different densities in those spots. Variable thickness of the external soft parts will have a similar effect; thus the right infra-clavicular region is less resonant than the left in robust persons whose employment requires much use of the right arm; the pectoralis muscle enlarges from use. Here the explanation is obvious; but the explanation is not obvious when the right infra-clavicular region emits less tone than its fellow in persons presenting no muscular thickening of this kind.¹ Such inferiority of resonance (sometimes attended, too, with slight elevation of pitch) is never great, provided the lungs be perfectly healthy; it holds good, whatever be the direction given to the percussing fingers, and whether they fall outwards towards the humerus or inwards towards the sternum.

¹ Clinical Lectures, Lancet, loc. cit., p. 196.

The pitch is higher and the quality harder in some individuals at the left than right sterno-clavicular angle.

§ III.—PERCUSSION IN DISEASE.

193. Whatever be the nature of the morbid conditions of the sound discovered in any case, the area within which they exist, like that of the unhealthy textural state causing them, may be either accurately defined or not. In the latter case there is no difficulty experienced in ascertaining the precise limits of the diseased part; in the former there often may be some indecision on the point, and it will be found useful to glide the pleximeter finger rapidly over the entire region under examination, continuing the percussion all the time it is moved. In this way the exact line at which change of resonance begins may be detected in difficult cases.

I.—ALTERATIONS OF SOUND.

A.—STATIC SIGNS.

194. As the percussion note possesses four distinct properties—intensity, pitch, duration, and quality—and as any single one of these, or any number of them in combination, may be altered independently of the remainder, it follows the possible modifications in disease are very numerous. But the varieties of practical significance are few, and may be tabularly set down as follows:—

Types of morbid resonance.	Intensity or mass of tone.	Pitch.	Quality.	Duration.	Resistance.	Corresponding physical state.
Type 1. <i>Tonelessness or Dulness.</i>	Diminished.	Raised.	Hardened.	Lessened.	Increased.	Air diminished; soft consolidation or fluid present.
Type 2. <i>Extra Resonance.</i>	Increased.	Lowered.	Softened, more or less tympanic.	Increased.	Decreased.	Moderate excess of air.
Type 3. <i>Hardness.</i>	Not sensibly changed, may vary.	Raised.	Hardened,—or still further modified [205].	Not sensibly changed.	Increased.	Air diminished;—hard consolidation.
Type 4. <i>Muffled tone.</i>	Diminished.	Lowered.	Annulled.	Lessened.	Increased, of peculiar character.	Great excess of air, with parietal tension.

195. *Type 1.*—Diminution of intensity, resonance, and mass of tone (gradually passing into more or less complete tonelessness, so-called dulness) accompanied with elevation of pitch, loss of the normal soft pulmonary quality, and shortening of the sound, occurs in a certain proportion of cases where the density of the materials, under the part struck, is increased.¹ Thus, deficient resonance with these accompaniments exists to various amounts: *First*, where new

¹ Some apparent exceptions will be discussed by and by [199].

material of greater density than lung and air, combined in the natural relationship, has accumulated within the chest; whether it be in the lung proper, as in the engorged and hepatized stages of pneumonia, abscess, gangrene, serous infiltration, apoplexy, simple chronic consolidation, infiltration or tuberculous accumulation of exudation matter, tubercle or cancer within the parenchyma, or in the pleura, as in cases of hydro-pneumothorax, hæmothorax, pleurisy in the periods of exudation, effusion, and retraction, empyema, serous infiltration of old false membrane, and solid adventitious products of all varieties; or in the bronchi, as in cases of abundant mucopurulent accumulation within the tubes; or in the mediastina, as in cases of hypertrophy of their cellulo-fatty tissue, enlarged bronchial glands, abscesses, and adventitious solid products. *Secondly*, such deficiency of resonance arises where any condition, either physical or dynamic, exists, favoring expiration and impeding inspiration, as in obstructive diseases of the upper air-passages, spasm of the glottis, and spasmodic asthma; in the latter affection the presence of pulmonary emphysema often prevents the failure of resonance from being discovered. *Thirdly*, dilatation and thickening of the bronchi, condensing the adjacent parenchyma, produce a similar effect. Further, serous infiltration of the parietes, abscesses, tumors,¹ soft osteophytic enlargement of the ribs in chronic empyema (U. C. Mus. No. 4067), and thickening of the costal periosteum in syphilitic persons, will deaden the sound and raise its pitch. The influence of the heart and great vessels will be elsewhere considered.

196. Deficiency of resonance does not vary in amount or in attendant characters according to any known laws, determined by the pathological nature of its cause. It may be affirmed, however, that extreme tonelessness with greatly heightened pitch and strong resistance goes far sometimes towards establishing the diagnosis in cases of intra-thoracic tumor. Between this extreme and the opposite one of slight impairment of sound in spasmodic asthma, all shades of difference may be observed.

197. *Type 2*.—Increase in the mass of percussion-tone, fall in its pitch, and increase in its length, while the quality grows even softer than that of health, and the resistance under the fingers decreases, are noted, when the relative quantity of air within the chest is increased, either generally or locally. The type belongs to diseases which may be familiarly called rarefying,—except under peculiar circumstances to be presently (*Type 4*) considered.

Here may be enumerated pneumothorax, hydro-pneumothorax, atrophy and emphysema of the lung,—pulmonary hypertrophy, too, if accompanied with cell-distension. And extreme anæmia, probably by lessening the relative quantity of blood in the lung,

¹ Cancer of a rib producing this effect in the interscapular region, case of Jennings, U. C. H., Females, vol. xv. p. 65, 1859.

may, as originally suggested by Dr. Stokes, produce the present type of morbid resonance.

198. This type comprises all cases of tympanitic resonance,—that is, the term being understood to signify (as it always does in this work) pulmonary resonance exaggerated, and resembling that of a drum.

199. *Type 3.*—Heightened pitch, quantity of tone not sensibly changed (if anything, increased), while the quality becomes hard, wooden, or even tubular [208], is a combination frequently met with in certain conditions of induration of the lung-substance. It is, perhaps, the most frequent state of the percussion-sound at the apices in early tuberculization. This type, again, is observed where there is a surplus of air in the subjacent part, with considerable induration of tissue between the surface and the part containing that surplus,—a combination of conditions met with where a superficial cavity in the lung has a thin, indurated, and adherent wall; or where dilated tubes are surrounded by very hardened tissue, as in pulmonary cirrhosis.

200. *Type 4.*—Numerous observers have noticed that in cases of pneumothorax the resonance, originally of Type 2, occasionally changes wholly in the progress of the disease. The change is connected with extreme distension of the pleural sac, and is characterized by diminished intensity of resonance,¹ fall in pitch, loss of distinctive quality, and lessened duration. M. Woillez, correctly distinguishing this tonelessness, from ordinary so-called dulness, invents for it the title *obtusio* of sound—the phrase *muffled tone* will perhaps convey the idea. The resistance is very peculiar in character—suggestive of extreme tension and thinness of the resisting material.

201. Distension of the pleura with air being the admitted cause of the exaggerated resonance of type 2, why does the tympanitic quality become less marked, when air-distension reaches an extreme point—when, in other words, the cause appears increased in amount? Whatever be the explanation, a similar phenomenon is observed in the drum; if a drum be tightened to the extreme point possible, and all escape of air from its cavity prevented, its sound, when struck, becomes muffled, toneless, almost null. Some maintain that the excessive stretching of the chest-walls or drum-ends impedes their vibration, in conformity with results obtained by Savart on the vibration of tense membranes; others, that the walls becoming vibratile when stretched to the maximum, their vibrations interfere with those of the contained air, and so nullify the sound, which is really and solely produced by that air. It may be that the mere size of the pleural sac has something to do with the phenomenon; an aperture is essential to sonorous vibration in large hollow instruments, whereas the vibrations of the air in small cavities are said to be soniferous, although perfectly closed: it is doubtful, however, that the difference in capacity of a moderately and a greatly distended pleural sac is sufficient to warrant this explanation. M. Woillez (maintaining that the diminution of sound has nothing to do with increased tension of the

¹ Plympton, U. C. H., *Males*, vol. iv. p. 410. I believe Skoda to have been the earliest person who put the fact on printed record.

walls, inasmuch as the more compact the chest-wall, the more intense the sound¹) suggests that, as by gradually distending to extremes a hollow organ with air, the pitch is lowered and the sound lessened, the sound in the cases of pneumothorax under consideration is diminished simply and alone from excess of graveness.

202. Another strange fact is, that over different parts of the same air-distended side may be heard by percussion amphoric note with metallic echo, true tympanic note and the muffled type of resonance or obtusion, just discussed.²

203. But, in addition to forming an element of these morbid types of percussion, pitch and quality may be either solely, or so predominantly, affected, as to constitute the essential morbid condition.

204. Alterations of pitch rarely exist unassociated with other changes. Slight sharpness of tone at the apex in commencing tuberculization is the only useful example I can adduce. This sharpness may, I conceive, depend on connected congestion of the part—the rapid changes which it may present under treatment seem otherwise inexplicable.³

205. *Changes of Quality.*—Instead of the quality *sui generis* which distinguishes the natural sound emitted by the chest, others, assimilable to those of various well-known tones, exist in certain states of disease. These morbid varieties of quality may be arranged thus:—

- | | | |
|-----------------------|---------|----------------|
| (1.) Hard | Wooden. | |
| (2.) Hollow | { | |
| | | Tubular. |
| | | Amphoric. |
| | | Cracked-metal. |
| (3.) Tympanitic. | | |

206. (1.) The healthy softness of pulmonary resonance is very easily lessened by consolidating diseases: the resulting hardness eventually passes into the wooden quality—closely resembling that of the sound yielded by mediate percussion of a deal table, and distinctly conveying the idea of hardness. The duration of the sound having this quality is commonly less, the pitch higher, than in the natural state, and the sense of resistance experienced by the fingers unusually great.

207. (2.) The *hollow* type occurs under three varieties—the tubular, amphoric, and cracked-metal.

208. The *tubular* quality is precisely like that of the resonance emitted by the trachea under mediate percussion. The sound it characterizes is of some duration, and the thoracic elasticity some-

¹ In illustration M. Woillez compares the greater resonance of the ribs with the lesser tone of the interspaces. But he here seems to confound combined quality and pitch of sound with amount of sound: he forgets, too, the difference of the material of the rib and intercostal space.

² Reilly, U. C. H., Males, vol. xvi. p. 168, 1859.

³ A patient exclaimed, while I was percussing his anterior apices, "that sound has fallen a quarter of a tone, since you last examined me"—referring to the note under one clavicle. The two examinations were made at an interval of fourteen days only. It may be well to add, in explanation of the patient's acoustic acuteness, that he was an orchestral player.

what impaired. This quality is to be detected (always more readily if the patient's mouth be kept open) about the inner part of the infra-clavicular region in cases of pleuritic effusion, occupying the lower parts of the chest—sometimes during the height of the disease—sometimes, when absorption has just commenced; sometimes in the stage of retraction of the same disease. So, too, when solidified lung, pent-up collections of pus, or solid products of any kind lie between the large bronchi and the costal surface, the sound acquires this quality. Mere dilatation of the bronchi will have the same effect. Sound of this quality is most common in the infra-clavicular and upper mammary regions; but it may occur in the inter-scapular region from enlarged bronchial glands,¹ or over a great part of the back in cases of intra-thoracic tumor.² Excavations in the lung of small and medium size furnish similar resonance.

209. The *amphoric* quality, the tubular on a larger scale, is heard in typical perfection in the sound produced by filliping the cheek, when the mouth is closed and fully, but not too tensely, inflated—and also in the abdominal percussion-sound in certain states of distension of the intestines. I have observed this perverted quality over the entire upper front of the chest, including the clavicle and first bone of the sternum, in a few cases of pleuro-pneumonia, and in as great purity as it is ever heard over the intestines. When of this origin, the sound does not last long. But the common source of the sign is a cavity of large size, near the surface, and provided with hard and thin walls. Here, as also in pneumothorax,³ it may be followed by a metallic, almost tinkling, variation.

210. The *cracked-metal* quality (*bruit de pot fêlé* of Laennec) somewhat resembles that of the sound resulting from striking the back of the hands, loosely folded across each other, against the knee—the contained air being forced out quickly and abundantly between the fingers at each blow. When this character modifies the percussion-sound of the chest, there is coupled with it almost invariably a good deal of the amphoric quality, and the combination gives a result altogether *sui generis*, which, once heard, cannot easily be forgotten. Let there be a pulmonary cavity of large size with anfractuons walls, and communicating freely with the bronchi, the corresponding parietes being at the same time particularly yielding, and percussion will elicit this variety of quality. It is commonly said to depend on the collision of liquid and air produced by the blow; but the sudden propulsion of air, forcibly expelled from the cavity, against the walls of the passages with which it comes in contact, seems sufficient to generate it. In the first place, cracked-metal resonance is producible over cavities, when free from fluid—

¹ Petrolini, U. C. H., *Females*, vol. v. p. 176. Here the tubular quality, distinct on gentle, disappeared on strong, percussion.

² *Nature and Treatment of Cancer*; case of S. C., p. 362, 1846.

³ Reilly, U. C. H., *Males*, vol. xvi. p. 168, 1859.

at least if the absence of cavernous rhonchus is to be trusted to as evidence. In the second place, if, as I found several years ago,¹ the nose and mouth be tightly closed in a patient furnishing the cracked-metal sound when they are open, that character will at once cease to be producible, though percussion continues to give an amphoric note.² The fair interpretation of this fact seems to be, that the sudden rush of air from the cavity outwards, produced by the forcible blow upon the yielding parietes in the ordinary open state of the mouth and nose, but completely prevented by their closure (the only condition materially altered in the experiment), is the real cause of the phenomenon. Whether the communication with the external air be interrupted or not, the contents of the cavity may be dashed together by percussion: were the common notion correct, the cracked-metal quality ought therefore to be elicited in both cases. This explanation derives support from the conditions of production of the amphoric and cracked-metal sounds by striking the hands, closed so as to form a hollow, against the knee: if they be so closed as to prevent air from being forced from between them by the blow, the amphoric character only is detected—if air be allowed to escape freely, the character analogous to the cracked-metal is superadded; yet here, certainly, there is no liquid to take part in its production. I have known a tubular note in pneumonia become distinctly cracked-metal when consolidation was at its height; and several instances have occurred to me of cracked-metal resonance under the clavicle of the affected side in pleuritic effusion.

211. It has been well observed by Dr. Stokes, that a "metallic resonance, somewhat analogous to the cracked-jar sound of cavities, but evidently more diffused, is occasionally discoverable in cases of bronchitis, particularly in children. I have repeatedly observed this in infancy; it becomes especially likely to mislead, when there is evidence of tuberculous disease in extra-thoracic organs, as the brain or meninges.³ The sound is certainly more diffused than, and otherwise different from, that dependent on excavation; but the absence of other cavernous phenomena, and the knowledge of the fact that bronchitis may simulate (for it does no more than this) the sound, are the best safeguards against error. The pliancy of the chest-walls explains the peculiarity.

212. If the chest of a crying infant be percussed in expiration, the resonance will be of cracked-metal quality, though the lungs are perfectly sound.⁴

213. (S.) *Tympanitic Quality*.—I reserve the title tympanitic for quality resembling that of a drum. By thus using the word in its

¹ Lancette, Française, 1834.

² The result will be the same, if the breath be purposely retained; a patient with tuberculous excavation, ascertaining this accidentally, amused himself with mystifying the bystanders, by sometimes having, sometimes not having, cracked-metal resonance.—Quin, U. C. H., Males, vol. vii. p. 291.

³ Wright, *æt.* 4; U. C. H., Females, vol. viii. p. 193.

⁴ Bowen, *æt.* 4; U. C. H., Females, vol. vii. p. 296.

commonly accepted sense and this alone, the confusion arising from the varieties of significations given it by authors will be avoided. The note is loud, long, grave; the accompanying resistance of the walls tense, drum-like, elastic. It is the quality of health exaggerated—Avenbrugger's muffled-drum note minus the muffling.

214. The relationships of tympanitic resonance and pneumothorax have just been discussed [201]. In emphysema, with bulging of the chest, it is also occasionally observed, but never in the perfection attained in pneumothorax. Further, as was first noticed by that accomplished observer, Dr. Graves, the quality of the note over pneumonic consolidation, sometimes, temporarily becomes tympanitic; of this I have now observed two positive examples at the right base, in one with, in the other without, plastic lymph on the pleural surface; but they are excessively rare.¹

215. The distinction of the amphoric and tympanitic qualities cannot be set aside practically, for they are absolutely different to the ear. Yet they are allied in mechanism. In the abdomen, for instance, a knot of intestine distended to the full with flatus will yield a sound of tympanitic quality; if the distension become less by the movement onward of some of the flatus, the sound will often instantly become amphoric; this holds true whether there be notable fluid or not in the spot. There are cases, too, in which the resonance partakes of both qualities, I presume because the blows given affect portions of intestine differently distended.

216. In a moribund patient of Dr. Garrod's (U. C. H., Ward 7), to whom I was called accidentally in the absence of that physician, and in whom I found, in addition to the more ordinary signs of copious pleuritic affection, *amphoric*, not tympanitic resonance at the upper and inner part of the side, extending across the first bone of the sternum, the post-mortem examination, a few hours later, proved the presence of several cubic inches of gas in the site of the amphoric resonance. Local pneumothorax, at all events at the *upper* part of the chest, may then give an *amphoric* quality to the resonance. But as I have since found that in general pneumothorax the sound may be amphoric at the lateral base, tympanitic about the mamma, and toneless in the axilla [202], it is plain the contiguity of the trachea and large bronchi does not explain the amphoric quality in the case just referred to.

217. True tympanitic resonance is excessively rare over pneumonic consolidation;² and I have scarcely ever observed it at the upper part of the chest where pleural fluid had accumulated below. When such resonance occurs at the base of the chest, great distension of the stomach or colon might be suggested in explanation; but in point of fact, the stomach and colon are rarely distended enough for the conversion of their common amphoric into tympanitic quality; and in the only two positive instances I have observed of pneumonic tympanitic sound, the consolidation was on the right side above the liver. Can the phenomenon depend on temporary secretion of air by the pleural sac?³

218. On the other hand, tubular, or the larger scaled amphoric, quality is not very uncommon over parts acutely hepatized; is common on the level of chronic solidification; and is an almost unfailing attendant, at the apex regions, on pleuritic effusion at some period or other of its course.⁴ What is the cause of

¹ I am doubtful, however, whether Dr. Graves, in using the term tympanitic, did not mean to designate the quality which I should call amphoric.

² Bishop, U. C. H., Males, vol. ii. p. 194.

³ Vide art. Products, Adventitious; Cye. of Anat., p. 145.

⁴ My own experience would justify stronger language even than this: I have, in truth, never known pleuritic effusion run its course without infra-clavicular tubular resonance, in cases examined day by day.

this? Formation of intra-pleural air, only in rare and exceptional cases, such as that just referred to [216]; for unquestionably, unless under the influence of gangrene, or special alteration of the fluids, such formation is not admissible on any existing pathological principles.

219. An explanation of the infra-clavicular tubular note in pleuritic effusion, originating with Dr. Hudson, has generally been accepted in this country; he looks upon it simply as the natural note of the trachea and main bronchus conducted to the surface by the pushed up and condensed lung. And I believe that the trachea does sometimes exercise this influence, just as it will where a mass of enlarged bronchial glands bridges the space between itself and the surface. But this explanation is utterly inapplicable to all cases; what light does it throw for instance on the occurrence of tubular note at the right posterior or lateral base?¹

220. Skoda regards the phenomenon as an illustration of the following law: if the lung contain less than its normal quantity of air, it yields a sound which either approaches to, or is distinctly, tympanitic. Skoda is unquestionably right as regards the matter of fact, provided the word be understood to mean tubular or amphoric,² and the reduction of air be limited in amount. The effect will be the same whether the diminution of air depend on compression from fluid in the pleura, or on "an increase in its own fluid or solid constituents."

221. But neither the explanation of this law, which has been offered by Skoda himself, nor the theory of annulled "Hallerian Extension" of the lung, which M. Woillez (loc. cit.) seeks to introduce in its stead, seem to me at all satisfactory.³

The most intelligible rationale of the peculiar tone seems to be this. If the consolidating material within or without the lung be not accumulated to such extent as to obliterate by external pressure the multitude of minute bronchiæ within it, these tubes (like so many miniature tracheæ) give their special resonance, conducted by the quasi-solid or fluid material intervening, to the percussion-note on the chest-surface. If, on the contrary, the accumulation be sufficient to close up the fine tubes, the source of tubular sound is annulled; and the resonance becomes that of the consolidating material and consolidated lung-tissue combined—that is, acquires the character of the toneless Type 1 [195].

But there still remains for interpretation an important point, namely, the constant extension of the tubular note beyond the area of the compressed lung (sometimes as far as the vertical line of the nipple on the other side), for which no one, as far as I am aware, has even attempted to assign a cause. Obviously it cannot depend on the compressed lung being pushed to the opposite side; hence the unavoidable inference that *the percussion-sound of a given spot may depend, not on the condition of the parts directly beneath, but of those more or*

¹ Tubular notes identically the same may exist over *fluid* below and *condensation* above—physical conditions so different. Ward, U. C. H., Females, vol. xi. p. 67; proved post-mortem.

² Skoda actually does include under this term the tubular and amphoric as well as the true drum-like resonance. Singularly enough, he nowhere states what he himself precisely means by the word tympanitic.

³ At the post-mortem examination of a case of acute tuberculization and consolidation, the following singular facts were observed. "In the third and fourth right interspaces, close to the sternum, where amphoric percussion note was so marked at the last examination during life (forty-eight hours before death), the resonance is now totally without amphoric quality. . . . About eight ounces of serosity in the right pleural sac; entire right lung solid, bearing on its surface the impress of the ribs. . . . Corresponding to site of amphoric resonance in front, the lung is thoroughly solid and cuts almost crisply; this portion of the lung lies over the main bronchial tube, which, however, lies deeply. . . . At the *posterior* aspect of the lung, about three inches from the apex, close in towards the spine, and at about half an inch from the surface, is a cavity capable of lodging a walnut." Hodson, U. C. H., Males, vol. ix. p. 18.

less distant in the fellow half of the thorax. To me the phenomenon seems only intelligible as a result of *horizontal impulse and horizontal conduction*.

222. Meanwhile the practical truths in the matter may be fixed on the student's mind by the following tabular arrangement:—

PERCUSSION-SOUND OF

	Intestine, containing	Lung, containing
Medium amount of air. }	Slightly tympanitic; pitch medium.	Muffled tympanitic (normal); pitch medium.
Little air.	Amphoric; pitch rises.	Amphoric; pitch rises.
Extremely large amount of air. }	Tympanitic up to toneless; pitch falls.	Tympanitic up to toneless; pitch falls.

223. *Movableness of area of morbid percussion-signs*.—The superficial extent and locality of percussion-changes, important guides to the detection of their cause, will be dwelt upon in the description of individual diseases. It may be remarked here, however, that the area, within which loss of resonance is detected, may either be *fixed*, or *changeable with the position of the patient*. The former is by far the more common case; no matter how the posture be varied, the line of demarcation of the naturally and morbidly sounding parts commonly remains unaffected. But under certain comparatively rare circumstances, the boundaries of the morbid sound may be more or less completely altered by causing the patient to vary his posture; the infra-scapular region, which may have been toneless almost when he lay on his side, or reclined backwards, will give a well-toned normal sound, after he has remained leaning forward for a short while, and *vice versa*. This movableness of the sign indicates movableness of its cause; and fluid collection in the pleura, from pleurisy, hydrothorax, and perhaps hæmothorax, is the only physical state of which the percussion-signs have, hitherto, been admitted to be thus characterized: the fluid will, of course, gravitate to whatever part of the patient's chest his changes of position render the most dependent. It is, however, by no means so constant a sign of pleuritic affection as might, from *à priori* considerations, be expected. The liquid is retained *in situ* in some cases by adhesions, which easily explains the fixedness of the deficient resonance; in other instances, the explanation cannot be found.

224. I some time since met with a case in which a massy encephaloid tumor hung by a sort of peduncle of condensed lung-substance to the surface of the organ, and so loosely that it must have altered its position as the patient turned from side to side.¹ But there was enormous pleuritic effusion present on the patient's admission, which

¹ Dewing, U. C. H., Males, vol. v. p. 19. Museum, No. 4000.

would of course have prevented the discovery of any change of place of the tumor, had the idea of looking for such locomotion occurred to me: the source of fallacy must be infinitely rare. More recently I ascertained, in a case originally seen by Dr. Evans, of Birmingham, that even in cases of solid infiltration of a lung, decumbency on the sound side may displace the morbid resonance of the diseased one,—carrying it to the opposite side of the median line at mid-sternum.

225. In hydro-pneumothorax the air and fluid may sometimes be made to change relative positions, to a certain extent, by changing the patient's posture; the site of the exaggerated resonance will, unless adhesions interfere, always be towards the upper surface.

B.—DYNAMIC SIGNS.

226. It has been seen, that in health the act of respiration modifies the results of percussion in three different ways; now in disease the natural modifications may be perverted or impeded, and hence a certain number of dynamic signs. Few of these signs are of practical importance; but occasionally some of them prove valuable.

227. As regards the increased volume of the lung, and the consequent extension of pulmonary resonance, attending inspiration—neither will occur in cases of hydrothorax, pleuritic effusion, and pneumothorax, in emphysema, and obstruction of the chief bronchus, either from foreign bodies or inspissated mucus within it, or from pressure, aneurismal, glandular, or other, without it. In a remarkable case of the latter kind, where the respiration was permanently weak, the failure of inspiration in increasing or extending the resonance of the side, contributed much to the diagnosis of obstruction of the main bronchus.¹ Further, in cases where, during expiration, air, which in health would escape, still stagnates within the chest, the residual and supplementary volumes [122] are constantly on the increase, and there will not be a sufficient reduction, during expiration, of the area over which pulmonary resonance is discoverable.

228. *Mutatis mutandis*, the respiratory influence on the percussion-note may be similarly affected. In health, full inspiration increases the loudness and lowers the pitch of the sound of percussion, and equally so on both sides of the chest. Certain states of disease, impeding full pulmonary expansion on either side, interfere on that side with the production of the changes discoverable on the other after full inspiration; hence a sign founded on *comparatively deficient increase of loudness and fall of pitch at the close of a full inspiration* on either side, the sound being equal on both in the ordinary state of respiration. Again, the sound of the healthy

¹ Mary Ransom; U. C. H., Nov. 1848.

chest is somewhat deadened and its pitch raised by full expiration, and equally so on both sides of the chest. Certain states of the lung destroy this equality by rendering the sound disproportionately toneless in the situation where they exist: hence the sign of *comparatively great diminution of tone with too high pitch at the close of full expiration*. Both these delicate signs sometimes give very satisfactory results in cases of small, irregularly scattered indurations, tuberculous or other, of either apex. The mechanism of the former is obvious; the latter depends on reduction of size of the lung, in expiration, bringing within a small space solid matter which had previously been more widely scattered.

229. Or, on the other hand, other states of the lung, by impeding the expulsion of air, render the sound disproportionately pulmonary; hence the sign of *comparatively deficient diminution of tone with too low pitch at the close of full expiration*, a sign discoverable in emphysema and obstructed bronchus. If there be air in the pleura, the same result will occur.

230. The diseased conditions in which respiration ceases to exercise any influence on the position of the heart and abdominal viscera may be inferred from the foregoing exposition.

II.—ALTERATIONS OF RESISTANCE.

231. In his introductory observations upon physical diagnosis in general, Laennec makes a passing allusion to the "sense of elasticity perceived" in percussing; but in no instance refers to the diagnostic indications derivable from changes in this elasticity. Piorry and others have availed themselves of them fully, but their importance is not generally appreciated. There are cases of not very rare occurrence in which erroneous inferences would almost inevitably be drawn from the sound elicited by percussion, were these not corrected by the information derived from the degree of resistance felt by the fingers. Take the case of a cavity seated close to the surface; the unnatural amount of sound which sometimes distinctly exists over such cavities, quite independently of tubular or amphoric quality, might not only lead to an incorrect estimate of the state of the subjacent part, but also to the inference that the lung in reality least affected was the most diseased. The sensation of hardness and firm resistance experienced by the fingers points to the true cause of the unusual resonance. Besides, the cases are extremely numerous in which it is satisfactory to have the corroborative evidence, furnished by the state of resistance, in favor of the inference drawn from the sound. That doubt often exists as to the relative resonance on the two sides is unquestionable; and in these cases the condition of the subjacent parts may frequently be settled by taking into consideration the amount of resistance. To those persons whose sense of touch is more delicate than that of hearing, this source of diagnosis is of especial value.

232. In the descriptions of changes of sound, a good deal has

been incidentally said on those of resistance; but recapitulation is advisable. The resistance depends on the state of the contents, and of the walls of the chest. All conditions lessening the relative quantity of air in the lung, while they deaden the sound, increase the resistance; they have already been enumerated. All conditions which conversely increase the relative quantity of air decrease that resistance, while they increase the volume of resonance; these also have been enumerated; pneumothorax is the typical disease. But the walls of the chest may be so stretched in that very affection by excessive accumulation of air that the resistance becomes considerable, though the sound continues abundant and toned. Here the state of the walls themselves modifies the resistance; as it does likewise where solid or liquid matters accumulate in their substance, where the periosteum thickens, or the ribs either enlarge, or, as in the retraction-period of chronic pleurisy, become unduly approximated to each other.

SECTION V.—AUSCULTATION.

233. AUSCULTATION means the act of listening, and is termed pulmonary or cardiac, according as the sounds listened to are produced in the lungs or in the heart.

234. The direct object of pulmonary auscultation is the appreciation of certain sounds audible on the external surface of the chest, and either produced by the respiratory play of the lungs themselves, or transmitted in a modified form by these organs from others, as, for example, the heart, in which they are actually evolved.

235. The method of performing auscultation may be *immediate* or *mediate*. In the first case the ear is applied directly to the chest; in the second, an instrument of variable material and construction (originally a hollow cylinder of wood, to which the name of stethoscope¹ was given by Laennec, a name retained for its various modifications) is used as a conducting medium between the surface examined and the ear.

236. Both of these methods of auscultation have had their favorers and their detractors. The advocates of mediate auscultation urge that—The stethoscope can be closely applied to several points of the chest, as the axillary, upper scapular, supra-clavicular regions, and acromial angle, where the ear cannot be placed in accurate contact with the surface;² the use of the stethoscope enables the observer to auscult in a posture more easy to himself than that he is obliged to assume if he apply the ear directly; it is indelicate to place the head upon the persons of females; it is disagreeable to bring the head in contact with the bodies and clothes of some of the lower orders; the limits within which the various sounds are

¹ From *στήθος* "the chest," and *σκοπεῖν* "to examine."

² These points are still more numerous in malformed chests.

perceived are more nicely circumscribed with the stethoscope than with the unassisted ear; certain phenomena, as pectoriloquy, are more distinct when the stethoscope is employed. On the other hand, while the partisans of immediate auscultation admit that in lean persons it is difficult to place the ear appropriately in some few situations, they affirm that such cases very rarely occur, and that in all others the stethoscope is an *inutile lignum*, the direct application of the ear giving as precise indications as the employment of that instrument, with less appearance of fuss, and less real trouble. For my own part, I entertain no doubt that Laennec and others have greatly exaggerated the superiority of mediate over immediate *pulmonary* auscultation in respect of the distinctness with which the phenomena are heard, and the precision with which they are circumscribed, in cases where both modes of auscultation can be employed; and that this distinctness and this precision are in fact greater in such cases with mediate or with immediate auscultation, according as the observer is more habituated to one or other of these modes of examination. It seems very plain, however, that as there are cases in which the ear cannot be directly applied, or in which it is disagreeable or indelicate to do so, mediate auscultation is the method with which the student should most closely familiarize himself; while, on the other hand, as it is often difficult to persuade children to allow the stethoscope to be applied, and as we may often desire to auscult an adult when no instrument is within reach, the ear should be practised in immediate auscultation also.¹

237. The proper construction of the stethoscope has been a subject of constant dispute. As was felt by Laennec, theory, in the present state of acoustics, deposes in favor of the solid instrument; yet, as a hollow one is almost universally employed, it may be inferred that theory is somewhere at fault. From trials with hollow and solid ebony and cedar stethoscopes, I have come to the following conclusions: That with the hollow instrument the respiratory sounds appear stronger, lower pitched, and more open in quality—with the solid, weaker and sharper, so much so that a bronchial character may be simulated; that cavernous phenomena lose in

¹ Beyond all doubt, first-rate skill in *pulmonary* auscultation might be acquired without using the stethoscope at all, though it is common to hear the *invention of the stethoscope* spoken of as constituting Laennec's claim to immortality. No! his name will be imperishable because he *discovered auscultation* (for the claims of Hippocrates, Hook, and Double, may, without injustice, be ignored), described accurately the sounds it detects, and traced these sounds to their physical conditions. Persons, indeed, are to be found who seem to think that the stethoscope possesses some mystic faculty of communicating diagnosis, and saving the auditor all trouble of thought; unfortunately, the instrument is no more than

. . . das tote Sprachrohr, das den Schall
Empfängt und wiedergiebt, und selbst nicht höret.

The motto of the stethoscope might aptly run:—

. . . fungar vice cotis, acutum
Reddere quæ ferrum valet, exsors ipsa secandi.

some measure their hollow quality with the solid instrument; that friction-sounds are sometimes materially better heard with this; that the natural vocal resonance over the trachea is hollower, graver, and better articulated with the hollow cylinder; and that the resonance of the observer's own voice, as he speaks, while ausculting the chest of another person (autophonia), is materially more intense with the solid than the hollow instrument.

238. Glass, gutta-percha, and metal have been tried, but are certainly inferior, for various reasons, to wood, deal and cedar on the one hand or ebony on the other. Ivory (as I once had an opportunity of observing with an instrument lent by Mr. Cheverton) notably intensifies the sound. But the really important point is, that the ear-piece should fit the ear well—it is as necessary to try on a new stethoscope, as to try on a new hat. Beyond this, all depends on the use to which the student puts the instrument, and not on the density or quality of the material or the direction of its fibres.

239. A double flexible stethoscope, recently patented by Dr. Cammann, of New York, so intensifies the sound, according to Dr. Flint, as to render auscultation available to persons with impaired hearing. But as confessedly the instrument alters the pitch and the quality of the sounds—makes them that to his ear which they are not—is it not likely the deaf observer would be rather deceived than enlightened by the information acquired?

240. Dr. Alison recommends the interposition of an India-rubber bag of water (hydrophone), as a useful adjunct to the stethoscope, under a variety of circumstances.¹

241. In performing auscultation, several precautions, affecting the observer and the observed, are to be attended to. 1. The chest should be uncovered; or if, from circumstances, such exposure be inadmissible, as thin a layer of clothes as possible allowed to remain between its surface and the stethoscope. 2. All friction between the stethoscope and the patient's or the observer's clothes should be carefully prevented. 3. The position of the patient should be regulated in the same manner as for the performance of inspection; an unconstrained state of the muscles being particularly necessary, in order to insure free entry of air into the lungs. The sitting posture is, everything considered, the most conducive to perfect investigation, provided the chair employed have a tolerably high seat, and the observer be of the middle height; a tall person will find himself most at his ease, if the patient stands. It of course frequently happens that the recumbent posture is the only one the patient can easily assume—he may be perfectly unable even to turn on either side. Under these circumstances the utility of the flexible stethoscope has been insisted on, as it may be applied far back laterally, and even to the dorsal regions, if the body be inclined a little sideways,

¹ Medical Times, July, 1859.

without moving the patient. I confess I have never yet seen an ordinary case of pulmonary disease, whether primary or secondary, in which, so long as it was a matter of importance to auscult the chest, the patient might not be raised sufficiently by careful attendants, to admit of the examination being efficiently made, for practical purposes, with the common stethoscope or ear alone. But attendants may not be within reach; and, in special cases, tendency to syncope may make it dangerous to raise the patient's head; here the flexible instrument will be useful. Besides, it saves the observer the necessity of stooping—which may to some persons be a matter of importance. If in the sitting posture, while the front of the chest is submitted to examination, the patient should sit not exactly erect, but with the trunk sloping a little backwards, the arms being allowed to hang loosely at the sides. When the observer proceeds to examine the lateral regions, the patient may be directed to clasp his hands on the top of the head—in other respects, retaining his former posture; and, lastly, when the dorsal regions are examined, sit upon the chair sidewise or, if a male, a-straddle, with his back to the observer, his arms crossed, and his head bent somewhat forwards. *Mutatis mutandis*, the same precautions are to be taken when the patient stands, lies, or sits up in bed. 4. It is of importance to apply the stethoscope firmly, but not forcibly, to the surface: too slight or too strong pressure interferes with the accurate transmission, or alters the character, of the sounds. 5. Great care must be taken to insure accuracy of contact between the skin and every point of the circumference of the end of the stethoscope; as a necessary condition for this, the instrument must be applied perpendicularly to the surface, and held until firmly placed, by its applied end: the auscultator may then readily assure himself with the fingers, whether the skin and the edge of the instrument are in accurate apposition. 6. The posture of the observer should be free from all constraint; he should apply his ear to the stethoscope with as much care, as the instrument to the chest; concentrate his attention upon the sound examined; and, unless he be thoroughly experienced, proceed, as far as is compatible with the patient's safety, slowly with his examination. The motto *festina lente* is a good one for the beginner in the study of physical diagnosis. 7. It is advisable to commence the auscultation of patients, while they breathe in the manner to which they are naturally inclined; because it is important to ascertain the precise condition of the *tidal* respiration, and because directions for the regulation of the act often puzzle. Some individuals, however, absolutely require guidance: as the moment they perceive the instrument applied to their chest, they throw the muscles of the trunk into violent and unnatural motions, which materially impede the entry of air into the lungs. The simplest way of making such persons breathe in an efficient manner is, to perform several quick noiseless respirations before them, and desire them to imitate these. This method will, however, occasionally

fail; our object may then be gained by desiring them to sigh, to speak, or to cough. The deep inspiration required for the performance of these acts will at once enable the observer to ascertain the condition of the sounds; and, indeed, there are many states of the lung in which, quite irrespectively of the patient's manner of breathing, much information may be gained by a single cough. It is to be remembered, however, that by these artifices we lose the simple tidal respiration. 8. The sounds produced in the pharynx by the passage of the air are liable to be confounded with the true pulmonary sounds of respiration; the error may be avoided by directing the patient to open the mouth, if it have been previously shut, and *vice versâ*. If the sounds heard have their seat in the lungs, they will suffer no notable change from this opening or closing of the mouth; if in the pharynx, they will be more or less modified in character. It is, however, only in unusual cases that a direction of this kind is necessary to enable a practised auscultator to avoid the error referred to; though it may often be advisable to corroborate thus the impression derived from ordinary examination. The sensation of distant production which attends the pharyngeal sounds, and the occurrence of a distinct interval of time between inspiration and expiration (a point to which I particularly recommend attention), will suffice to distinguish them from the true pulmonary sounds. With ordinary watchfulness, the observer may distinguish the two kinds of sound at the same time. 9. Both sides of the chest must be submitted to precisely the same examination—conducted precisely in the same way—as already explained in reference to percussion. 10. Auscultation should never be considered complete, until the entire chest has been examined: it is often in some or other situation, where symptoms would least have taught us to look for disease, that auscultation proves its existence. 11. In acute affections, auscultation should be repeated twice, at least, in twenty-four hours. 12. The student should accustom himself to the use of both ears.

§ I.—THE SOUNDS OF RESPIRATION.

I.—IN HEALTH.

242. Two sounds, discoverable by auscultation of the breathing apparatus in the state of health, attend each act of normal respiration; one, corresponding to the movement of inspiration, the other, to that of expiration. These are the *inspiratory* and *expiratory sounds*.

243. The *essential or primary properties* of these sounds, practically considered—those which, in their modified states especially, possess diagnostic importance—are: *Special Character and Quality; Pitch; Intensity; Duration; Liquidness; Softness; and Rhythm*.

244. By the *special character* of a sound is understood that peculiarity, which must, under all conditions of intensity, duration,

rhythm, pitch and key, distinguish it from others; the special character of the sounds of a piano-forte, for example, will invariably differ from that of the tones of a violin. Here also, for the purpose of simplifying the subject as far as possible, without incurring any material sacrifice of accuracy, may be included that property of sound known as *quality*; though, in point of fact, the *quality* or "timbre" of a sound is a different thing, acoustically speaking, from its *character*. Thus, two voices, identical in point of character and of register—say, tenor—will sound the *same note*, in the same *rhythm*, with the same amount of *liquidness*, with the same *intensity*, and for the same *duration* of time, and yet a marked difference shall exist in the sensations impressed upon the ear by the two tones: that difference depends on the *quality* of each; and by it any two tenor or soprano voices are as easily distinguishable from each other, as any one of the four from those of bass or contralto register. Variety in quality is supposed to depend on varying form of the sonorous waves; but the conditions determining that form have not been ascertained. As the quality of the notes of musical instruments varies with the precise form and properties of the material composing them (the secret of the Cremona violins lay in their form and component woods), it may reasonably be conjectured that the form of the vocal tube and the tension, dryness, elasticity, and other properties of the tissues engaged in the production of laryngeal and pulmonary sounds modify the quality of these.¹ The *pitch* of sounds rises as the frequency of the vibrations in a given time of the sonorous body; the evident variations in pitch of the respiratory sounds under different circumstances immediately depend on variations in that frequency—but why, or through what mechanism, the frequency is affected by different anatomical conditions, is unknown.

245. The terms *intensity* and *duration* explain themselves. The notions of *dryness* and *liquidness* of sound may be at once obtained by squeezing close to the ear first a perfectly dry, and then a moistened sponge. Similarly if we press together a mass of wool held beside the ear, the property of *softness* in sound will at once become intelligible; its converse *hardness*, by grating together any two hard bodies. The *rhythm* of a sound means its mode of progression or evolution, which may be continuous and equable, or interrupted and jerking.

246. Although in originally establishing the varieties of morbid breathing, every respiration-sound requires to be analyzed in re-

¹ Some of the conditions regulating the quality of the human voice are theoretically under the influence of the will; and, as matter of experience, it seems certain that effort—and imitative effort especially—will modify the quality of singing tones. Thus, I know a tenor singer who managed during the opera-season to throw into his voice, one of every-day tenor character, a something of the marvellous quality of Mario. This person assured me, that the power, which almost completely disappeared with the annual disappearance of his model, came of imitative effect.

spect of these various properties, the complexity of the matter is much less in actual practice than it seems; for experience proves that several of these properties are almost invariably altered simultaneously, and of course such compound states may be described for convenience sake by single phrases.

247. The properties of the sounds differ in the various divisions of the respiratory organs; for each of these divisions there is a healthy type of respiration, termed, *pulmonary*; *bronchial*; *tracheal*; *laryngeal*; *pharyngeal*; according to the part of the respiratory passages from which the sounds audible externally are transmitted.

248. The sole point in which these varieties of respiration agree is, that in all of them the audible sound may be resolved into two—an inspiratory and an expiratory. From their numerous distinctions they require separate consideration.

249. *Pulmonary*.—The pulmonary *inspiratory* sound is of gentle breezy character; neither liquid nor dry; soft; of a certain intensity and duration; and in respect of rhythm, gradually developed and continuous. The *expiratory* sound, slightly harsher and hollower than its predecessor, and of lower pitch, is about three or four times the weaker and shorter of the two, and in about one of every four healthy persons, especially at the left side of the chest, is actually inaudible.¹

250. The term “breezy” seems the fittest by which to describe the *character* of the healthy respiratory sounds. They suggest in their pure state the sighing murmur of the breeze among leaves, the only difference being one of intensity. The use of the term *vesicular*, in speaking of the natural condition of these sounds, has led to an erroneous impression. It was originally applied to designate the seat of their production; but not a few persons have incorrectly referred the term to their special character. There is nothing in the nature of the respiratory sounds suggestive of a connection with vesicles; and, whenever such character occurs, the phenomenon it attends is morbid.

251. The two sounds so closely follow each other in each healthy respiration, that they may, practically speaking, be said to be con-

¹ The fact that the escape of air from the lungs during expiration is commonly attended with audible sound was known to, and is distinctly stated by, Laennec. But the importance of the expiratory sound, the valuable indications its modifications afford in the diagnosis of disease, did not sufficiently attract his attention; and to the late Dr. Jackson, Jr., of Boston, U. S., belongs the credit of conceiving the value and extent of information which might be obtained from its analysis. In a most ingenious paper, read in 1832, before the Medical Society of Observation of Paris, that zealous inquirer forcibly drew attention to the subject. M. Louis and several of his pupils submitted the remarks of Jackson to the test of observation; his announcements were found generally correct, and thenceforth the separate consideration of the expiratory sound became with them habitual. Dr. Cowan subsequently favored the English public with a valuable paper on the subject (“Lon. Med. Gaz.” vol. xviii. p. 332). M. Fournet has since investigated it more thoroughly than his predecessors, and has popularized what had previously been known only to the comparatively few; but he seems to have fallen into repeated errors of over-refinement.

tinuous. This continuousness, indeed, forms an important character of *pulmonary* respiration of *healthy* type. It would of itself be sufficient to announce the lung as the part ausculted; for it will be found that in proportion as auscultation is practised, in health, at a further point from the pulmonary parenchyma, so will the two sounds be more and more distinctly separated from each other by an appreciable interval of time,—an interval which consequently attains its maximum opposite the larynx and upper part of the throat.

252. What is the site of production of the pulmonary sounds?—and what is the mechanism by which they are generated? M. Beau¹ endeavored to show that the respiratory sounds, heard on the surface of the chest, are not produced in the lungs; but are simply the pharyngeal sounds attending the entrance and exit of air through the pharynx, transmitted through those organs. Two facts seem to disprove this theory;—the existence of an appreciable pause between the respiration-sounds opposite the pharynx, while there is none such over the pulmonary structure; and the occasional possibility of hearing at one and the same spot of the chest-surface, both ordinary respiratory, and pharyngeal, sounds. Besides, the two pharyngeal sounds are quasi-equal in length, the pulmonary extremely unequal; and destruction of portions of the fauces does not alter or impair the pulmonary sounds. The three first of these objections are equally fatal to Dr. Spittal's theory,² that in the glottis is the main origin of the sounds. A fourth is to be found in the fact that there is no direct ratio between the intensity of sound heard over the larynx and that audible over the chest: the loud pulmonary inspiration-sound with which air makes its way into the lungs, through an artificial opening in the trachea, is well known,³ while, *per contra*, laryngeal and tracheal stridulous respiration is commonly attended with very weak pulmonary sound. Laennec believed that the sounds were engendered by "the entrance of the air into, and its expulsion from, the air-cells of the lungs;" and this, with a qualification to be presently considered, appears to be their essential cause. The terminal portions of the bronchi are also probably concerned in the sounds,—the vibrations of the moving air, and moving parenchyma, and the distension of the air-cells, all, doubtless, contributing to the general result. The excess of inspiratory over expiratory sound seems explicable by the greater resistance of the textures during inspiration, and by the current being in the former instance directed towards, in the latter from, the ear of the observer. If a sponge, slightly moistened, be placed between two stethoscopes, and one person breathe naturally into one of these, while a second auscults by the other, it will be

¹ Arch. Gén. de Médecine, 1834.

² Edin. Med. and Surg. Journal, vol. xli.

³ Cole, *etat.* 4; U. C. H., Females, vol. ix. p. 167. I have observed the same fact in four or five other cases of tracheotomy.

found that the difference in force of the sonorous currents towards and from the ear of the auscultator is about the same as between the intensities of natural inspiration and expiration. And, again, if a sponge in the same state be held close to the ear, and alternately pressed and allowed to expand, it will be found that the closure of the cells of the sponge is almost noiseless, their expansion accompanied with well-marked sound: the ratio is very much that of the expiratory and inspiratory sounds.

253. But Laennec was incorrect, I feel persuaded, in supposing that the actual air of each inspiration is directly concerned in generating the corresponding sound. The tidal air, in truth, does not reach the cells. In calm breathing the stagnant air [122] is never expelled from these; in forced breathing the supplementary share of the stagnant volume is expelled; but the residual and persistent quotas remain. Clearly, then, it is not the tidal air itself that, impinging against the cell-walls, evolves the sound, but rather the supplementary and residual volumes which, in their retreat before the influx of tidal air, recover the position they had partially evacuated in expiration.

254. The conditions of the pulmonary sounds may vary within certain limits from those just described without the type of respiration ceasing to be compatible with health of the lungs. In other words, there are *healthy varieties* of respiration. They are referable to the following circumstances: *age; sex; the part of the chest furnishing the sounds; the rapidity and fulness of respiration; temperament; and idiosyncrasy.*

255. *Age.*—The description given of healthy respiration refers to that of adults; at either extreme of life its characters are different. In infancy the *intensity* of sound is considerably greater than at a more advanced age, all the other properties of both sounds remaining unaltered both positively and relatively (*puerile* respiration); the expiration-sound appears disproportionately long only from its greater intensity. The smallness of the vesicles at this age, and hence the more extensive surface concerned, as just explained [253], in the production of the sounds, seems to account best for their excess in infancy. The slightly greater frequency of respiration in childhood seems inadequate to its explanation, especially as there is no such difference in the laryngeal respiration of childhood and adult age. In old age, on the other hand, the *intensity* of the sounds is sometimes diminished, and the duration of inspiration lessened, while that of expiration is increased (*senile* respiration). Healthy senile respiration, as it may be called, differs from morbidly *weak* respiration in the increased duration of expiration. Andral has referred to its characters, and justly connects it with the rarefied and inelastic state of the lung which arises, as a condition of natural decay, in advanced life.

256. *Sex.*—The pulmonary respiration-sounds are generally louder in the female than the male; and certain peculiarities, to be

presently mentioned, are of more frequent occurrence in the former than the latter.

257. *Region and Side of the Chest.*—The sounds are fuller superiorly than inferiorly, especially in women, and in front than behind. They are audible even at the lower edge of the right and left infra-mammary regions on full breathing; if the liver be enlarged, they may even be heard, within the confines of the abdomen, over that organ. Similarly over enlarged kidneys and abdominal tumors they can occasionally be caught posteriorly, at a short, not precisely limitable, distance below the area of the chest.

258. The conditions of respiration vary of necessity at certain corresponding parts of the two sides in consequence of difference in the subjacent structures; obviously the breath-sound must be dissimilar over the mid-heart region and the fellow spot on the right side. But where the constitution of the texture beneath is nearly or perfectly identical, is there an absolute identity in the sounds? I have devoted much time to the examination of this point at the apices of the chest (where for obvious reasons it possesses most importance) since the last edition of this work was published, and the results obtained oblige me to somewhat modify opinions formerly expressed. It is quite true there is no excess, as a constant condition, in the length and intensity of the respiration-sounds in either upper region of the chest, nor do the pitch and quality of necessity differ. But appreciable differences in these points are of sufficient frequency in perfectly healthy chests to impress upon us the wisdom of caution in ascribing to incipient disease very slight inequalities in the two sides, even where pulmonary or dubious general symptoms may entitle us to look for something physically wrong in the lungs. The infra-clavicular regions may be tabularly compared as follows:—

	INSPIRATION.		EXPIRATION.	
	Right.	Left.	Right.	Left.
Intensity	—	+	+	—
Length	—	+	+	—
Pitch	Higher	Lower	Higher	Lower
Quality	Harsher	Softer		

From a glance at this table it becomes apparent that a greater tendency exists to bronchial character in the respiration at the right front apex than at the left, while excess of loudness and duration of inspiration may pretty frequently be looked for at the left. The same differences very closely obtain at the supra-spinous fossæ. The student will remember that the statements in the table profess only to show what kinds of difference are *most common*,

where difference exists at all; I cannot pretend to supply a numerical estimate of the relative frequency of each.¹

259. *Rapidity and Fulness of Respiration.*—The *intensity* of the respiratory sounds increases directly as the rapidity of breathing; their duration, as its fulness. When the respiration is at once full and rapid, both those properties are affected simultaneously; but neither *character* nor *pitch* suffer change.

260. *Temperament.*—The respiration sounds are, generally speaking, of greater intensity in persons of nervous temperament, or laboring under certain nervous affections, as hysteria, than in persons otherwise constituted.

261. *Idiosyncrasy.*—In some individuals the respiratory sounds are unusually weak or unusually strong—and the peculiarity, not being traceable to any particular cause, is spoken of as an idiosyncrasy.

262. The proportional duration and intensity of the expiratory sound vary much in different chests; in not a few persons, as we have already seen [249], expiration is non-sonorous—noiseless in fact. This absence of expiratory sound is, according to my experience, most frequent in males; and when it exists, is a natural peculiarity, and in no instance the effect of disease. The exception which may be taken to this latter statement, in some cases of emphysema, is only an apparent one.

263. *Bronchial respiration*, audible between the scapulæ, at the upper end of the sternum, and the sterno-clavicular angles, in the sites corresponding to the bifurcation of the trachea, wants in both its divisions the perfect softness and gentle breeziness belonging to the pulmonary species; both are slightly harsher, of higher pitch, more rapidly evolved, especially the expiratory, and follow each other less closely, are less accurately continuous, than in pulmonary respiration. In some persons the respiration is very purely pulmonary, even between the scapulæ.

264. *Tracheal, laryngeal, pharyngeal respiration.*—The respiratory sounds, as heard over the trachea, larynx, and pharynx, are considerably more intense, less soft, drier, hollower in quality, more whiffing, of higher pitch, and more rapidly evolved, though of greater duration than in the divisions hitherto considered. While in pulmonary respiration the two sounds differ very materially in duration and intensity, in these upper sections of the system they tend to equalization in these respects—the second perhaps slightly exceeding the first; and instead of being almost continuous, are separated by an interval of some duration. The expiratory is also sharper than the inspiratory sound.

¹ Dr. Flint, in a most careful examination of healthy apices, found an interval between inspiration and expiration-sound in “several cases” under the right clavicle. This would be an additional approach to bronchial breathing; but for my own part I have failed to find it in positively healthy infra-clavicular regions, except at the sterno-clavicular angle, where the respiration is confessedly, as a natural state, more or less bronchial.

II.—IN DISEASE.

265. The phenomena discoverable by auscultation of the lungs in disease are: Modified breathing-sounds; and Adventitious sounds produced by the act of respiration.

A.—*Modified Respiration-Sounds.*

266. It is extremely rare to find one only of the primary properties of the respiratory sounds affected; in by far the greater number of cases two or more of them suffer alteration at the same time; and thus are produced compound conditions of change, which may be described as distinct species of morbid respiration, and classified as follows:—

Species of unhealthy respiration distinguished by changes of

(a) *Duration and Intensity*; exaggerated, weak, and suppressed respiration:

(b) *Rhythm*, either solely or in conjunction with other properties; jerking, and divided respiration; deferred inspiration; unfinished inspiration; altered ratio of inspiration to expiration:

(c) *Quality*, and in addition other properties, especially *pitch and rhythm*; harsh and bronchial respiration and blowing respiration, with its main varieties, simple and hollow.

267. (a) *Alteration of intensity and duration.*—*Exaggerated respiration* is essentially distinguished by an increase in the intensity and duration of both sounds, especially the expiratory,—an increase unattended with modification of any kind, either in respect of special character, softness, or liquidness. It is, likewise, termed *supplementary*, because the pulmonary tissue, in which it is produced, often supplies by increased energy the loss sustained by the inactivity of some other part; and *puerile*, on account of its similarity to the natural respiration of children. However, there is this difference between the supplementary respiration of the adult and the natural respiration of infancy, that the expiratory portion of the former is proportionally more affected. Undue prolongation of the expiratory sound depending directly on disease, may be distinguished from that of exaggerated respiration, by its being attended with modifications affecting *quality, softness, and liquidness.*

268. The causes of exaggerated respiration are unnaturally rapid influx and efflux of tidal air through the lung, together with an increase in the quantity and the force of impulsion of the retreating residual air [253] against the walls of the vesicles, and probably, in the number of these expanded by each inspiration in the spot:—all this being the result, except in very rare cases, of the inaction of some part of the same or of the other lung. Of very variable seat and extent, it occurs: (1). In healthy tissue, adjoining parts *obstructed* by bronchitis, new productions or foreign bodies in the bronchi; *condensed* by plastic effusion, by pneumonia, by tuberculous, cancer-

ous, or simple consolidation, by apoplectic effusion, &c.; or *rarefied* by vesicular emphysema: (2). In healthy tissue, suddenly *released from bronchial spasm*, as in spasmodic asthma: (3). In tissue itself affected with *hypertrophy*. Exaggerated respiration, then, though not a direct result or sign of disease, except in the last rather doubtful case, furnishes valuable indirect evidence of its existence, and bears the same relation to the morbid condition entailing the excess of breathing, as, to use the happy expression of Fournet, the shadow to the substance.

Exaggerated respiration at an apex, in which tuberculization is commencing, is a source of error against which the student must be on his guard.

269. *Weak respiration* is characterized by a simple diminution in the *intensity* and *duration* of the respiratory sounds, without change of their other properties. When the quality of the respiration is simultaneously altered, the breathing belongs to another type. There are two varieties of weak respiration; the *superficial* and the *deep-seated*. In the former the weak sounds appear to be produced at the surface of the lung or immediately under the walls of the chest; in the latter, at a greater or less distance from these walls. The physical conditions present explain these peculiarities; in the latter, the portion of lung in which the weakness exists is in reality removed to a certain distance from the walls of the chest by the intervention of adventitious fluid or solid matter; in the former, no such removal of lung occurs.¹

270. Weak respiration depends on deficient flux and reflux of air in the affected part, itself commonly caused by mechanical obstruction. It is of variable seat, limited to a spot in one lung, or pervading the entire of both lungs.

271. The *superficial* variety occurs in a *persistent* form in obstructive diseases of the larynx and some of the pharynx; narrowing or obliteration of a bronchus by contraction, thickening of mucous membrane, accumulated mucus, or pressure of tumors, cancerous or other; bronchitis; chronic consolidation of the lung, or infiltration with tubercle or other morbid product in a limited space; vesicular emphysema; pneumonia, previous to engorgement and after resolution; pulmonary œdema; pulmonary apoplexy, and imperfect respiratory movements from paralysis. In an *intermittent* form it occurs in pleurodynia, in the dry and plastic stages of pleurisy, spasm of the glottis, spasmodic asthma, and where foreign bodies block up the air-passages. This intermittence constitutes an important feature in the physical signs of a foreign body in either bronchus, depending manifestly upon its motions from place to

¹ It is said by Skoda the distinction of superficial and deep-seated sounds within the chest is impossible. The point is only to be determined by experience; but why, even *primâ facie*, the idea of variable distance should not belong to sounds produced in different parts of the chest, as well as to sounds in general, does not appear very plain.

place, and consequent greater or less interference from time to time with the entry of the air. In some cases of pneumonia the same intermittent character of respiration may be observed; it indicates intermittent pressure on the main bronchus of the affected side.¹

272. The *deep-seated* variety occurs in the effusion-period of pleurisy, in hydrothorax of moderate amount, and in pneumothorax.

273. In Cholera Asiatica the weakness of respiration seems partly dynamic, and partly of hæmic, or blood origin.

274. *Suppressed Respiration* consists in a total absence of the respiratory sounds, without their being replaced by any kind of audible phenomenon. There is a complete negation of breathing-sound in the part; but it is urged by M. Fournet there is still heard in some cases, towards the close of the movement of inspiration, a slight noise, "which appears to result from the lateral pressure, exercised on the pulmonary tissue, of the column of air which fails in entering the bronchial ramifications." For this noise he proposes the name of "sound of pulmonary compression." I have not, in such cases, been conscious of the recurrence of a distinct sound; but an indefinable sensation of struggle within the chest against obstruction may often be perceived.

275. The causes which produce weakness of respiration entail, when carried to extremes, its total suppression. It is probable that the respiratory sounds are actually more or less extensively suppressed in almost all cases of infiltrations of the lung, tuberculous or other; but it is, for obvious reasons, in rare instances only that the suppression can be detected, adjoining exaggerated respiration masks the local deficiency. In some rare cases of pneumonia, independently of accidental co-existing obstruction of a main bronchus, there may be no audible respiration—I have seen two such. But, clinically, the common causes of such suppression are fluid and aeriform effusions in the pleura, and complete obstruction of a bronchus; in some rare cases of vesicular emphysema, and during intense paroxysms of spasmodic asthma, all respiration-sound may be locally deficient.

276. (*b*) *Alterations of rhythm. Jerking Respiration.*—When the movement of inspiration, instead of being accompanied by a sound continuous from the outset to the close (which may be represented thus), is attended with an interrupted one, divided into several unequal parts (thus . . . | . . | . . . | . . . &c.), the respiration may be called *jerking*. The expiratory sound more rarely possesses this peculiarity, and, as far as I have observed, is scarcely ever affected alone; but it is generally somewhat increased in duration, while the inspiratory (if the moments during which sound is actually perceptible be alone considered) may be somewhat decreased in this respect.

¹ Beckett, U. C. H., Males, vol. v. p. 231.

277. Jerking respiration may exist through the entire of one or of both lungs, when it deserves the name of *general*; this is very rare; or be limited to a certain spot, when it may be called *partial*. The former variety is observed in incipient pleurisy, pleurodynia, pulmonary and intercostal neuralgia, hemiplegia, spinal irritation, hysteria, and spasmodic affections of the air-passages. The partial variety occurs in cases of solid lung-infiltration and of pleuritic adhesion.

278. In some cases of incipient tuberculization the tidal air seems to struggle against minute obstructions in the finer tubes, whence a rhythm of sound resembling that of a *cogged wheel* in rotation: it appears probable that glutinous mucus adherent to the walls, and which the air, in its flux and reflux, disturbs, without forming into bubbles, may be the cause of the phenomenon; the nature of the sound is rhonchoid, and it seems to pass into actual rhonchus in some cases.¹

279. This peculiar rhythm is most commonly found in connection with tubercle; but I have observed it at one or both apices, when free from solidification of any kind.² It may be most marked with expiration, and lose in distinctness in forced breathing.³ It is often found at a consolidated apex, when fine liquid rhonchus exists at the base.⁴

280. *Divided Respiration*.—Instead of the two sounds, inspiratory and expiratory, succeeding each other so closely in each act of respiration that they may be considered continuous, they are sometimes separated by a distinct interval or pause: respiration of this rhythm I designate by the title *divided*. In advanced emphysema this separation of the sounds clearly appears to depend on the destruction of the walls of the air-cells, and the impaired elasticity of the remaining texture. In all the varieties of bronchial and blowing respiration there is a pause, more or less marked, between the two sounds; and I cannot impress too strongly on students, particularly on those who have difficulty in appreciating changes in quality and pitch, the importance of attending to this perversion of rhythm as an attribute of those forms of morbid breathing.

281. *Deferred Inspiration*.—In emphysema each inspiratory action of the chest often commences, and continues for a brief, though appreciable interval of time, before sound is produced: the closing instants of the act only are attended with audible noise. The sound of inspiration may be said to be deferred.

282. *Unfinished Inspiration*.—Conversely, the inspiratory sound sometimes ceases, before the accompanying expansion of the chest:

¹ M. Kenny, U. C. H., Females, vol. vii. p. 9.

² R. Smith (subcutaneous cancer), U. C. H., Males, vol. vii. p. 876, or Med. Times, 1852.

³ Tagg, U. C. H., Females, vol. ix. p. 83.

⁴ Simmons, U. C. H., Males, vol. ix. p. 57.

this effect may be observed in consolidations of various kinds.¹ The phenomenon is rare, and I know not on what special condition of the consolidation it depends. Unfinished inspiration is always of harsh quality and heightened pitch.

283. *Altered Ratio of Inspiration to Expiration.*—Instead of the former of these sounds being to the latter very closely, as 3 : 1, in point of intensity and duration, the ratio may be converted into as 1 : 4. This enormous relative prolongation of expiration sound is only met with in emphysema; but minor degrees occur in various indurated conditions of the lungs, and in pleuritic effusion and pneumothorax. I can scarcely believe that prolongation of the expiratory sound is capable of existing independently of other alterations, as I have never met with it to any well-marked amount without co-existing change of quality, of pitch or of both. However, in some cases, the increase of duration is much more striking, and therefore, clinically, more significant than the other changes; occasionally in tuberculization, often in emphysema.

284. The signification of the expiratory sound was, in some degree, mistaken by its rediscoverer, Jackson [249]; he exaggerated its specific importance as a diagnostic sign of tubercles, and in this he has been generally followed.² Many persons forget that what may appear in a given individual, as compared with another, prolonged expiration, is really in him a natural state;³ some confound with it the pharyngeal expiratory sound; the normal existence of lengthened expiratory sound at the right apex of many females is habitually forgotten; and too few observers seem to be aware that, under whatever circumstances an obstruction exists to the free circulation of the air in the lungs, the expiration will be prolonged—an obstruction which rarely, if ever, acts on the duration of the sound, without affecting some of its other properties. The fact of obstruction appears to me to account satisfactorily for the phenomenon. Expiration is, unless in exceptional persons, sonorous under all circumstances: where the reflux of the tidal air is rendered more difficult and slower than natural, the most natural consequence in the world is, that the attendant sound should be proportionally intensified and lengthened.

285. Diminished elasticity of the lung will, if there be obstruction superadded, produce the maximum prolongation, as in emphysema with bronchitis; very often, however, the sound spoken of as prolonged expiration in this disease is nothing more than sibilant rhonchus,—true breathing-sound being totally absent.

286. (c) *Alterations of quality, pitch and rhythm combined.*—The morbid conditions of respiration falling under this head, are by

¹ Thus, in very solid hepatization, Shears, U. C. H., Males, vol. xv. p. 86.

² Students, especially in the early period of their career, are more frequently deceived by it than by any other sign: easily ascertained, as the condition is, it is unfortunate it is not more significant.

³ Vide Table [258].

far the most practically important, and may be arranged as follows.¹

- a. Harsh, bronchial.
- β. Blowing { Simple . . . { diffused
 { tubular.
 { Hollow . . . { cavernous
 { amphoric.

287. (a) In *harsh respiration* both sounds have lost their natural *softness*; a peculiar *dryness* accompanies them; the breezy character of health is exchanged for one sharper and more blowing, which is generally more marked in expiration than inspiration. The *intensity* of the expiratory sound appears augmented from this superadded character; its *duration* is increased; both these latter properties may be, and commonly are, unaffected in the inspiratory sound. This type insensibly passes into the higher grade—*bronchial respiration*. Both sounds are now *rough* and *hard*, and notably more *dry* than in the natural state; the sharp blowing quality is heard in inspiration as distinctly as in expiration, and in the latter to a greater degree than in respiration of the previous type.² The *intensity* of both sounds appears increased, the *duration* of expiration is considerably augmented, and is even greater than in normal bronchial respiration: otherwise morbid breathing-sounds of this type closely resemble the natural sounds in the larger bronchial tubes.

288. In harsh respiration the expiratory sound commonly alone suffers change of quality; in the bronchial variety the inspiratory shares in the alteration. The usually earlier implication of the sound of expiration was first noticed by Jackson, and has since been insisted on by M. Fournet. This writer states that alterations in quality always set in with the expiratory sound, and only affect the inspiratory secondarily. With this statement I find that my own experience accords in respect of chronic affections, if the word habitually be substituted for always: I believe it to be correct also in the very great majority of cases of acute alteration of the parenchyma of the lungs. There is, however, a kind of rare bronchial respiration in which the inspiration alone suffers, the expiration retaining its natural properties; this seems to me insignificant in

¹ This arrangement has been criticized as wanting in "simplicity." No one is a greater admirer of simplicity than myself, where it can be attained without sacrifice of accuracy; I simply join issue with those who assert it can here be insured by any less complicated division than that I suggest. What is practically gained by Skoda's very simple division of morbid respirations into "bronchial" and "indeterminate?" What idea does the word indeterminate convey? What sound does it help the observer to identify? An indifferent student would doubtless worship any "authority" prepared to go a step further and teach that the best, because the most simple, division, is into "healthy and morbid;" but would the diagnosis of disease benefit by the simplification?

² The expiratory sound may be, however, of lower pitch than the inspiratory, even where there is a considerable amount of condensation at the apices; e. g., Stammers, U. C. H., Females, vol. xi. p. 87.

diagnosis, and rather to be an individual peculiarity of healthy breathing.

289. Harsh respiration, attending condensation or rarefaction of pulmonary substance, and dryness of the mucous membrane of the bronchi, is observed in incipient tuberculization, dry bronchitis, vesicular emphysema, chronic pulmonary consolidation, dilatation of the bronchi, and incipient cancerous infiltration of the lung,—in cases where the lungs are slightly compressed by plastic or tuberculous matter in the pleura,—in the resolution stage of pneumonia,—at different periods of pleurisy, and in pulmonary apoplexy. Bronchial respiration is met with under all circumstances of slight condensation of lung-substance; unless, between the condensed part and the surface, there exist such quantity of healthy tissue as to mask the morbid sounds by its own natural ones,—or, unless fluid, solid, or gaseous accumulation in the pleura interfere with the conduction of the sounds.

290. In *blowing respiration* both sounds are, as the name indicates, of blowing or whiffing character; and, in its most marked degrees, a sensation as if the air were drawn during inspiration from the observer's ear, or from the surface of the chest, and puffed back during expiration, is distinctly perceived. Both sounds are *rougher* and *harder*, and especially *more dry* than in altered states of less advanced type, and more or less *metallic*. The expiratory sound is of much *greater duration* than in the natural state: the inspiratory varies in this respect; both are more intense and of higher *pitch* than natural; and in both *quickness* of production and progress constitutes, in the most marked forms especially, a characteristic feature. The *rhythm* is divided [280] from a halt between the two sounds, not from the peculiarity I have called unfinished inspiration [282].

291. There are two main varieties of *blowing respiration*: the *simple* and the *hollow*.

292. *Simple blowing respiration* is commonly associated by writers with the bronchial variety. This seems an injudicious attempt at simplification; for the two species not only differ in intensity, but in quality (mere bronchial respiration is never metallic), in quickness of evolution, and in pitch; it seems, too, that the term bronchial should be limited to morbid respiration, simulating that naturally heard in the bronchial tubes.

293. Simple blowing respiration occurs in two forms—the *diffused* and the *tubular*. If to the description above given be added the qualification that the whiffing sounds appear to be produced with but moderate intensity, and sometimes at a distance from the ear, over a tolerably extended space, the description of the *diffused* form will be completed. In the *tubular* form, on the contrary, the phenomena appear to occur in a space limited to the immediate neighborhood of the part examined, and that space to be of tubular shape, cylindrical or flattened. The metallic character is highly

developed, to such a degree that the sound may, without exaggeration, be compared with those produced by blowing sharply through a brass tube; their *dryness*, *rapidity of production*, and *intensity*, are still greater than in the *diffused* variety. It is in the tubular variety, too, that the sensation of air being drawn from, and puffed back towards the ear, is most distinctly marked.

294. The tubular form occurs in perfection in but one condition of lung, that of hepatization; so true is this, that tubular and pneumatic breathing may be used as convertible phrases. But not unfrequently pneumonia runs its course without having produced true tubular breathing—diffused blowing being alone audible. I had thought it probable the *diffused* blowing respiration is transmitted from a number of small bronchi, the *tubular* from a few large ones. Were this the case, the change in character from *diffused* to *tubular blowing* would be referable to the compression and obliteration of the smaller bronchi, corresponding to the increase in extent and the amount of solidification, and would account for the fact which may, I think, be frequently observed, that the well marked *tubular* form signifies a more advanced degree of disease than the *diffused*. But this explanation will not, at least always, hold; the consolidation may be very extensive and dense, and the true tubular quality nevertheless be wanting.¹ Less perfect tubular breathing is heard in cases of pulmonary abscess, or solid accumulation of moderate size, near the large bronchi. The diffused form occurs, or may occur, in all conditions of diffused solid consolidation, intra or extra-pulmonary, simple, tuberculous, carcinomatous, fibro-fatty, &c., and in dilatation of the bronchi. There is, besides, a condition under which I have frequently observed the diffused variety of blowing respiration, and where it is likely, unless the examination be conducted carefully, to deceive the observer. In certain cases of tuberculous excavation, auscultation may have been performed in two or three places at the apex without cavernous respiration with the hollow metallic character being discovered, the diffused variety of blowing respiration being the condition observed; yet at some other spot close by that variety of breathing may at length be detected, and so one evidence of excavation established. In these cases the cavernous character is evidently masked by the diffused blowing, which is the result and exponent of the condensation existing around the excavation. This is one reason why a cavity may escape discovery unless the examination of the chest be very carefully performed. On the other hand, in certain cases of pneumonia of the anterior apex, of tumor connected with a large bronchus, and of dilated bronchi, true blowing respiration may acquire a hollow character, and hence simulate cavernous breathing.

¹ Shears, Males, vol. xv. p. 85. Where the respiration is very frequent, the pitch of the sounds is generally higher than in the diffused variety, even though the solidification be only moderately dense.

295. Lastly, in pleuritic effusion, if there be adhesion or agglutination of the pleura, respiration of the diffused blowing type, often sufficiently marked to suggest the idea of hepatization, is more or less extensively audible; the presence of condensed lung near the surface sufficiently explains its existence. But it is not alone in these cases of adhesion, that blowing respiration may attend pleuritic effusion; it may be present where no adhesion exists, and the effusion is abundant. It does not, as far as I have known, pass into the tubular variety under these circumstances, is never intense, and in the majority of cases, very feeble, especially when compared with the amount of percussion-dulness present; it is also distant from the ear except in the close vicinity of the spine, and generally limited to the middle height of the back—in other words, to the neighborhood of the main bronchi: in some cases it has all the characters of, and is obviously, transmitted pharyngeal respiration.

296. The theory of bronchial and blowing respiration commonly admitted, regards it as transmitted natural bronchial breathing. Either the sounds of the air-current in the larger bronchi of the solidified lung, or (inasmuch as the respiration-play of that organ is more or less diminished, and therefore little or no flux and reflux of air can occur even in its medium-sized tubes) the sounds of the air-current in the trachea and in the main bronchi of the non-affected lung, are supposed to be conveyed thence through the hepatized tissue with an intensity varying directly as the increase by consolidation in its conducting power. Three objections occur to me as negating either explanation—or at least as proving their inadequacy: the sounds in pneumonic tubular breathing habitually differ in quality and pitch from those of the trachea and larynx; they are commonly much stronger than the latter; while in some rare cases of perfect consolidation, without obstruction of the main bronchus, there is dead silence over the hepatized structure. The conducting power, in regard of breathing-sounds, of hepatized tissue removed from the body, I have found by experiment to vary inexplicably.

297. Skoda¹ appears to hold that the laryngo-tracheal sounds and those of both main bronchi consonate in the air contained within the bronchi permeating the consolidated parenchyma, and thus produce the phenomenon of bronchial respiration, when intense and of high pitch; whereas weak bronchial respiration of low pitch comes directly without consonance from the lower part of the trachea, the main bronchus, or one of those of second order. It seems doubtful whether this theory can be the true one; for the pitch of metallic pneumonic respiration is irregularly higher than of the laryngo-tracheal, whereas consonating sounds are always either of the same pitch, or of pitches bearing a certain harmonic relation to each other.

298. The difficulties to be explained are obviously the greater intensity of the thoracic than of the tracheal breathing-sounds, and the irregular differences in their relative pitch. As the same difficulties occur, and appear similarly explicable, in the theory of morbid resonance of the voice, the reader is referred to the discussion on the latter subject [421—442].

299. The essential peculiarity of *hollow* respiration is signified by its name. It is of two kinds, differing only in scale—cavernous and amphoric, small and large.

300. In the *cavernous* kind the ear receives the impression most

¹ Auscultation, vierte Auflage, pp. 91 and 104.

distinctly of connection with a hollow space; the *character* of the sounds is *hollow*, whiffing, and moderately metallic; their pitch lower than in tubular breathing—the expiration sometimes higher, by far more commonly lower, pitched, than the inspiration.¹ The peculiar *quickness* of production is less marked than in either kind of simple blowing respiration—there seems to be a delay in the interior of the chest. Cavernous respiration, though rarely, is sometimes attended with the sensation of air being drawn from the surface and puffed back again—the peculiarity appearing to announce the close vicinity of the seat of the phenomenon to the surface.

301. The veiled puff (*souffle voilé*) is a modified cavernous respiration, in which a “sort of movable veil interposed between an excavation and the ear” seems to be agitated to and fro: such is Laennec’s description of a phenomenon so rare, that I had never, until quite recently, met with it.²

302. Globularly and largely dilated bronchial tubes, and excavations in the substance of the lung (the less fluid they contain, the more solid their walls, and the freer their communication with the bronchi, the better) give cavernous respiration. Tuberculous excavation is by far its most frequent cause,—cavities produced by gangrene, abscess, cancer, pulmonary apoplexy, and intra-thoracic purulent collections perforating the lung, much rarer ones.

303. The mechanism of cavernous respiration is probably of at least two kinds. If the influx and efflux of air into and from the hollow space concerned be free, the quality of the sounds is simply explicable by the form of that space. If from rigidity of the thoracic walls, or other physical impediments, the cavity itself can scarcely be supposed the seat of active movement of air, the cavernous quality is probably that of the neighboring bronchial breathing modified and reinforced within the excavation. Among the physical conditions most favorable to the perfect development of the different varieties of blowing respiration, is absence of solid or fluid in the space where they are actually produced, and from which they are transmitted to the ear. This is true of all the varieties; and hence true, whether the seat of the phenomenon be the bronchi, a pulmonary excavation, or the pleural cavity communicating by a perforation with the bronchi. If the bronchi or pulmonary cavity contain fluid, the tendency will be to the production of various liquid rhonchi instead; and hence the phenomena of cavernous rhonchus and cavernous respiration are habitually in the inverse ratio of each other, as regards degree and perfection of development.

¹ It has been suggested by Dr. Flint that bronchial respiration may be always distinguished from cavernous by the relative pitch of inspiration and expiration—the latter higher than the former in bronchial [287], lower in cavernous breathing. Exceptions are so common, I fear, as to render this alleged rule unworthy of trust.

² Tagg, U. C. H., Females, vol. ix. p. 108.

If an excavation be partly filled with fluid and partly with air, the possible conditions are of three kinds: *a*. When the quantity of liquid is small, and the bronchus communicating with the excavation opens above the level of the liquid, pure cavernous respiration will be heard: *b*. When the communication with the bronchus occurs below the surface of the liquid, cavernous rhonchus is heard alone: *c*. When a double communication exists, that is, above and below the surface of the fluid, cavernous rhonchus and respiration will both be present. But it must be confessed, although all this has been *observed* by myself and others, the cases are rare in which such nice discrimination can be effected.

304. The cavernous quality is often, confessedly, deficient where excavations actually exist. Is it ever present when they are absent? Unfortunately in regard of the facility of diagnosis, my existing experience obliges me to answer this query with an emphatic yes. Over certain solidifications surrounding bronchi not necessarily even modified in calibre, there may exist at once the breathing, the rhonchus, and the vocal phenomena commonly associated with, and commonly supposed peculiar to, actual excavation in the lung-substance. I have observed this both in fatal and in cured cases of pleurisy¹ and pneumonia²—the phenomena disappearing in the cases of recovery in such manner, as to prove the total absence of any loss of pulmonary substance—which in truth had never been even remotely indicated except by the physical signs. The bronchi, blocked up at one end, might be assimilated to as many elongated cavities, and so a form of explanation found—but only to be rejected: for were it correct, these quasi-cavernous phenomena ought to be the rule instead of the rare exception, in solidification either by pressure or infiltration. Evidently some accidental condition occurs—probably a mode of localization of the indurated tissue, causing it to form a direct solid link between the root of the lung and the surface examined.³

305. Shall we then reject cavernous respiration as a variety, and blot out the term from our phraseology? No. For auscultation, as an art, is based on the sole teachings of the ear; and the cavernous character is real, as an auditory impression. We will simply bear in mind that there are certain rare physical states, rudely imitating excavation of the lung, which furnish, as might be expected, respiration-sounds resembling those of an excavated space; and others yet rarer, where the explanation has yet to be established.

306. The *special character* of the *amphoric* kind is derived from the attendant sensation of air passing into a large empty cavity having dense walls—such as is perceived on blowing into a water croft.

¹ Fosbury, U. C. H., Males, vol. ix. p. 350—352; E. Smith, U. C. H., Males, vol. xi. p. 135.

² Wright, U. C. H., Females, vol. xv. p. 14.

³ This important matter will be further discussed with the subject of Pleurisy.

It is strongly metallic, and sometimes, but rarely, associated in one and the same respiration with metallic tinkling.¹ The amphoric character accompanies both sounds, but especially the expiratory, though occasionally more markedly the inspiratory; in some instances it only appears on forced breathing; in rare cases it may be heard even at a distance from the chest.² Commonly audible at the middle height of the chest, rare at the upper part, and yet rarer at the base, its physical cause and theory are much the same as of cavernous breathing; the cavity concerned is simply larger.³ Hence it *may* exist in tuberculous or other excavations in the lung, but they rarely combine the necessary conditions; broncho-pleural fistula with hydro-pneumothorax is its common anatomical cause, whether produced, as is by far most usual, by tuberculous perforation of the lung and pleura, or by perforation of the lung attending the transit of pus either from the pleural sac or from distant parts. The communication with the bronchi must, for perfection of the sign, be above the level of any fluid in the echoing cavity.

B. *Adventitious sounds, produced within or about the thorax by the act of breathing.*

307. The essential difference between the morbid states of respiration hitherto considered, and those now to be described, is, that, in the former, modifications only of a natural sound exist, while in the latter there is actual generation of new phenomena. These adventitious sounds may be produced in: (a) The air-passages or cavities communicating with these; (b) The lung-substance; (c) The pleural cavities; (d) The mediastina; (e) The thoracic parietes; (f) The neighboring organs.

308. (a) *Adventitious sounds originating in the air-passages (rhonchi or rattles).*—A rhonchus may be defined as an adventitious sound, audible in inspiration or in expiration, or in both; of dry or moist character; masking the natural breathing more or less completely; persistent or intermittent; originating in the air-cells, the minute or the larger bronchi, the trachea or larynx, and in excavations of the pulmonary substance; and produced either by the passage of air along bronchi of altered calibre, by air bubbling through fluid contained in the sites mentioned, or by the vibration of semi-solid plastic matter in the tubes, or of prominent folds of their own lining membrane.

¹ Reilley, U. C. H., Males, vol. xvi. p. 168—pneumothorax.

² In a case by Louis (Phthisie, 2ème éd. p. 406), at $2\frac{1}{4}$ inches distance.

³ It does not, however, necessarily follow that where amphoric respiration exists, the excavation is of large size: one of moderate dimensions will suffice, provided the surrounding substance be extremely solid, and closely bound to the costal surface.

309. The audible characters of rhonchi divide them into the following genera and species:—

Whistling	{ high-pitched. low-pitched.	
Crepitating.		
Crackling	{ dry. moist.	
Bubbling	{ small. large.	{ simple. hollow.

310. Whistling rhonchus is either of high or low pitch; in the former case called *sibilant*, in the latter *sonorous*.

311. *Sibilant* rhonchus is dry-sounding; commonly coexistent with both inspiration and expiration, but especially marked in the former, and occasionally limited to either, it varies much in intensity and duration; recurs irregularly instead of accompanying every respiratory movement, and is high-pitched, sometimes so much so as to be *hissing* in character.

312. Laennec taught that the sibilant rhonchus of acute bronchitis depended on diminution of the calibre of the bronchi, caused in turn by inflammatory thickening of their lining membrane and sub-mucous tissue. The natural intermittence of the rhonchus argues strongly against this notion, as the thickening of tissue must be a persistent state; and it is further opposed by the fact that whistling rhonchus may be interrupted and silenced for a variable number of respirations in any given spot, by causing the patient to cough. Coughing, we can readily understand, will alter the position of viscid mucus; but it cannot be supposed to have any direct and immediate influence on the thickness of the mucous membrane, or even on the conditions of a vibrating fold of its substance. The rhonchus, though dry to the ear, clearly depends on the influence of air on fluid, and may be imitated by blowing through saliva between the lips at a certain amount of separation.

313. When the cause, at least remote cause, of the sibilant rhonchus is of a permanent nature, as diminished calibre from the presence of a tumor, it is said that the rhonchus is itself permanent. But I have, even in cases of this kind, found that the morbid sound will be altogether removed for a while by the act of coughing; and hence believe that the altered form of the bronchus has less to do with the production of the rhonchus than has the existence of local accumulation of viscid mucus, whether this be a mechanical result of the pressure of the tumor, or the effect of circumscribed super-secretion. If this notion be correct, it is manifest that rhonchi of this class have no claim in respect of their mechanism to the title of dry; the impression made upon the ear alone justifies the application of the term.

314. *Sonorous rhonchus*, varying in special character, is always

marked by graveness of tone and dryness; usually coexisting both with inspiration and expiration, but especially marked in the latter, to which it may be limited; varying in intensity from a very slight sound to one loud enough to be audible at some distance from the chest, and to be attended with thoracic fremitus over a surface of variable extent; varying in duration, but having a natural tendency to prolongation; continuously and steadily evolved, unless of very short duration, when it is produced in a quick and abrupt manner; occurring interruptedly, or, in rare instances, attending every successive respiration; and sometimes alternating with the sibilant or with bubbling rhonchus.

315. The special character of the sonorous rhonchus varies; it may be *snoring, rubbing, or cooing*.

316. The essential cause of whistling rhonchus is the vibration of secreted matters in the tubes—viscid mucus, plastic substance, &c.: in certain positions it may be produced by the vibration of a thickened fold of the mucous membrane itself: irregular and instantaneous spasm of the smaller tubes frequently induces it by narrowing abruptly the diameter of the passages through which the air moves; as, conversely, relaxation of that spasm instantly removes it [ASTHMA]: lastly, it may in some instances indirectly proceed from permanent constriction of the tubes, caused either by disease of their coats or by pressure from without.

317. As a general rule, the low-pitched sonorous rhonchus originates in the large, the high-pitched sibilant in the small, the very acute hissing in the minutest bronchi. But as large tubes may, practically speaking, be made small ones by disease, sibilation may and does occur in bronchi of second and third orders.

318. *Crepitating* (or *crepitant*) rhonchus, when developed in perfection, occurs in puffs more or less prolonged, but rapidly evolved, composed of a variable, sometimes immense, number of sharp crackling sounds, all perfectly similar to each other; conveying the notion of minute size; dry; coexisting exclusively, except in rare cases, with inspiration; and, once established, remaining a persistent condition until superseded by other phenomena.

319. The most accurate comparison which has been made between the crepitant rhonchus and any other species of sound seems to me unquestionably that of Dr. Williams, who likens it to the noise produced by rubbing slowly and firmly between the finger and thumb a lock of one's hair near the ear. In every respect, both as regards the crepiti themselves and the entire act of crepitation, the similarity amounts almost to identity; but it must be remembered that it is to perfect crepitation, and to this alone, the comparison is to be understood to refer. Dryness is one of the best marked acoustic properties of true crepitation; the sensation is not that of bubbles bursting, but rather of delicate tissue undergoing minutest ruptures with a crackling noise in many points simulta-

neously.¹ Again, rapidity of evolution is an important property of crepitant rhonchus, and among other characters serves to distinguish it from the small bubbling species; the crepiti appear to be nevertheless successively produced in tissue nearer and nearer to the ear. So, too, persistency is a feature of some importance as distinctive of crepitant rhonchus: other rhonchi are manifestly influenced in the regularity of their production by the occurrence of expectoration, for example; but over true crepitation this appears to exercise no control. The first effect of a fit of coughing, indeed, is to render the rhonchus more distinct and abundant even than before; deep inspiration produces the same effect: under both circumstances parts of the lung, passive in ordinary breathing, are suddenly expanded.

320. When at its maximum crepitant rhonchus accompanies almost the entire act of inspiration; when first developed, and when about to be superseded by blowing respiration, it appears towards the close of inspiration only. Under all circumstances it is, to say the least, rare to find this rhonchus coexistent in any degree with expiration; the statement that it may generally be heard to a diminished amount with this division of the respiratory act, appears to me to have originated in the confusion which long prevailed between the crepitant rhonchus of pneumonia and the small bubbling rhonchus of capillary bronchitis.

321. The mechanism of this rhonchus is yet undetermined, and its consideration implies that of certain phenomena themselves involved in obscurity, namely: *a.* The intimate seat of production of the rhonchus; *b.* The physical condition of that seat at the moment of production. It has been said (*a.*) the cavities of the pulmonary cells are the seat of the rhonchus; because: 1. The rhonchus is evidently a diminutive of the finer mucous bubbling species, which is confessedly produced in the smaller bronchi: the comparatively small size of the "bubbles" is explained by the less calibre of the cavities in which they are evolved. 2. The "bubbles" are extremely small and numerous, and equal in size, like the cells themselves. 3. In old people the "bubbles" are larger than in adults, just as the cells are of enlarged dimensions from the process of atrophy which the lung has undergone. 4. In infants, on the contrary, the "bubbles" are sometimes of extremely minute size, and in infancy the cells of the lung are well known to be proportionally small. 5. The shape of the "bubbles" appears to furnish an exact representation of that of the cells. But these arguments are not convincing. In the first, the question is begged; the difficulty is to ascertain whether the rhonchus *is* a diminutive of the mucous. 2. The sounds convey the notion of minute and of equal size, it is true; but this is no proof that they originate in the cavity of the cells. 3. The alleged fact is probably correct, and is connected no doubt with the atrophy which commonly exists in individuals of advanced age; but this atrophy may be understood to modify the rhonchus, without the seat of this being necessarily admitted to be the interior of the cells: the parenchyma too is looser in aged persons. 4. Against the correctness of this statement I must express myself most strongly. I have never yet heard a crepitant rhonchus having as much of the character of minuteness in the infant as in the adult individual; and, indeed, the non-development

¹ And yet, as we shall by-and-by see, liquid of the thinnest possible kind may play an essential part in the generation of the sound [324].

of the true primary rhonchus in children of very tender age is a fact familiar to all auscultators. 5. The notion respecting the "bubbles" seems to be an illusion; and its want of import is rendered sufficiently obvious by the circumstance that the best imitation of the crepitant rhonchus is furnished by rubbing a lock of hair firmly between the fingers. The real existence of "bubbles" is similarly shown to be, at the least, a matter by no means proved by the *character* of the rhonchus. For these reasons, I am disposed to believe that the development of the crepitant rhonchus in the *interior* of the vesicles may legitimately be questioned.

322. (b) The passage of air through liquid contained in the cells is commonly believed to be the physical cause of the rhonchus; but writers differ respecting the consistence of the fluid. 1. Some maintain that it is of aqueous or serous consistence, founding their belief upon the state of the liquid expressible from the lung after death during the first stage of pneumonia; and upon the fact that it is found experimentally, the more viscid the fluid through which air bubbles, the less perfect will be the similarity of the noise produced to the crepitant rhonchus—to such a degree, that when pure mucilage is employed, no crepitant sound is produced at all. 2. Others maintain that the perfection of the crepitant character depends on the fluid through which air bubbles being viscid in a high or at least a notable degree. Each of these opinions is supported by experiments and arguments subversive of each other; but there is a more cogent argument against the notion that the consistence of the secretion occupying the cells exercises material influence upon the rhonchus; namely, that both the ordinary true crepitant and the exceptional fine bubbling rhonchi occurring in pneumonia coexist with expectoration of various degrees of liquidness or viscosity.

323. It appears inferrible, from what has now been said, that the theories of the mechanism of the crepitant rhonchus hitherto proposed cannot be considered satisfactory: it is unfortunately easier to make this manifest, than to substitute a less objectionable one in their room. It seems, however, most probable, that the phenomenon occurs in the parenchyma of the lung itself, especially in those portions of it immediately contiguous to, and actually forming the walls of, the ultimate terminations of the bronchi; and that its physical cause is the sudden and forcible expansion of that parenchyma, glued together, as it were, by the viscid exudation with which it is infiltrated. Each single crepitus or click would thus signify the expansion of a cell, and be produced by the unfolding of surrounding glutinous tissue necessary for that expansion. Thus conceived, as respects its mechanism, the chief phenomena of the crepitant rhonchus become perfectly intelligible: its dryness and sharpness; the sensation of minute size attending the sounds of which it is composed; the similarity to the sound of minute ruptures of tissue, and the total absence of the bubbling character; its occasionally accompanying the entire inspiratory act, and sometimes appearing only at its close, according as the infiltration of viscid lymph less or more completely prevents expansion of the vesicles. We can on this supposition also readily understand why crepitation should exist in inspiration only: though the rapid and abrupt unfolding of the glutinous mass be productive of crackling noise, it is very unlikely that the comparatively slow and equable restoration of the tissue to its previous collapsed state would be thus productive—indeed the presumed physical cause of crepitus has ceased to exist. On the other hand, there is no reason why in the ordinary theory crepitation should not as regularly exist, though not with the same loudness, in expiration as in inspiration. The air is presumed in inspiration to have passed through a certain fluid; if so, it must re-pass through it during expiration, and assuredly with a noise similar in kind, though less in degree: when rhonchi are manifestly produced by the passage of air through liquid, they attend both inspiration and expiration. Further, the nature and mechanism of pleural, mediastinal, and intra-parenchymatous pseudo-rhonchi support the views here taken.

324. But I cannot put forward this theory as wholly unopen to objection—at least as far as the glutinous quality of the adventitious matter is concerned.

For though, as matter of clinical experience the combination of rhonchal characters described is almost peculiar to the early stage of pneumonia (whether this depend on any specialty of the fluid in that disease, or on the rarity with which the actual air-cells and adjacent parenchyma contain fluid in other affections), still I have heard crepitant rhonchus of typical perfection in a few instances where post-mortem examination proved the purest watery oedema to be the sole morbid condition. I have not met with true crepitation in pulmonary apoplexy or in the hæmoptysis either of phthisis or of plastic bronchitis.

325. *Crackling* rhonchus is *dry* or *moist* in character.

326. The *dry crackling rhonchus* is composed of a succession of minute, dry, short, sharp, crackling sounds, few in number, rarely exceeding three or four in a respiration; coexisting exclusively, or almost exclusively, with inspiration, though in very rare cases most obvious in expiration, especially when it has existed for some time; permanent, in the great majority of cases, after its characters have once been perfectly developed, until it ceases altogether to be produced, in consequence of its passing into the moist variety; and usually conveying the impression to the ear of being evolved at a distance from the surface.

327. In stating that the dry crackling rhonchus, once *perfectly* developed, remains commonly a persistent condition until the transition into the moist form is established, I wish to lay particular stress on the circumstance of its being so developed. While yet producible only by forced respiration, and appearing only with an occasional inspiration, it is liable to disappear for a day or two, and then recur; but when once it has acquired sufficient perfection and stability to maintain itself steadily through a number of ordinary respirations, it apparently constitutes a persistent state.

328. This rhonchus, though its mechanism be unexplained, is not without diagnostic importance. It is of tolerably frequent appearance on the eve of the softening process in tubercles, and may hence by possibility be discovered wherever that product exists in the first stage,—but is most common in the infra-clavicular, or supra-scapular regions,—especially in the former. Its natural course is to pass into moist crackling; and, according to M. Fournet, in cases of acute phthisis, the transformation occurs in the majority of instances in from eight to twenty days: in from twenty days to two months and a half, or three months, in the chronic form of the disease. These statements respecting time must be received with caution, however, and are subject, as admitted indeed by this writer himself, to very distinct exceptions.

I do not, however, coincide with those who look upon this rhonchal sound as actually distinctive of tubercle,—at least, I am very certain it is occasionally to be heard in bronchial irritation of the apex, where the subsequent progress of events very clearly disproves the fact of tuberculization. My opinion has changed in regard of the significance of this sound, just as it has concerning the allied phenomenon, cogged-wheel rhythm [278].

329. *Moist crackling*.—A rhonchus composed of a series of clicking

sounds—few in number—of moderate size—occurring during both respiratory movements, but with greater regularity and distinctness of character in inspiration and eventually passing into, or rather superseded by, rhonchi of the bubbling class.

330. Although this rhonchus may most commonly be connected clinically with incipient softening of tubercle, its mechanism is almost as obscure as that of the dry crackling. It appears rather to be produced in direct connection with tuberculous matter, which has commenced to undergo softening, than to constitute a mere form of bronchial rhonchus, having its seat in the bronchi, and produced by bubbling of air through mucus. The clicking character it possesses, combined with the special nature of the anatomical conditions which it is known to attend, points to a peculiarity in its mechanism. Possibly it originates in the interior of softening tubercles which have just commenced to communicate with the minute bronchi. If so, its “conversion” into bubbling rhonchus would in reality be nothing more than its being superseded by that state.

331. I do not by any means believe, however, as taught by Fournet and others, that it is possible to distinguish with certainty by the ear this rhonchus from crackling sounds produced in the smaller bronchi, when surrounded with hardened tissue.

332. *Bubbling* rhonchus is *simple* or *hollow* in character. The simple kind varies in the size of its component bubbles, which are *small* or *large*—a subdivision of clinical significance.

333. In *small-sized bubbling* (sub-crepitant) rhonchus, the component sounds have a distinctly bubbling character; they are of moderate size; humid; scarcely ever occur in puffs; are evolved with variable quickness, but rarely with much rapidity: are few in number and dissimilar to each other; occur with more or less irregularity; and attend both respiratory movements. The bubbles vary in size and liquidness.

334. Produced by bubbling of air through liquid of variable consistence in minute bronchial tubes, this rhonchus, if occurring at both bases posteriorly, indicates idiopathic capillary bronchitis, if at either apex, tuberculous bronchitis—if at one base posteriorly, it most commonly depends either on pneumonia in a state of resolution, or on bronchitis attending tubercle of the *upper* lobe, though occasionally connected with emphysema in excess on the same side. With very liquid bubbles it occurs in various parts of the chest from pulmonary apoplexy—at both bases posteriorly from idiopathic or post-pneumonic oedema. Auscultators are indebted to M. Louis for establishing its frequency, at both bases, as a sign of capillary bronchitis.

335. In the *large-sized bubbling* rhonchus (so-called *mucous, sub-mucous, &c.*), the bubbles are of unequal size, but all materially larger than in the last described species, variable in number—distinctly liquid—irregular in recurrence—modified by the acts of

coughing and of expectorating, and coexistent with both respiratory movements. The size of the bubbles commonly localizes the rhonchus in the larger or smaller bronchi: yet not always, as fine rhonchus may, in very rare cases, form even near the bifurcation of the trachea.

336. Caused by bubbling of air through liquid (mucus, serosity, blood, pus) contained in tubes of moderate or considerable calibre, and most commonly audible towards the central parts of the lungs, this rhonchus attends the secretion-stage of bronchitis, bronchorrhœa, dilatation of the bronchi, bronchial hemorrhage, hæmoptysis, evacuation of pus from the pleura or elsewhere through the bronchi, and occasionally, the suppurative stage of pneumonia.

337. *Hollow bubbling rhonchus* (cavernous or gurgling), consists of a limited number of bubbles of large size, distinctly liquid, occasionally disappearing for a time, having a peculiar ringing hollow metallic character, and coexisting commonly with inspiration and expiration—in some cases with either alone—and associated or not with cavernous respiration. The size of the bubbles varies; whence the rhonchus has been called *amphoric*, *cavernous*, and *cavernulous*. In the last and smallest there is distinctly a clear metallic character, but the sensation of hollowness, is not perceived, or at least imperfectly. Cavernous rhonchus may be sometimes heard at a distance from the patient's chest.

338. The causes of temporary cessation of cavernous rhonchus are—1. Complete evacuation of the liquid contents of the space in which it is produced; under these circumstances it is replaced by cavernous respiration; 2. Diminution of the contents to such extent as to bring the level of these below the bronchial opening or openings into the cavity; 3. Absence of air in the cavity, the entire space being filled with fluid; 4. Obstruction, by inspissated mucus or otherwise, of the bronchi communicating with the cavity; 5. Pressure of the lung by pleuritic effusion¹—a rare cause, seeing that the surface of the excavated parts is commonly agglutinated to the costal pleura.

339. Whenever bubbles burst in a hollow space within the chest, the resulting clicks resound and may be actually echoed by the walls of that space,—the harder and smoother the walls, the more perfect the reinforcement by resonance, and the more certain the occurrence of echo [433]; the softer and more rugged, the less perfect and the less certain. So true is this, that excavations of small size, and surrounded with even tolerably healthy parenchyma, furnish no real hollow rhonchus,—the bubbles form and burst, but their clicks are not echoed. The common cause of bubbling is, of course, the passage of air in and out of the excavation; and, according to the relative position of the contained fluid and the communicating bronchi, will the period of the acts of respira-

¹ Stafford, Consumption Hospital, Chelsea, in "Lancet," July, 1844.

tion, at which the rhonchus is best heard, vary. The bubbles may sometimes probably burst at the bronchial orifices, and then echo within the cavity. Besides this a species of gurgling, resembling cavernous rhonchus somewhat, and becoming metallic in quality, if the mouth be held open, may be produced in large cavities from the agitation of their contents by the impulse of the heart.¹ I have only heard this in the left lung, but Dr. Stokes has observed it in both, and even in the posterior portion of the right lung, producing a "tick loud enough to reckon the pulse by." Under all circumstances it is rare,—even when the heart and cavities are closely contiguous.

340. Excavations from tubercle are, of course, the most common anatomical state present; but those of abscess, sphacelus, softened cancer, pulmonary apoplexy, and perforating empyema, &c., as likewise dilatations of the bronchi, may be the seat of the phenomenon.

340*. In an emaciated middle-aged man, whose history pointed to abscess in the neighborhood of, and opening into, the œsophagus, there was audible under the right clavicle large-sized thin ringing rhonchus,—gurgling, but not metallic. The possibility of communication having taken place between the abscess and œsophagus on the one hand and a large bronchus on the other, suggested itself; and this diagnosis, supported by a non-phthisical history and the existence of fairly pulmonary percussion-note under the clavicle, proved correct.² But had there been any deficiency of infra-clavicular resonance,—or had the previous events been reconcilable with the idea of phthisis, I do not see how error could have been avoided.

341. *Dry crepitant rhonchus with large bubbles*, "observed only during inspiration, conveys the impression as of air entering and distending lungs which had been dried, and of which the cells had been very unequally dilated, and entirely resembles the sound produced by blowing into a dried bladder." Such is Laennec's description of a "rhonchus" which he believed peculiar to emphysema, pulmonary and interlobular; the phenomenon is excessively rare, and cannot be correctly spoken of as a rhonchus,—it is rather a form of respiration, distinguished by dryness and crispness, and is totally wanting in bubbling character. It mainly indicates the existence of dry distended pouches under the pulmonary pleura,—the most advanced condition of pulmonary emphysema. In the few instances in which I have heard the sound, it was transitory.³

342. Under the title of consonating, Skoda describes a rhonchus,

¹ Jamieson, U. C. H., Males.

² Post-mortem examination made by Mr. W. Groves. Two of these openings in the œsophagus communicated directly with the right main bronchus.

³ Hayes, U. C. H., Females, vol. v. p. 24; Quinland, U. C. H., Females, vol. xiv. pp. 40, 41.

clear, high-pitched, and unequal-bubbled, accompanied with resonance, which is, however, neither metallic nor amphoric. It is found along with bronchial breathing and bronchophony, and generally signifies pneumonia or tuberculous infiltration. This description would answer to bubbling rhonchus, produced in tubes surrounded by solid tissue. That a rhonchus, produced in one part of the air-passages, can be reinforced by consonance to an amount clinically appreciable in another and distant one, remains, I think, to be proved. Nor do I find that Skoda gives any satisfactory rules by which the alleged dependence of a rhonchus on consonance can be established during life.

343. (b) *Adventitious sounds originating in the lung-substance (pulmonary pseudo-rhonchi)*.—If individuals, whose lungs are healthy, or diseased only at the apices, and whose breathing is habitually calm, are made suddenly to respire deeply, a peculiar, fine, dry crepitation, accompanying inspiration only, may often be detected at the bases posteriorly. But after two or three, or at most five or six, acts of respiration, it either totally or almost totally disappears. This pseudo-rhonchal sound seems to depend on the sudden and forced unfolding of air-cells, which are unaffected by the calm breathing habitual to the individual; and its only importance arises from the possibility of confounding it with crepitant rhonchus.

344. Here we have a minor degree of the phenomenon observable in the same regions when any considerable portion of the base of the lung is under the influence of persistent pressure from tumors or enlarged abdominal organs. I mean the pulmonary compression pseudo-rhonchus,¹ which consists of a series of fine, very dry crepiti, evolved at a peculiarly slow and drawling pace, variable in number, but generally very numerous, and commencing towards the close of inspiration, or in some cases apparently when this movement has almost ceased.

345. This sound of unfolding lung varies in quality if the lung be diseased. Thus, in a case of arrested phthisis, at the apex of the lung, where, nine months before, softening signs were most manifest, I have recently found percussion toneless, feeble bronchial breathing, and a deep-seated creaking noise accompanying inspiration: in all probability the unfolding of induration-matter in the lung is the cause of this sound. I have repeatedly observed this sign without having traced the progress of its development so well as in this instance.

346. (c) *Adventitious sounds in the pleuræ*.—Daily experience proves that the collision of the opposite laminae of each pleura during inspiration and expiration is not in the healthy state productive of appreciable sound. Experiments upon the lower animals might, were this necessary, be referred to in confirmation of

¹ Clinical Lectures, *Lancet*, 1849, p. 525, in case of enlarged liver; also in case of enlarged spleen, . . . Dujardin, *U. C. H., Males*, vol. v. p. 195.

the fact. This noiselessness of movement of the pleural surfaces upon each other depends at once upon their perfect smoothness and slight humidity, and upon the statical laws of the breathing apparatus which insure the surfaces from mutual pressure. When these conditions become changed by disease, the gliding motion is attended by different modifications of sound, varying with the nature and amount of the existing anatomical change. While these different sounds all agree in being produced by friction, some of them also convey this sensation to the observer, and are, therefore, commonly designated as *pleural friction-sounds*.

347. *Pleural friction-sound* consists either of a single, or more commonly, of a series of abrupt jerkily produced noises, few in number, and manifestly superficial in seat: it is audible over a variable but usually limited extent of surface; persistent or intermittent; of variable, but commonly more or less considerable duration; ranging, in point of intensity, from a scarcely audible noise to one of extreme loudness; attended with a sensation of dryness: almost invariably heard in inspiration, and habitually, but by no means always, more intensely developed with that movement, most frequently accompanying both inspiration and expiration, seldom expiration alone;¹ produced with ordinary respiration, or only after coughing, or by deep inspiration; in strongly-marked cases attended with fremitus palpable to the hand, and perceptible to the patient, and sometimes increased by pressure with the stethoscope. Calm may give more friction than forced respiration.²

348. The species and varieties of intra-pleural noises may be arranged thus—the mechanism of each species is different from that of the rest:—

- (a) Attrition; 1, grazing; 2, rubbing; 3, grating.
- (b) Creaking.
- (c) Crackling.
- (d) Rumbling.

349. (a) *Attrition species*.—1. The *grazing* variety, the most delicate form of friction, is usually a single sound; audible over a very limited extent of surface; occurring with an occasional respiration only; remarkable for mobility; more rapidly evolved, and of less duration than the other varieties; dry and limited strictly to inspiration. Changing from hour to hour, it may be, in precise site, this variety is almost peculiar to the dry period of pleurisy, occurring rarely at the absorption-period, and is mostly met with in the phthisical form of that inflammation. In primary idiopathic pleuritis it is very rarely to be detected, because the period of its

¹ Clansey, U. C. H., Males, vol. viii. p. 73. Total limitation to expiration is of temporary duration. Friction sound may also be most prolonged, and consist of the greatest number of jerks in expiration, *e. g.*, Humbert, U. C. H., Males, vol. ix. p. 14; Bassett, U. C. H., Females, vol. vii. p. 226.

² Basset, U. C. H., Females, vol. vii. p. 229.

existence has usually passed away before the chest is submitted to examination. In cases of intercurrent pleurisy, where the patient has been under treatment for the primary disease, a better opportunity is afforded of establishing its existence. Another source of difficulty in its detection, even in tuberculous cases, is the shortness of its duration: a single day suffices for its production, development, and termination; and this series of changes may, as I have, though rarely, observed, be accomplished several times successively in the course of a few days.

350. The ordinary seats of grazing friction are the infra-mammary, infra-axillary, and infra-scapular regions; I have not yet satisfied myself of its existence, either in the supra-spinous, supra-clavicular, or infra-clavicular regions: probably it is masked in these vicinities by the louder morbid sounds usually present. The sign is not only of clinical but of pathological importance, because it has helped to connect the fugitive chest-pains of phthisis with local and evanescent pleurisy.

351. 2. *The rubbing variety*, a more advanced type of friction, consists of a series of jerking sounds, rarely exceeding three or four in number; is audible over a tolerable extent of surface, provided the necessary condition of motion of the lung exist; of rather considerable duration, slowly evolved, attends both inspiration and expiration, and is more frequently than other varieties attended with friction-fremitus. It occurs in acute pleurisy, at the periods of plastic exudation, and of absorption, being more frequently detected at the latter. The mechanism of friction-sound causes a difficulty in conceiving its production, where great liquid effusion is present in the pleura; and ordinary experience is in accordance with *à priori* considerations—the two conditions are not observed to coexist. Dr. Stokes was, however, the first to mention a case in which, though great and universal dulness of the side existed, friction phenomena were audible, and even perceptible to the patient in the postero-inferior and lateral portions of the chest: “they may then,” he infers, “coexist with extensive liquid effusion. There is one source of fallacy in such cases: supposing them to have reached the period of absorption, the fluid might have been nearly removed, and yet the condensation of the superficial strata of the lung combined with an accumulation of plastic exudation-matter, been sufficient to produce extensive and marked dulness. Now, under such circumstances, the production of friction phenomena would have been inevitable. However, the retention of some portion of the lung’s surface in tolerably close proximity to the costal pleura, by means of adhesions, also renders the production of friction-sound possible, although a considerable quantity of fluid be present in the pleura. M. Fournet states that he once ascertained the coexistence of these three conditions; and I presume that three examples I have myself observed of coexistent friction-sound, and general

effusion-signs, were thus explicable.¹ Effusion-signs may be evident in the back, and friction-signs in front; this is common.

352. Laennec described friction-sound as an attendant upon, and one of the most important diagnostic signs of, interlobular emphysema; while he made no mention of its existence in pleurisy. The experience of his followers has reversed the connection which Laennec sought to establish: it is now believed that emphysema of any anatomical form is as incapable of producing friction-signs, as pleurisy is indubitably their common cause. Andral, Louis, Stokes, Fournet, and other writers, agree in denying, either directly or by inference, that the collision of subpleural sacculi, or of pulmonary septa rendered prominent by infiltration of air, against the opposite pleura, is an observed cause of friction-sound. Such was the opinion which I held upon the point also; and I still believe that we want the anatomical proof of the phenomenon being thus generated. But from some cases I have met with of very advanced emphysema, manifestly attended with a low degree of rubbing-sound at the postero-inferior part of the chest, where subpleural sacculi are very commonly developed, and presenting neither signs nor symptoms indicative of pleurisy, I am induced to think that Laennec's belief respecting the occurrence of friction-signs in some forms of emphysema was not erroneous.² Upon referring to certain cases in my possession of individuals dying with extensive infiltration of air under the pleura, I find the existence of friction-sound during life noted, and certainly not a syllable respecting exudation-matter in the pleura among the details of the post-mortem examination. I can scarcely think that so obvious an appearance as this would have been forgotten, had it existed. These cases, too, are perhaps deserving attention, because collected at a period when I had a preconceived notion against the possibility of friction-sounds being evolved in the manner now referred to. It is true, Dr. Stokes maintains their evolution under the circumstances to be physically impossible. "It is only," he observes, "when the surfaces are rendered dry by an arrest of secretion, or roughened by the effusion of lymph, that their motions produce sounds perceptible to the ear." But this remark, which is perfectly just, if applied to these surfaces when holding to each other their natural relation of simple approximation without mutual pressure, begs the question at issue when applied to pleural laminæ, one of which presents elevations on its surface necessarily productive of some slight pressure against the other.

353. *The grating variety* conveys the sensation indicated by its name; and, except in respect of its greater sharpness, is charac-

¹ Friction sound may exist in the inflamed pericardium with an amount of fluid (sixty ounces) which makes its mechanism difficult of comprehension, Bartlett, U. C. H., Males, vol. iv. p. 292.

² I have (Hayes, U. C. H., Females, vol. v. p. 25,) distinctly observed them in the mammary region also.

terized as the last variety. It may occur at the period of absorption, with or without retraction of the chest, and occasionally at that of exudation. It sometimes indicates that the exudation-matter is laid down in the granular form; and may also be produced by subpleural miliary tubercles, causing superficial prominences.

354. (b) *The creaking species* is suggestive of the noise produced by the creaking of new leather of moderate hardness; in other respects it resembles the rubbing variety, with which it has a tendency to coexist. It commonly indicates dryness, firmness, and toughness on the part of the exudation-matter, and hardly occurs, except in cases lapsing into the chronic form. The capsule of induration-matter, that sometimes caps tuberculized apices, furnishes in rare instances, *by its own motion on itself*, a modification of this sound, most frequently audible in the supra-spinata fossa,—hence the necessity, on the score of mechanism, of making it a species apart.

355. (c) *Crackling (pleural pseudo-rhonchus)*.—In the winter of 1842 I made the following observation: In a male adult presenting the most evident signs, both in front and behind, of a cavity at the left apex, an extremely abundant* medium-sized rhonchus occurring almost in puffs, and having the liquid bubbling character in a most marked manner, was day after day during the week previous to death, detected in the entire height of the left side posteriorly. The rhonchus was, however, distinctly more abundant and more liquid, as noted in writing during life, in the upper scapular and upper part of the lower scapular regions, than elsewhere. As the patient was anasarcaous to a high degree, the urine albuminous, and as he constantly lay on the left side, the explanation of the rhonchus naturally suggesting itself was, that it depended on œdema of the pulmonary tissue generally, but most marked at the apex, and there of course affecting tissues lying between the cavity and the surface of the lung. At the post-mortem examination, however, I found this explanation was inadmissible; for the thin lamella of tissue between the cavity and the surface was as hard as cartilage, and contained not a particle of serosity; nor was the organ in any part distinctly infiltrated with fluid, being, on the contrary, particularly dry from its excessive induration. But all along the posterior surface of the pulmonary pleura there appeared, in addition to ordinary dense pseudo-membrane, a quantity of fine adventitious cellular tissue, abundantly infiltrated with liquid. Masses of some size were formed from place to place by the accumulation of fluid in the meshes of this cellular tissue, and it was observed by those present, who had not seen the patient during life, that they were much larger than elsewhere at the apex. There was no air either in the cavity of the pleura, or intermixed with the serosity. Now, although it was possible to suggest another explanation, it seemed most reasonable to suppose, under the cir-

cumstances, that the rhonchal sound was actually produced in the masses of infiltrated tissue referred to, and therefore outside the lung, and independently of air.¹

356. Subsequent experience has amply proved the correctness of this explanation, and shown that moist sounds, rhonchoid in properties, are producible whenever adventitious tissue within the pleura is infiltrated with serosity, and the movements of the chest continue free. The sounds occur in two forms, *squashy* and *crackling*. The character of the first is represented by its name, and coupled with the sensation of extremely superficial site, suffices for its diagnosis.² The crackling form, in itself indistinguishable from some conditions of subcrepitant rhonchus, may be diagnosticated by the coexistence of friction-sounds, constant or occasional, and by its being unaffected by coughing. Mere moisture in plastic matter within the pleura seems enough to give a rhonchoid character to friction-sound.

357. (*d*) *Rumbling*.—Instead of being composed of a series of distinct interrupted jerks, friction-sound may be prolonged without cessation from the beginning of inspiration to the end of expiration; for this variety, evidently allied to pleural pseudo-rhonchus, the name of *rumbling* may be chosen.³

358. The duration of each jerk of friction-sound, as also of the whole series in each act of respiration, depends on the extent of surface in a state to furnish the sound, the freedom of motion, and dilatibility of the lung. The length of time friction-sounds may continue audible in a case of pleurisy, especially during its absorption period, varies greatly.

359. Although the audible characters of friction-sound are, as mentioned above, somewhat influenced by, they do not bear any constant relationship to, the physical state of the exudation matter generating that sound. We cannot predicate from the character of friction-sound the state of the pleural exudation—it is even doubtful, that we can affirm, on the evidence of friction-sound, whether this is caused by exudation or by mere dryness and vascularity of surface—as will be more fully shown with the history of pleurisy.

360. The motion of respiration is, of course, the ordinary dynamic cause of the collision of surfaces required for the generation of pleural friction-sound; where movement is seriously obstructed by dense hepatization, there may be abundant plastic exudation on the surfaces without a particle of friction-sound.⁴ Besides, as first noticed by Dr. Stokes, the heart's impulse may, under favoring circumstances produce intra-pleural rubbing-sound. The rhythm of

¹ Phys. Diagnosis of Dis. Lungs, p. 285, 1843.

² The precise spot where infiltrated false membrane exists may be pointed out during life by this sound: *e. g.* cases of Griffith's U. C. H., Males, vol. ii. p. 183; and Donovan, U. C. H., Males, vol. ii. p. 202.

³ Case of Lockett, Clin. Lectures, Lancet, April, 1849, p. 390.

⁴ Shears, U. C. H., Males, vol. xv. p. 87.

ordinary pleural friction coincides with the movements of respiration; that of the variety, generated by cardiac impulse, agrees with the heart's movements; hence a difficulty, considered in connection with Diseases of the Heart, in determining on the pericardial or really pleural origin of such friction.

361. (d) *Adventitious sounds in the mediastina.*—Crepitation, inspiratory and expiratory, of variable degrees of dryness, abundance, and size, audible in forced respiration only, or in calm breathing, constant or intermittent, disappearing after a few chest-expansions, or continuing through a long examination, is sometimes to be discovered over the sternum, generally or partially, while it is completely wanting over the contiguous portions of lung. No symptoms of any kind necessarily attend this state.¹

362. How is it produced? When the cellular tissue is infiltrated with serosity and air, the production of such sound through the movements of the chest is quite intelligible. I observed the fact in a remarkable case, where air was infiltrated into the mediastina through perforation of the œsophagus and pericardium, effected in the attempt to swallow a knife.² But whether the presence of air be absolutely requisite I do not know as a matter of experience. This pseudo-rhonchus derives its clinical interest from the likelihood of its being mistaken (as it has actually been) for the crepitant rhonchus of marginal pneumonia.

363. A rhonchoid sound may be produced in the mediastinum by the heart's impulse against the infiltrated cellular tissue; it is then of cardiac rhythm;³ or, in the same individual, the mediastinal space may give rise to squashy sound of cardiac and pulmonary rhythm combined.⁴

364. (e) *Adventitious sounds in the thoracic parietes.*—Various sounds generated in the framework of the thorax and its integuments by the breathing movements, aided or not by pressure of the stethoscope, derive interest from the chance of their being confounded with intra-thoracic sounds, a chance not unfrequently realized. There is scarcely a form of pulmonary morbid sound that may not be thus simulated.

365. Pseudo-crepitation will occur if the stethoscope be accidentally placed over hair on the surface; in a less deceptive form if the subcutaneous cellular tissue be emphysematous. The crepitus of a fractured rib has been mistaken for the rhonchus of pneumonia.

366. Creaking sounds are sometimes heard about the cartilages, probably from interstitial dryness, as they are by far most common in aged persons; I have known these mistaken for creaking pleural friction-sound.

¹ Scott, U. C. H., Males, July 23, 1850.

² Ramo Samee, Univ. Coll. Mus., No. 3859.

³ Lewis, U. C. H., Females, vol. xiv. pp. 73, 111.

⁴ Beere, U. C. H., Females, vol. x. p. 98; Baker, U. C. H., Males, vol. xvi. p. 150.

367. A moist rhonchoid sound, perfectly resembling fine bubbling, is often audible when the integuments are infiltrated with serosity. This anasarca sound may disappear totally when the subjacent fluid has been completely pressed aside by the end of the stethoscope.

368. Pseudo-friction sound is also, though less frequently, producible by anasarca of the chest walls. The imitation may be distinguished from the reality by its being limited to œdematous spots, by its existing in the abdominal as well as the thoracic walls, by its not being perfectly synchronous with the respiration-movements, and by its disappearing after steady pressure with the stethoscope.¹

369. A sound, imitative of intra-thoracic friction, may be produced by the movements of the scapula in breathing, probably when the cellular tissue between that bone and the chest-wall is unusually dry. When occurring in the upper fossa, it simulates somewhat the cogged-wheel-rhythm [278]. At either fossa the sound is removable by a few brisk movements of the arm.

370. The muscular actions going on in the chest-wall give rise in some persons to a peculiar buzzing rumbling sound; its amount does not appear to be directly as the muscularity of the individual. It is increased by efforts of all kinds—as, for instance, that of maintaining an uncomfortable posture; it is continuous, not rhythmical with respiration; and rather increases, than diminishes, in intensity when the breath is held. It may in some spots be removed by putting the muscles in a state of relaxation; but in the infra-axillary regions, where it is sometimes highly marked, cannot be thus arrested.

371. According to the site of various of the sounds now passed in review, they may, without due care, be taken for evidences of pleurisy, pericarditis, pneumonia, œdema of the lung, or phthisis.

372. (*f*) *Adventitious sounds produced in neighboring organs.*—Very little care will prevent the rhonchoid noise, caused by swallowing saliva, and by intestinal borborygmi from being mistaken for intrapulmonary sounds. In cases of great gaseous distension of the stomach, the bursting of bubbles within that organ may simulate amphoric rhonchus with echo and metallic tinkling: the percussion-sound will at the same time be extensively amphoric (not tympanic), in the left inferior regions; but there will be no amphoric breathing, and the act of swallowing fluid will immediately increase the rhonchoid sounds.

§ II.—THE RESONANCE OF THE VOICE.

I.—IN HEALTH.

373. The particular rules for performing auscultation of the voice are not numerous. The most essential point is, that its pitch, in-

¹ Peculiarities all of them observed in the case of J. Morris, U. C. H., Males, vol. vii. p. 159.

tensity, and tone be the same, while different points of the chest are examined. Now this uniformity can only be insured by causing the patient to repeat monotonously the same word or syllable: even slight inflection of tone may modify the resonance; and variation in the class of consonants pronounced will have even more certainly the same effect.

374. Generally speaking, the patient's utterance should be loud, while the vocal resonance is examined; but in the auscultation of the voice over caverns, the most decisive information is sometimes obtained from the whisper, beyond which the patient is, in the advanced stages of tuberculous disease, frequently unable to raise his tone.

375. The stethoscope should be laid firmly upon the surface, and the ear similarly applied to the instrument, but without any degree of forcible pressure; if either be too lightly applied, a tremulous character may be given to the resonance; if too forcibly, the distinctness of this is diminished. It is scarcely necessary to add, that the instrument should be used in precisely the same manner, and in precisely corresponding spots upon both sides of the thorax. The condition known as exaggerated resonance is perhaps more accurately appreciable by means of immediate than mediate auscultation; all other unnatural states of vocal resonance are more satisfactorily and distinctly ascertained with the stethoscope.

376. In examining certain regions, great care must be used both in the manner of applying the instrument and in drawing inferences from the results obtained; the chief of these regions are the post-clavicular, the upper sternal, and the inter-scapular. The vicinity of the trachea or large bronchi is, without such care, liable to mislead the observer, on account of the naturally greater resonance to which that vicinity gives rise. When the post-clavicular space is examined, especially its inner part, the stethoscope should be held as nearly as possible parallel to the trachea.

377. If the stethoscope be applied over the larynx or trachea of a healthy individual while speaking, the voice is transmitted, imperfectly articulated, through the instrument to the ear, with a degree of force, loudness, and concentration so great, that the experiment may be productive of actual pain to the observer, especially if the voice examined be grave and powerful. The same transmission of the voice occurs at the lateral parts of the neck, and even over the spinous processes of the vertebræ behind, but with less intensity than on the middle line in front. The resonance of the voice heard in these situations is called *natural laryngophony* and *tracheophony*. At the upper part of the sternum, on the middle line, the vocal resonance is considerably weaker; towards the edges of the same part of that bone a still further diminution is perceptible, and the resonance is here reduced to the state called *natural bronchophony*. The sound is now more diffused, its articulation very imperfect, its quality like that of the voice heard through a speaking-

trumpet; it also appears to be, as it actually is, produced at a greater distance, and no longer seems to strike directly against the ear. This species of resonance is also observable posteriorly on the middle line over the division of the trachea, and on either side of that division between the spines of the scapulæ. Over the parietes of the chest, with the exception of the parts just referred to, the natural resonance of the voice amounts to no more than an obscure buzzing, unattended with any approach to articulation, and appearing to reach the ear from, rather than to originate at, a certain depth within the chest, and from an indeterminate extent of surface; in many persons even this obscure buzzing is wholly deficient.

378. The intensity and quality of this natural resonance are modified by certain circumstances altogether independant of disease. Thus, the natural resonance is *cæteris paribus* marked in proportion to the graveness of the voice. This statement is only true of intensity, however; there is no greater tendency to concentration or articulation of the sound when the voice is grave than when it is shrill: Secondly, vocal resonance is, as a corollary from the last proposition, more marked in males and in adults than in females and in children; it is also more marked in aged persons than in adults, doubtless on account of the wasting of the pulmonary parenchyma, and the thickening and hardening of the bronchi in old age: Thirdly, the quality of the resonance varies with the quality of the speaking voice; thus in people of advanced years it is very commonly tremulous and bleating: Fourthly, the resonance is more strongly developed, the larger the chest, and the less loaded its walls with fat and muscle: Fifthly, it is stronger in front than behind, with the exception of the interscapular region; and at the upper than the lower parts of the thorax: Sixthly, as first stated by Dr. Stokes, its intensity is greater on the right side generally than the left—a fact chiefly significant, though by no means valueless elsewhere, under the clavicles and in the interscapular regions; there is no resonance over the superficial cardiac region, nor over the hepatic surface below the sixth rib: Seventhly, the intensity of vocal resonance, as of the respiratory sounds, varies much in persons apparently presenting the same physical conditions for its development; hence the danger of drawing any inference directly from the state of vocal resonance in a given portion of the chest; it is only by the application of the principle of comparison of the two sides that any safe result can be obtained, due allowance also being made for their natural differences.

379. Vocal resonance may be well marked while vocal fremitus is feeble or deficient [78, 404*].

II.—IN DISEASE.

400. The signs derived from modified vocal resonance are uncertain in character and obscure in theory, and, though occasion-

ally not devoid of clinical signification, hold, as a rule, a very low place among physical aids to diagnosis.

401. The natural vocal resonance may be diminished or increased in intensity, without or with alteration in equality. Its perversions may be arranged thus:—

Diminished Intensity	{	Weak	{	Simple.
		Suppressed.		
		Exaggerated		Pectoriloquous—amphoric.
Increased Intensity	{	Bronchophony	{	

402. Diminution of resonance varies between weakness and suppression. *Weak resonance*, as the title implies, signifies a state in which the vocal resonance is distinctly less marked than natural; commonly spoken of as rare, it is really of frequent occurrence. Thus in the dilatation period of liquid and æriform effusion into the pleura, in cases of obstructed main bronchus, even in solidification of the lung, and over excavations, the corresponding resonance may be temporarily weaker than natural.

403. *Suppressed resonance* means that rare condition in which all transmission of the voice to parts of the surface, where naturally perceptible, has ceased; no audible sound being conveyed there. Impairment of vocal resonance exists in emphysema; and in pneumothorax, simple or fistulous, actual suppression may occur. But neither of these conditions is constant: in emphysema the resonance may be extra-powerful. Simple pneumothorax is so rare that we have little opportunity of substantiating its signs, and special peculiarities occur in the fistulous variety. During the dilatation-period of pleuritic effusion the resonance may be weakened even to suppression.

404. Increased resonance presents itself in the forms of *exaggerated resonance* and *bronchophony*, which are little more than forms of each other. The intensity of sound in the former undergoes simple increase; in the latter there is, besides, just as in the natural resonance over the main bronchi, a greater concentration of sound: the former may be considered a *diffused* bronchophony; the latter a *concentrated* resonance of exaggerated force. In bronchophony the sound is also ringing and more distinct; unattended with distinct articulation; and occasionally producing a quivering sensation in the ear of the observer. Both are usually constant phenomena, so long as they exist; that is, produced every time the patient speaks. The area of bronchophony may, or may not be, sharply defined; in other words, the transition from the most distinct bronchophony to the natural resonance may be sudden; or, as is more common, a gradual diminution of the phenomenon is traceable. In quality it may be metallic, sniffling, or partake, chiefly in aged persons, of the tremulous and bleating tone especially characterizing ægophony.

404*. As in the case of natural resonance, there is no uniform

ratio of strength of morbid bronchophony and of vocal vibration; the audible impression may be powerful while the tactile is null [78]: of the converse condition I have no experience, at least that I can remember. The inequality seems paradoxical enough, but not more strange than the sudden cessation of fremitus in running the gamut, when a certain note is reached, no matter how loudly it be sounded [73, note], while with all tones lower in the scale, even though feebly uttered, the vibration may be strong.

405. The physical conditions in which simple bronchophony is clinically observable are: 1. Increased density of the pulmonary tissue either surrounding pervious bronchi, or forming a medium of communication between pervious bronchi and the spot of the thoracic surface examined, whether that increase of density be caused by solid, semi-solid, or even liquid infiltration of the parenchyma. 2. Increased density of texture, produced by extraneous pressure. 3. Presence of any solid extra-pulmonary formation in such a situation as to form a connecting link between the surface examined and a bronchus of some width. 4. Increased width and hypertrophy of the substance of the bronchial tubes. 5. Diminished density of the lung, as in the rarefaction of vesicular emphysema. 6. Excavation of the lung. The diseases referable to the first head are the common causes of bronchophony, but any hypothesis in explanation of the phenomenon must also apply to the other and comparatively rare causes.

406. Thus in its maximum degree, and marked by the metallic and sniffling quality, bronchophony coexists with tubular blowing respiration, in the parts corresponding to hepatized lung. In the non-metallic form it is heard in tuberculous and plastic consolidations, in pulmonary apoplexy, slightly in pulmonary œdema. It exists in dilatation of the bronchi; but the enlarged calibre of the tubes is not habitually the sole condition of its presence; coexisting thickening and hardening of their walls, and condensation, attended with chronic induration of more or less pulmonary substance around (as in so-called cirrhosis of the lung), contribute materially to its production: still, increased width may be the sole appreciable cause of the sign. Bronchophony cannot be regarded as an ordinary sign of pleurisy with effusion. At the stage of effusion with general dilatation of the chest, when a broad mass of fluid intervenes between the lung and parietes, all vocal resonance habitually ceases; but when the effusion is moderate, bronchophony may commonly be detected in the immediate vicinity of the larger bronchi between the scapulæ.¹ So, too, if there be induration of pulmonary substance, superadded to the mere condensation from pressure, bronchophony may be sometimes very manifest posteri-

¹ An amount of effusion sufficient to push the heart to the other side and annul tubular resonance under the clavicle, may be attended with strong bronchophony about the inferior angle of the scapula.—*e. g.* Crowhurst, U. C. H., Males, vol. ix. p. 142.

only and laterally; for example, where slight hepatization coexists with effusion. Bronchophony may often be heard in the upper front regions, when the effusion is sufficient to condense a considerable portion of the lung inferiorly. Again, it is affirmed by M. Reynaud that in many cases of pleuritic effusion, where in the sitting posture resonance has been ægophonic, this may be converted into bronchophonic by making the patient lie on the abdomen, the fluid being thus thrown forwards, and the lung-substance brought well up to the posterior chest-wall.¹ Bronchophony is common also at the period of absorption and retraction of the chest-walls; and, from the existence of partial pleural agglutinations or adhesions, bronchophony is sometimes locally audible throughout the entire course of effusion. Compressed texture, whatever be the cause of compression, may give bronchophonic resonance, if of any notable bulk. The connection of bronchophony with excavations will be by and by considered.

407. There are two conditions of vocal resonance, described by Laennec under the names of pectoriloquy and ægophony, the nature and significance of which are yet *sub judice*.

408. The essential character of pectoriloquy is, according to its discoverer, complete transmission of the voice through the stethoscope—that is, a sensation as if the words uttered passed directly into the ear of the observer from the spot beneath. This condition of resonance he believed to be peculiar to excavations in the substance of the lung, and, besides, an invariable attendant on them, except when extraneous circumstances interfered with its production or propagation. As, however, he repeatedly met with excavations which furnished during life only a more or less faint imitation of such resonance, he found himself constrained to admit “imperfect and doubtful” varieties of pectoriloquy—obviously nothing more than simple bronchophony. But he does not seem

¹Skoda declares he has frequently repeated Reynaud’s experiments, but never obtained the like result. He indirectly even questions the possibility of the lung being brought nearer the posterior surface by the above change of position, because the compressed or hepatized lung is heavier than pleuritic fluid, and consequently the change would have the precisely contrary effect on the relative positions of the organ and surrounding liquid. I disagree completely, as matter of actual experience, with Skoda in this form of *à priori* objection to Reynaud. I have repeatedly found, and shown to a clinical class, that in cases of pleuritic effusion, friction-sound may be made audible in spots where none was to be heard in the sitting posture, by causing the patient to lie on the face for a short while. How is this to be explained but by the lung being brought, through the changed attitude, into apposition with the posterior chest-wall? Relative gravity is evidently not the sole element in the matter. Besides, I have occasionally found by experiment a positive change in the ægophonic quality of the resonance producible in the manner described by Reynaud (*e. g.* Ward, U. C. H., Females, vol. xi. p. 65, proved *post mortem*). How can Skoda say he has repeatedly performed Reynaud’s experiment, when almost in the same breath he affirms “patients having non-sacculated fluid effusion in sufficient quantity to cause increased vocal resonance, either could not bear at all, or bear only for a few moments, the change of posture required for Reynaud’s experiment?” *Zweite Auflage*, p. 68.

to have been aware that most perfect pectoriloquy, as defined by himself, may occur where a solid mass, of medium size, is interposed between a main bronchus and the surface, and hence, under conditions, the most strongly opposed to those of excavation. Facts of the first class show that cavities may exist without pectoriloquy; of the second prove that pectoriloquy may exist without them: hence, in his notions of the diagnostic force of the sign, Laennec was indubitably wrong. But neither the one nor the other class of facts disproves the reality of the specific propagation of articulate sounds to the ear, as described by Laennec.

409. In conformity, then, with the principle of recognizing the individuality of every sound having special acoustic properties, I retain pectoriloquy—merely, however, as a variety of simple bronchophony, under the title of *pectoriloquous*. It closely resembles the resonance heard over the larynx, and may exceed this in intensity; like the laryngeal voice, it appears to pass directly through the stethoscope into the observer's ear, and may throw the concha, and even the neighboring part of the skull, into more or less strong vibration. Limited generally to a small and accurately defined space, it may have a hollow and ringing character or not. Though, generally speaking, loud, this is a wholly unessential property of pectoriloquous bronchophony, depending in great measure on the power of the laryngeal voice: the hollow and ringing characters, the insulation of the phenomenon, and its transmission in an articulated form through the stethoscope, may be distinctly marked, even when the ordinary voice is almost destroyed. When the physical conditions of its production exist in a patient thus reduced almost to a state of aphonia, it becomes peculiarly characteristic—low muffled whispers pass directly into the ear, articulated sometimes with as much, if not more, precision than the laryngeal voice (whispering pectoriloquy, or *whispering chest-speech*): here there is no tactile fremitus on the surface, nor is any thrill communicated to the concha of the listener—proof unmistakable that such thrill is not an essential element of pectoriloquous bronchophony. Loud pectoriloquy may in each syllable be followed by a sort of whispering echo—sometimes also be preceded by an inarticulate whisper.

410. Bronchophony becomes pectoriloquous in certain conditions of solidification and of excavation in the lungs, and in cases where solid masses lie between the bronchi and the parietes: the most marked pectoriloquy of the *loud* form I have almost ever heard, existed near the right sterno-clavicular angle, over a fibrous nodule in the pleura, the lung being healthy and simply slightly condensed at the spot by pressure.

411. Here, then, is a sign common to two conditions, which are, to all seeming, in physical constitution the precise reverse of each other; do there exist any means of surely determining to which the sign may be due in any individual case? Where the quality

of the resonance is markedly hollow and ringing, and where it exists in the *whispering* form, I long believed that it strongly indicated a cavity; but, as I have found whispered pectoriloquy over even simple acute hepatization,¹ as well as in the retraction-period of pleurisy [304], it is plain that particular character fails to distinguish the two modes of causation. And it is rather through the coexistence of pectoriloquy than through its own attributes, its mechanism may be made matter, sometimes of certainty, sometimes merely of surmise.

412. Whatever be the nature of the excavation, gangrenous, purulent, apoplectic, cancerous, or tuberculous, globular dilatation of a bronchus included, pectoriloquy *may* be perceptible. But it may not occur at all; or, if occurring, may be transitory or intermittent. The conditions of an excavation most conducive to such resonance are—moderate size; smoothness and density of its internal surface, hence absence of bands either traversing its area or coasting its walls; emptiness; superficial position, and especially adhesion of its periphery to the parietes of the chest; thinness and hardness of that portion of its walls next the surface; and free communication with the bronchi. Where, on the contrary, a cavity is possessed of flaccid irregular walls, is more or less nearly filled with fluid, and deeply seated, with healthy lung interposed between it and the surface, the resonance will be wholly deficient in pectoriloquous character, and may be strongly or faintly bronchophonic, or *absolutely null*. Moderate size is of importance; small cavities, unless under special circumstances of seat, are rarely pectoriloquous; and very large dimensions are equally opposed to such resonance.² Very small diameter of the communicating bronchi impairs the distinctness of the phenomenon; and want of communication with the bronchi, also, will prevent its development, persistently or temporarily, according as the obstruction is itself permanent or dependent upon passing circumstances, such as accumulation of sputa in their interior. On the other hand, as observed by Laennec, where the number of fistulous openings by which a large excavation communicates with the bronchi increases, pectoriloquy becomes indistinct or ceases altogether; and if a communication be set up between a cavity and the pleura, or if the contents of the former escape into the subcutaneous cellular membrane, the phenomenon of pectoriloquy disappears. It follows very clearly from these facts, that pectoriloquous bronchophony must be frequently wanting in cases of caverns in the lungs, and that the other signs of destruction of pulmonary substance are much more trustworthy.

¹ McLane, U. C. H., Males, vol. xii. p. 181, Oct. 1855. Bronchophony is actually sometimes better perceived with the whispered than the ordinary voice: Wright, U. C. H., Females, vol. xv. p. 14.

² Thus (Green, U. C. H., Females, vol. v. p. 148), over an enormous tuberculous cavity furnishing perfect amphoric respiration with metallic echo, there was occasionally complete absence of vocal resonance of any kind.

413. When the vocal resonance has a metallic character, is not transmitted forcibly through the stethoscope, is not articulate, but conveys the impression of its being produced in a hollow space of large size it is called *amphoric*, from the similarity of the phenomenon to that produced by speaking into an empty pitcher.

414. *Ægophony* (*αἴγος* gen. of *αἴξ*, a goat, and *φωνή*, voice), the name given by Laennec to a special resonance, distinguished by its tremulous, nasal, and cracked character, suggestive of the bleating of a goat, is another variety of bronchophony. When most strongly marked it is distinctly ringing, jarring, and muffled; is synchronous with the articulation of each word, or follows it immediately, like a feeble, sometimes whispered, echo of higher pitch than itself; conveys the idea of somewhat distant origin; does not appear to traverse the stethoscope, but rather to flutter tremulously about the applied end; is commonly persistent, but of short duration; audible over a very limited surface, and occasionally capable of being altered in position by varying the posture of the patient. Certain modifications of pure ægophony have been happily compared by Laennec to the voice passing through a metallic tube or cleft reed—that of a person speaking with a counter between his lips and teeth—and to the nasal twang of the exhibitors of Punch.

415. Rarely lasting more than from two to five days, Laennec has known ægophony continue in cases of chronic pleuritic effusion for several months. It does not accompany all notes of the voice, nor all words, even though pronounced with the same pitch: this peculiarity does not depend on the loudness of the laryngeal voice.

416. Pure ægophony is observed in certain cases, where a stratum of fluid contained in the pleura compresses the lung. The precise thickness of the layer of fluid most favorable to its production cannot be either laid down as matter of observation, or satisfactorily calculated. Laennec states that he has discovered this sign, when there were not more than three or four ounces of fluid in the chest: I have certainly no experience of its occurrence with an amount even nearly so small. It appears in fullest force during the period of gravitation, before any detrusion of the parietes has occurred, and consequently while the fluid is still moderate in quantity, and at its upper part spread thinly over the pulmonary surface. With the increase of effusion it disappears altogether, to return again when absorption has reduced the liquid to a thin layer. So, too, in cases of paracentesis for empyema, ægophony sometimes appears after a certain portion of the fluid has escaped. On the other hand, exceptional instances occur, not always explicable by the existence of adhesions, in which ægophony remains in spite of very abundant accumulation. I have seen such cases,¹ and such a one has been published by Andral (*Clin. Med.*, t. ii., Obs.

¹ c. g. Ward, U. C. H., Females, vol. xi. p. 63.

xxi.), where displacement of the diaphragm and heart gave evidence of the abundance of the fluid.

417. Supposing the patient to be examined in the sitting posture, the seat of the phenomenon will be found to be the neighborhood of the inferior angle of either scapula, and a few inches on either side in a line with that angle; in very rare cases extending almost to the nipple in front. This limitation of seat is important as diagnostic of true ægophony. The shrill ægophonic quality of resonance, traceable to a naturally sharp and tremulous character of the voice would be thus at once distinguished from resonance actually caused by the presence of fluid in the pleura, inasmuch as it would exist in the highest degree wherever the dulness under percussion was most marked; that is, commonly at the base of the lung. Now ægophony does not exist where the dulness is greatest: far from this; such a quantity of fluid as is capable of causing very notable dulness (rise of pitch with loss of tone) will almost inevitably, as just seen, cause the disappearance of ægophony, if it have previously existed. Exceptional cases are met with, however, in which the seat of true ægophony is more extensive. Laennec sometimes observed it over the entire affected side at the commencement of the disease. In two such cases he "ascertained, by examination after death, that this peculiarity depended upon the retention of the lung in partial apposition with the chest by means of pretty numerous adhesions, so that the lung became invested by a thin layer of fluid over its whole surface. In cases of this kind, the sign in question is observable during the whole period of the disease." Whether ægophony is produced precisely on the level of the upper border of the pleural fluid, or at a variable elevation of that fluid, where it is of a certain thickness, is a very difficult point to decide; but the conditions of the respiratory sounds and of the percussion-note, appear, as a rule, to support the latter, the less commonly received, view.

418. Movableness of ægophony [406] is essentially a character of short duration: the displacement of the fluid either ceases to be possible from the interference of plastic exudation, or the quantity of fluid increases to such a degree as to exclude altogether the conditions of its development.

419. Inflammatory and dropsical accumulations of fluid in the pleura are the states to which true ægophony is almost peculiar—its existence in cases of hydropericardium is altogether exceptional. In cases of pleuro-pneumonia, when fluid exists to the necessary amount in the pleura, the resonance of hepatization becomes modified very usually by an ægophonic twang; but it is extremely rare to observe marked ægophony in these cases. It is true that, in the time of Laennec, the apparently important discovery was made, that ægophony exists in some instances of simple hepatization; but the observation (though confirmed of late years by Skoda) appears to me to require corroboration. The bronchophony of hepatiza-

tion is often sniffing and high pitched, but it is not tremulous, and I have never yet detected vocal resonance simulating ægophony, as an attendant on simple inflammatory induration of the lung, unless the ordinary voice of the patient was of shrill tremulous character. Hence this exceptional species of resonance is most frequently encountered in persons, more especially women, of advanced age. I have been gratified by finding that M. Grisolle's experience (*Pneumonie*, p. 242) has led him to a very similar conclusion. The bronchophony of hepatization may occasionally be given a shrill nasal ægophonoid character by making the patient speak with the nostrils closed.

420. The theory of vocal resonance, in itself of little direct clinical importance, has acquired great interest from the part it has been ingeniously made to play by Skoda in his attempt to remodel the doctrines of auscultation at large—more especially as whatever doctrine be accepted in its explanation may, *mutatis mutandis*, be applied to the varieties of bronchial breathing.

420*. Before we proceed to the discussion of this subject a few preliminary observations are requisite. In the case of natural respiration, that which is heard at any portion of the chest's surface is, it is taken for granted, produced in the lung-substance nearest the ear. The assumption is obviously, however, sometimes incorrect. At the sterno-clavicular angles, for instance, the bronchial breathing heard is not produced in the parenchyma overlaying the bronchi, but generated in those tubes themselves and conveyed to the surface—drowning, as it travels, by its greater intensity and harshness, the breathing-sounds of the intervening and adjacent lung-substance. Again, respiration can be distinctly heard in the mass of cases over the liver to a greater or less extent below the margin of the lung. Hence there are spots where, in the natural state of the breathing apparatus, we hear not what is passing immediately beneath, but at a greater or less distance. A striking illustration of another kind presents itself in the case of the voice, produced, as it is, in the larynx, yet audible, with various intensities, in various regions of the thorax.

Now in these cases the only principle in action is that of *conduction* of sound.

421. In disease, this phenomenon of conduction becomes most important, as it furnishes, according to common belief, the main, if not the sole clue to the explanation of a variety of morbid breathing-sounds.¹ Not only the lung-substance, but the parietes themselves conduct: thus the existence of bronchophony and bronchial breathing over the vertebral column in cases of hepatization is well known—the bony structures here play the part of conducting media.

This premised, let us consider the theory of bronchophony.

¹ Probably also applicable, as already suggested [221], in explaining morbid percussion-note under certain circumstances.

421*. Laennec regarded bronchophony as an essential dependence on increased density of the pulmonary texture, and supposed that it was simply produced by the greater facility with which comparatively dense and comparatively homogeneous tissue—homogeneous from the exclusion of air—conducted the laryngeal vibrations.

422. This explanation is inadequate to meet all the circumstances of the case. In the first place, bronchophony may exist, and this to an intense amount, over lung rarefied to such a degree as to give actually almost tympanic resonance under percussion. Of this fact, not generally known, or, at least, taught, I have observed a certain number of examples, where *post-mortem* examination left no doubt of the absence of any textural change in the lung except emphysema. In the second place, as was, I believe, first mentioned in print by Skoda, the voice resounds sometimes with greater intensity over the chest than over the larynx itself. In the third place, the pitch of the bronchophonic differs sometimes distinctly from that of the laryngeal voice. These facts, without disproving the partial correctness of Laennec's theory, show at least that it requires an addition of some kind to make it include all the varieties of the phenomenon.

423. Skoda, holding the general doctrine that the "varying conducting power of the healthy and diseased lung-substance cannot be taken as a basis of explanation of the phenomena of auscultation,"¹ specially opposes Laennec's views of the mechanism of bronchophony on the following grounds:—

424. (a) Bronchophony in the course of a few minutes appear and disappear over hepatized lung, the other physical signs, especially the percussion-sound, having undergone no change. (b) When vocal resonance thus suddenly disappears, it may as suddenly be restored by making the patient cough or breathe deeply, so as to free the bronchi from fluid in the part of the organ ausculted. (c) In cases of pleuritic effusion, the resonance grows weaker and weaker in proportion as the fluid increases; now as the lung grows more and more solid, the greater the quantity of pleural fluid compressing it, the reverse ought to be observed, were Laennec's doctrine of solidification and improved conducting capability well founded. (d) If a healthy and a hepatized lung be removed from the body, and if, while one person speaks through a stethoscope placed in contact with the surface of each organ successively, a second listens through another stethoscope placed at an opposite point of that surface, the listener will find that more intense resonance reaches the ear through the healthy than the diseased lung. (e) It is an error to suppose sounds are better conducted by solid bodies than by air; if it were so, we should use a solid, not a hollow, stethoscope.

425. What is the force of these objections? Let us examine them *seriatim*. (a and b) Since I first became acquainted with Skoda's statement concerning the appearance and disappearance of bronchophony in hepatization, I have repeatedly endeavored to produce artificially the change he describes. Now, as a rule, the experiment has wholly failed.² In some rare instances a very slight passing change in the force of resonance may, it is true, be perceived—the question is, what is its cause? Skoda, assuming that the alleged temporary disappearance of bronchophony over hepatized tissue depends on passing obstruction of the tubes with fluid secretion, conceives he has found an argument against Laennec's doctrine of increased conducting power in hepatization; for "were such increase of power real, it would be a matter of indifference, whether air or fluid were contained in the bronchial tubes." But is this the fact? Is it true that, on the doctrine of increased conducting power, it makes no difference whether one portion of the series of conducting media consist of fluid or air? Obviously the *onus* of proving the fact, if it be a fact, rests with

¹ Zweite Auflage, p. 36. In the fourth edition (p. 37) this negation is limited to the "strength and purity of the voice."

² e. g. Shay, U. C. H., Females, vol. ix. p. 144. (Pleuro-pneumonia) "Several coughs, which produce a good deal of loose rhonchus, do not in any way affect the characters of the bronchophony."

Skoda: meanwhile, we are justified in believing, that such partial variation in the composition of the conducting materials does exercise a certain influence on the general result; an influence quite capable of explaining the very slight variations in the intensity of bronchophony, that have fallen under my notice. Again: Let us suppose a case of hepatization of a tolerably thick stratum of the posterior part of a lung; bronchophony is heard, in such a case, at the posterior, not at the anterior, surface of the chest. Now, as, according to Skoda himself, reinforcement of voice would, under the circumstances, take place about the central tubes, how comes it, if his notion of the superiority of healthy over solidified tissue, as a conducting material, be constantly correct, that bronchophony is not heard in front over healthy texture, instead of being, as it is, audible in the hack, over the hepatized parts? This seems to me an objection fatal to the doctrine. (c) The argument derived from the phenomena of pleuritic effusion seems feeble, and, indeed, unsound. The interposition of a mass of fluid between the condensed lung and the surface alters the terms of the problem completely. It has been shown by Colladon and Sturm, that sonorous rays which reach the surface of water at a very acute angle do not pass into the air, but undergo reflection in the interior of the liquid. Now the angle at which the sonorous vibrations reach the fluid from the bronchi, and ultimately reach the outer surface of the pleural fluid, may very possibly often prove of the degree of acuteness fitted to prevent their passage into the air. At all events Skoda, by ignoring the new influences likely to be exercised by the fluid, renders his argument valueless. (d) The results I have obtained from some experiments on the conducting powers of hepatized tissue, do not agree with those announced by Skoda. First: It is, I admit, quite true, that tissue, called hepatized, may conduct the voice no better, or even less forcibly, than a similar thickness of healthy parenchyma; but it is equally true that this is not a constant result. I have occasionally found hepatized lungs, taken from the body, conduct the sound with extreme intensity. And these varying results may be obtained from different lungs, which the naked eye would judge to be in the same state physically, in regard of their shares of air, fluid, and semi-plastic substance: but it is evident, from the variations in result, that, acoustically, they are in *different* physical states; and that, therefore, such experiments as Skoda's are not to be trusted to. Specimens of parenchyma, apparently identical, are in reality widely different. There can, for example, be little doubt, that varying homogeneity plays a more important part than any observable so-called solidification in regulating the conducting power of the lung. In the varying homogeneity of different specimens may, in truth, lie the key to the difficulty—though, unhappily, it is a key which cannot practically be used. Secondly: If, while one person speaks into a stethoscope with its narrow end introduced into the trachea, a second listens over a part of the chest where hepatized lung lies beneath, and where intense sniffling bronchophony existed during life, the listener will often be surprised at the singular and total absence of sound. Skoda, admitting this fact, attempts to evade its force by supposing the vibrations to be interfered with by fluid in the bronchi. To this I would reply, that I have satisfied myself of the total absence of such *post-mortem* resonance over pneumonic solidification, in a case where the bronchi, to the third and fourth divisions, were peculiarly free from fluid, and scarcely any spumous liquid infiltrated the parenchyma—which very same parenchyma, removed from the body, conducted the voice from one stethoscope through another with striking intensity. If we consider the main difference in the physical conditions of the parts, when an individual himself speaks, or when another speaks into his trachea after his death, an obvious explanation of the experimental failures to imitate the bronchophony of life suggests itself. In the dead body, in truth, the laryngeal, tracheal, and bronchial walls take no share in the production or conduction of the sound, which is propagated by their contained air alone; whereas in life the walls of those tubes obviously conduct their sonorous vibrations. Besides, hepatized and healthy lungs are not strictly comparable in and out of the body in regard to this matter: *within the body* the contact of a hepatized lung with the chest-wall is more perfect than of a healthy

one; and, admitting that the former is a worse conductor in regard of the condition of its substance, it may be a much better one through the closeness of its union, especially if adhesive, with the parietes. Here is a point which has been totally overlooked by the Viennese physician and his followers. (e) The illustration of the habitual preference of the hollow over the solid stethoscope falls pointless—because as much importance is to be attached to homogeneousness as to density.

426. I conceive then, that, whether Laennec's doctrine be true or false, the arguments just reviewed fail to prove it unsound. Skoda himself naturally thinks otherwise; and, excluding the walls of the trachea and bronchi from all share in the *conduction* of the sonorous vibrations of the *chordæ vocales*¹ (an office assigned by him to the contained air of those tubes alone), maintains that bronchophony is really produced by consonance of the air in the bronchial tubes with the laryngeal voice.

427. The hypothesis of consonance does not appear to me satisfactory; and it unquestionably fails to meet all the circumstances of the case. The reasons on which I ground this opinion are as follow: (a) Air in any inclosed space does not consonate with every sound produced at its orifice, but only with the fundamental note of that space, and with certain others having a fixed harmonic relationship to that fundamental note—with certain of its *concord*s, in short. This is easily ascertained, in a rough way, by running the gamut with the voice at the mouth of an empty water-bottle; one note only of the octave is at all markedly reinforced² by consonance within the cavity—one or two others (according to the distance from the orifice at which the vocal sound is emitted, and the depth of the mass of air within the bottle), very slightly increased in loudness. Now, on the contrary, when bronchophony exists, it is audible with *successive notes* of the octave, standing in no harmonical relationship to each other—absolute *discord*s, in short. These successive notes are most loudly bronchophonic at the lowest part of each register (whether bass, tenor, or soprano); but the force of bronchophony gradually decreases, not at harmonic intervals, but on *each successive note from below upwards*, until the resonance disappears altogether; and obviously the greater force of bronchophony with grave tones, as contra-distinguished to acute ones, has nothing to do with the principle of consonance—for consonance, where its conditions are fulfilled, will occur with notes of the latter, as well as of the former class. (b) Bodies consonate only in unison, or in certain fixed harmony, with the original sound which throws them into vibration.² Now the pitch of the bronchophonic voice varies irregularly from that of the laryngeal with which it coexists. This difference of pitch is especially to be caught in cases of hepatization, and is sometimes very striking in amount; the corresponding notes heard in the larynx and on the surface of the chest are then, very perceptibly, *discords*. (c) Skoda's exclusion of the tracheal and bronchial walls from participation in the conduction of the laryngeal voice is at variance both with theory and experiment, and cannot for a moment be acceded to. (d) In cases where the bronchophonic voice is very positively and notably louder than the laryngeal, it is difficult to believe, from the mere fact of the intensity of the sound, that the phenomenon can be due to consonance. For a consonating sound, as a rule, is vastly more feeble than the primitive tone eliciting it: and the nicest adjustment of the quantity of air in the consonating body, presuming this to be hollow, is required, in order to produce any serious increase in the amount of loudness. Let it, however, be granted, *argumenti*

¹ Auscultation; Vierte Auflage, pp. 36, 40, and 68. He, of course, admits that the bronchial walls, in the spot where consonance takes place, intensify the consonating tones of the air within them by their own vibration; but this is a very different thing from professing those walls take part in the production of bronchophony by conducting the laryngeal voice.

² The unison-note alone is distinct to ordinary ears; the consonating harmonics are so faint as to require a most highly-trained, as well as originally perfectly endowed, ear for their detection.

gratia, that chance may sometimes cause the column of air between the larynx and the seat of bronchophony to be of the appropriate length to produce a marked increase of sound—the doctrine of Skoda gains nothing by the concession. For, be it remembered, Skoda rejects conduction as an element of bronchophony; bronchophonic voice is, in his apprehension, consonating voice alone; consonating voice is, then, under the above circumstances, by admission, louder than the original voice. Now, here is an idea irreconcilable with observation; for it does not appear that (provided the original and consonating sounds be produced by bodies of the same class, as vibrating strings, hollow boxes, solid plates, &c.) the consonating sound is ever louder than the original tone.¹ (e) If the excess of loudness of the bronchophonic over the laryngeal voice were from consonance, *vocal fremitus* (inasmuch as the walls of the consonating tubes must vibrate in the direct ratio of the vibration of their contained air) ought to rise and fall exactly as *vocal resonance*. Now, as is notorious, these two phenomena do not invariably maintain any direct relationship to each other; one may gain, while the other loses, in intensity.

428. These objections appear to me conclusive against the pure doctrine of consonance, while they show that if consonance plays any part in the production of bronchophony, it must be a subsidiary, rare, and accidental one. And even this concession is rather made on the ground, that the occurrence of consonance within the chest is, *à priori*, possible, than in deference to the arguments actually adduced in its favor.

429. From the discussion into which I have now entered, it would follow that the mechanism of bronchophony is probably complex, and certainly not, as the attempt is commonly made to prove it, invariably one and the same.

430. There are four points which appear especially worthy of consideration: the conduction of laryngeal voice; its possible increase of intensity, within the chest; the distance at which that increase of intensity, if real, is effected from the part of the thoracic surface ausculted; and the relationship of pitch of the laryngeal and bronchophonic voices.

431. *First*. In regard of conduction of laryngeal sound, theory would support the inference, that as the human voice is best propagated in air, the more the lungs were rarefied, the greater would their conducting power become; and, in accordance with this, it is certain that intense bronchophony is sometimes heard over highly emphysematous tissue. However, on the other hand, as both the tracheal and bronchial walls themselves vibrate during speaking, any really solid material directly connecting a large bronchus with the surface of the chest, must conduct those vibrations forcibly; and in accordance with this, we find that wherever solid fibrous structure is seated in the manner supposed, bronchophony of the most intense character is audible. But if the union of the solid material with the chest-wall be imperfect, if there be any interruption at the planes of union of the conducting materials, the acoustic conditions are completely changed, inasmuch as interruption at the union of media of different densities most deeply impairs the conducting faculty of the series. Here is one clue to the differences of vocal resonance, observed in cases where the physical conditions appear, on superficial view, identical; hence, too, we have no fair reason to expect that in all samples of the variable semi-solid states comprised

¹ The case may be very different where vibrations are communicated from a body of one physical constitution to a consonating body of another class. Thus, where a tube takes up the vibrations of a solid disk, the consonating note of the tube may (by managing carefully the length of the vibrating column of air in the interior) be made incomparably more powerful than the original tone: the quality of such notes is exquisitely pure and full; and long ago Savart suggested the construction of a musical instrument on this principle which, it seemed probable, would exceed in melody and power any of those in use. Civilized musicians have not profited by the philosopher's suggestion; yet the savages of some of the Pacific islands, curiously enough, have hit upon rude contrivances efficiently illustrating the principle.

under the title of "hepatization," conducting power should be affected in an uniform manner—as experiment shows that it actually is not. Experiment, in truth, alone can teach in each instance what the force of conduction really is in the various complicated conditions of physical change in the lungs.

432. *Secondly.* It is indubitable, that the bronchophonic voice is sometimes louder than that transmitted through the stethoscope directly from the larynx. The extreme rarity of this occurrence does not affect its reality; and hence, some explanation must be found for the increase of intensity within the thorax.¹

433. There seem to be three ways, as far as now known, in which a sound may be reinforced beyond the seat of its production; by, what may be called, *unison-resonance*, by *consonance*, and by *echo*. In all three, reflection of sound is concerned; but the laws of that reflection are in each case different. This will be best understood from a tabular view of the differences of the phenomena. The reader will bear in mind that by unison-resonance is meant the reinforcement which occurs in the box of the guitar or violin when notes are produced from their strings, or when a musical-box, instead of being held in the air, is placed on a table: by consonance is understood the reproduction of certain notes of instruments or of the voice by other instruments, standing by: by echo is meant the well-known phenomenon of repetition of sounds.² All three agree in that the reinforced sound may exceed in intensity the original, and, besides, differ from this in quality.

The table below, it may be well to observe, is to be read on the following plan. The original and secondary sounds are connected in regard of their place of production, in cases of unison-resonance, *directly*—in regard of pitch all notes of the octave are *secondarily intensified in unison*, &c.

Original and Secondary Sounds, how connected in regard of—

	Place of production.	Pitch.	Number of repetitions.	No. of notes <i>coetaneously</i> reinforced.	Time of production.
In unison-resonance.	Directly connected.	All notes of the octave intensified in unison.	No true repetition; only swelling of original sound.	Never but one.	Both simultaneous.
In consonance.	Separate, but near.	A single note only of the octave (or its harmonics) intensified; that note is the fundamental note of the consonating body.	Only one.	May be one, and certain of its harmonics.	Both nearly simultaneous
In echo.	Separate, and more or less distant.	Same note only.	May be several.	None.	One distinctly sequential to the other.

¹ Real increase of vocal force within the chest in any case of bronchophony has been denied as matter of fact. It is said the composition of the larynx renders conduction through its substance imperfect, and that the thoracic bronchophonic voice ought in fairness to be compared with that audible through the stethoscope held to, or actually put into, the mouth of the speaker. But the objector forgets that the converse, unfairness, might then be complained of; for the laryngeal voice is reinforced in the cavity of the mouth. Some singers make immense use of this reinforcing property of the mouth, thereby giving a peculiar character to their style: compare in this aspect the genuine larynx-singing of Mario with the artificial mouth-vocalizing of Ronconi.

² Strangely enough, Skoda's printed statements on the signification of "consonance" are not altogether free from apparent contradiction. Thus, in one place, he includes as examples of "consonance," both the reproduction of a note of the human voice by a guitar-string, and the strengthening of tone which a vibrating tuning-fork undergoes when held against a table, instead of being held in the air; that is, he includes under the term "consonance" both consonance and unison-resonance, as I have defined them above. Yet, in a later page, he tells us that "consonating" bodies only reproduce their own fundamental tones, and certain others numerically related thereto—that is, he excludes unison-resonance,

434. Now the loudness of the bronchophonic voice is in all probability partly due, under different conditions, to each of these three agencies in turn.

435. There can be little doubt that, in the natural condition of the chest, the principle of *unison-resonance* comes into play. But it is totally unavailable in the explanation of the bronchophony of hepatisation, for the simple reason, that such *unison-resonance* is perfect, exactly in proportion to the *amount of air contained in the resounding space*. Imagine the box of the violin filled with any solid or fluid material, and what comes of its property of reinforcing sound? Had this principle any influence in the generation of the bronchophony of pneumonia, its effect would obviously be to transfer the phenomenon to the healthy side of the chest, in cases where the solidification was limited to one lung.

436. I am not disposed to question that, under peculiar circumstances, there may be a repetition of sound by consonance, though this would be very difficult to prove; it does not appear to take place in hepatisation.

437. Echo, too, seems a very probable cause of reinforcement, and this in hepatised lung. The necessary conditions of reflection appear to be fulfilled; the tubes along which the voice is transmitted from the larynx are surrounded by semi-solid material, proper, when compared with healthy tissue, to reflect and concentrate the sound; while the air-cells and minute bronchi are closed to a variable distance, and prevent its divergence. The tubes resemble so many speaking-trumpets, and, just as in these instruments, the augmentation of sound is produced by reflection from their quivering walls; as this reflection tends to propagate vibrations (otherwise divergent) in the same direction, increased intensity of sound must be the result. And, further, if the reflected vibrations chance to be brought to a focus within a large tube, then *echo* will occur; and, as under ordinary circumstances, the echo may be materially louder than the original sound. But it may be inquired, how, upon this theory, is the admitted temporary diminution of bronchophony explicable? Conceivably, by the deadening influence of accumulated fluid in the tubes.² Under these circumstances, bronchophony would probably (I have not verified this conjecture) be heard at some point of the chest nearer the bifurcation of the trachea. Again, it is possible that certain changes of posture altering the relationship of the reflecting surfaces might interfere with the production of echo, by preventing the reflected sounds from coming to their usual focus. Besides, the position of the auscultator in respect of the focal point might prevent him from hearing an echo really existing.³ The force of the echo will also rise, the smoother the bronchial walls, and the larger the tubes in which it occurs. And numerous other

and hence, by implication, defines the phenomenon altogether differently (Vierte Auflage, pp. 37, 39). None of Skoda's commentators seem to have perceived (at least, they certainly have not noticed) this very serious discrepancy.

¹ Every schoolboy knows the increase of tone given to the sounds of the Jew's-harp by placing it in the ordinary position for playing, within reach of a resounding cavity,—the mouth; and there are few who have not accidentally learned the hopelessness of attempting to play, if the said cavity happen to be partly filled with eatables.

² The effect of carpeting, or woollen cloth of any kind, in deadening the sound of music in an apartment is well known. The intermixture of air and solid fibres in the carpets, through which the sound has to pass, deadens the echo between the ceiling and floor, by which the original sound is swelled.—Herschell, Art. "Sound," *Encyc. Metrop.* Aërated mucus and sanguineous serum in the bronchi would have the same effect on vocal echo in those tubes as the carpeting under the circumstances referred to above.

³ The existing theory of echoes generally is inadequate to explain many of their phenomena. There is, or was, a ruined fortress near Louvain well illustrating this. Here, if a person sings, he only hears his own voice, without any repetition; those who stand at some distance hear the echo, but not the voice,—and they hear the echo with surprising variations,—sometimes louder, sometimes softer,—now near, now distant.—*Burrowes's Cyclop.*, Art. "Acoustics."

circumstances may be conceived, but scarcely proved, to affect the phenomenon. Among these, the composition of the gases within the bronchi may, for aught that is known, hold an important place: hydrogen has been proved to deaden sound greatly; the effect of carbonic acid, mixed with other gases and aqueous vapour, can only be ascertained from experiment.

438. *Thirdly.* As concerns the distance from the point of auscultation at which the reinforcement of sound within the thorax occurs; the further away, the less of the resonance will reach the surface: the amount, however, will be modified by the conducting property of the interposed media.

439. A little consideration will show that these three conditions of bronchophony,—conduction of laryngeal sound, increased intensity of this within the thorax, and proximity of site of the increase,—may or may not be directly as each other; one may be in a state favorable to, the rest unfavorable to, the formation of bronchophony. Hence the variable state of the sign in different cases of the same disease.

440. *Fourthly.* The relationship of pitch of the bronchophonic and laryngeal voices seems the most difficult part of the subject—difficult, at least, in those cases where a distinct difference can be detected in the pitch of the two.

That the voice should, in travelling from one spot to another, undergo alteration in pitch, seems, on first thought, opposed to the commonest experience and to the recognized laws of acoustics. And in experimentally investigating the point there are some easy sources of fallacy. Bronchophonic voice may be muffled and husky, while the laryngeal tone is pure; and the quality of the two may be essentially unlike. Now these differences may readily, unless great care be taken, be confounded with differences in pitch. Fully alive, however, to the possibility of such deception, I have endeavored to guard against it; and am persuaded that the pitch of the bronchophonic voice does sometimes irregularly differ from that of the laryngeal. How, then, is the difference explicable? Conceivably (1) by the production of a new note within the chest chiming in with the laryngeal; or (2) by change of laryngeal note during conduction through *varying* media in the thorax.

(1) The production of new note within the chest is, we have seen, possible by unison-resonance, by consonance, and by echo. But the very name, *unison-resonance* shows that this principle cannot be employed in explanation, when difference of pitch is concerned. Nor will the principle of consonance serve us either. For, though it is true that under favoring circumstances a note differing in pitch from the original one may be generated by consonance, that different note is always an harmonic of the original tone. Now, the difference of pitch we have under consideration is irregular and non-harmonic. Nor will echo help us through the difficulty; for though an echoed sound may differ from its original in intensity and duration, and even in quality, it always agrees with it in pitch.

(2) We are driven, then, to the phenomena of conduction through varying media for release from our difficulty. And though it would probably be impossible to *prove* that the change in pitch is thus actually effected in the chest, there is strong argument in favor of this mode of agency.

Thus (it appears from an experiment of Savart) "let a long flat glass ruler or rod, connected with mastic to the edge of a large bell-glass, perpendicular to its circumference, be very lightly supported in a horizontal position on a bit of cork, and then let the bell-glass be set in vibration by a bow, at a point opposite the place where the rod meets it. . . . In this combination, *the original tone of the bell-glass is altered, and the note produced differs both from that yielded by it, or by the glass-rod vibrating alone.*"¹ Again, Odier long since ascertained, that if hydrogen be breathed, the voice is *raised in pitch.*²

Now, here are facts showing that pitch may be modified by conduction from one kind of vibrating solid to another, and that the pitch of sounds is controlled by the nature of the gases in which they are produced. The application of these

¹ Quoted by Herschell, Art. "Sound," p. 807, *Encyc. Metrop.*

² *Eod. Loc.* p. 766.

facts to our subject is sufficiently obvious; and, curiously enough, the revelations they afford on the question of altered pitch, lend unexpected support to Laennec in assigning the importance he does to conduction: they show that *one of the most important attributes of bronchophony is solely explicable by conduction*—a point on which the followers of Skoda should meditate.

441. Finally, bronchophony seems to be a resultant, in lung-consolidations, of conduction and echo: in emphysema, of conduction and unison-resonance: in lung-excavations, of conduction, unison-resonance, and echo: in cases of tumor uniting a bronchus, or compressed pulmonary substance, to the surface, of conduction in the main, of unison-resonance in a secondary degree. Besides, when the necessary acoustic conditions exist—that is, when the tones of the laryngeal voice chance to bear a certain mathematical relationship to the fundamental note of a resounding space in the chest—true consonance may take a part in the production of bronchophony.

442. There are, besides, some subsidiary conditions, the influence of which cannot be doubted; viz., the density of the gases in the thorax, their composition, their temperature, and the quantity of fluid in the tubes.

But, even with all these aids, there are some peculiarities of voice-resonance inexplicable. How happens it, for instance, that in the great majority of persons, the voice naturally resounds much more forcibly under the right than the left clavicle?

443. The whole of this argument on the subject of bronchophony is reproduced *verbatim* from the edition of 1854. Subsequently, views, in many respects similar, have been taken by Hoppe, Wint- rich, and others. Hoppe even goes so far as to argue consonance *cannot* arise under the circumstances which exist when broncho- phony occurs; but in this extreme opinion I believe, for reasons fully set forth in the text, he is in error. The most interesting recent contribution by far on the subject (especially so to me, be- cause it gives additional force to the echo theory) is that of Profes- sor Fenger of Copenhagen.¹ This observer has ascertained that in certain cases of posterior hepatization of one lung, the morbid vocal resonance and breath-sounds are not only audible over the entire breadth of the vertebral column, as has long been known [421], but that, on moving the stethoscope further out on the healthy side of the chest, the respiration and voice will be most distinctly found to retain a bronchial character at a certain distance beyond the column. Now this fact, which I can fully confirm,² may plainly be explained by simple conduction. But Dr. Fenger finds that the bronchial phenomena, having disappeared at a short distance from the spine, reappear or are reinforced at a greater distance from the same—for example, at the inner edge of the shoulder-blade, or in

¹ On Echoes in the Human Thorax, translated by Dr. Moore in Dub. Hosp. Gazette, Oct. 1856.

² Poole, U. C. H. Males, vol. xvi. p. 207. "July 28, 1859. Whereas, *about ten days ago*, on ausculting below and within the inferior angle of *left scapula*, there was heard high-pitched bronchial breathing, well marked; which said bronchial breathing was traced with accurately the same characters across the vertebral column to the corresponding point on the opposite *right side*; *now*, respiration at the *former point* is bronchial, but weak, mixed with rhonchal sounds of different kinds, and respiration on the *right side* is full, exaggerated, with scarcely the least bronchial quality. *On both occasions the percussion normal to the right of the middle line.*" This was a case of left pleurisy with effusion.

some instances much further out towards the axilla and side of the chest. Now, here conduction evidently fails: it cannot explain the phenomenon of reproduced sound; and Dr. Fenger traces this with much success to the intervention of the laws of echo.

444. Let us now glance at the theory of ægophony. Ægophony, according* to Laennec, is the natural resonance of the voice in the bronchial tubes, rendered distinct by the compression of the pulmonary texture, and tremulous by its transmission through a thin layer of fluid in a state of vibration. He thought it probable, also, that the flattening, which the bronchi undergo from pressure of the pleural fluid, had a good deal of influence in its production; the quality of resonance being such as might be anticipated from the shape of the vibrating tubes, resembling the mouth-piece of the bassoon and hautbois: it is not sufficient in itself for the production of the phenomenon; otherwise ægophony would exist in cases of absorption with *contraction* of the chest, which is not the case.¹ Laennec adduces various arguments in favor of these views, and affirms that by applying a bladder half filled with water over the larynx, the natural resonance is transmitted through the liquid with heightened pitch and slightly tremulous character. Skoda, holding that pure ægophony is audible in cases of pneumonia and tuberculous infiltration, with or without cavities, as perfectly as where fluid exists in the pleura, and maintaining that a piece of liver interposed between the larynx and stethoscope will produce the same effect on the transmitted voice as a stratum of water, rejects Laennec's doctrine *in toto*. He believes that the tremulous character arises only from impulses of a solid body against some other body, solid, fluid, or aëriform, impulses which cannot occur within the chest unless the voice consonates therein in a space filled with air; and that, "probably" in most cases, the wall of a bronchus, in which the air consonates, reacts through impulses on that contained air, and so causes ægophony; while it is also possible that the peculiar character may be occasionally given by "mucus, &c.," imperfectly closing the orifice of a bronchus, and imitating the reed in the mouthpiece of reed instruments. Dr. Sibson believes ægophony to be "pectoral resonance accompanied by whispering friction-sound; the two sounds are heard together, just as the drone and the notes of the bagpipe."

444*. (a) Dr. Sibson's theory is plainly inadmissible; because pure ægophony may be heard without the least shadow of friction-sound accompanying respiration, and because in cases of hepatization with slight plastic exudation on the pleural surface, there may be abundant friction-sound, while the vocal resonance is totally deficient in ægophonic quality. Besides, the chest-motion during speech is scarcely sufficient to produce friction-sound, which, at all events, could only be expiratory in rhythm. (b) If Skoda's main theory were well-founded—that of the quivering reaction of bronchial tubes on their contained air—it seems difficult to understand why the bronchophony of hepatization should not always be ægophonic; seeing that, as he himself teaches (what is of course true), vibration of the tubes always occurs when their contained air consonates. The subsidiary suggestion concerning the imitation of reed instruments by bronchial mucus is ingenious and plausible. Yet, whereas marked bronchophony with more or less liquid rhonchus sometimes exists over lung, at once emphysematous and bronchitic, I am not aware that an ægophonic quality has under the circumstances ever been detected: it may be rejoined, that the conditions of consonance do not exist here: but this would scarcely be a fair argument, as bronchophony (an alleged effect of consonance) does exist. (c) For my own part, believing as I do, that while other conditions may lead to a close simulation of ægophony, the pure quality described by Laennec depends upon the interposition of fluid, I look for the explanation of the phenomenon in some degree at least to that fluid. I admit at once that his experimental illustration of the doctrine fails in nine

¹ At least during the early period of such absorption; uniform or globular dilatation of the bronchi is well known occasionally to ensue at the advanced periods.

cases out of ten wholly; in a number of trials with oiled silk bags, containing various thicknesses of water, it has occurred to me but once or twice to catch anything of the quivering character which Laennec affirms attends the vocal resonance. But how rude the imitation of the state of things in the pleura! And as it is certain the peculiar character can in rare instances be perceived, may not the success of the experiment in those cases depend on the relationship of the superjacent water and the resounding larynx having by accident become in regard of acoustic conditions identical with or closely assimilated to those of the pleural fluid and bronchophonic lung? M. Woillez appears to me to have thrown out a valuable hint (*Recherches sur l'Inspection*, p. 437, 1838) in suggesting that the tendency to a vacuum within the pleura exercises an important influence on the phenomenon: "a stratum of liquid," as he observes, "no matter how thin it might be, could not vibrate so as to produce ægophony if it were compressed between the lung and the chest-wall." Further, the abruptness and the peculiar quality of ægophony are easily explicable by the intervention of liquid; the experiments of Colladon and Sturm have shown that the duration of sounds similarly produced differs notably in water and in air, and that their quality is completely different. Thus a bell struck under water gives not one as in air, but a quick sharp sound, as of two knife-blades clashed against each other.¹

445. *Autophonia*.—Before concluding the subject of vocal resonance, it may be observed that efforts have been made to connect peculiarities in the resonance of the observer's own voice (as he speaks with the ear applied to the chest directly, or with the intervention of the stethoscope) with the amount of density of the parts beneath. Few auscultators can have failed to notice that, while their voices sound with strong vibration from some chests, or from certain parts of these, no such resonance occurs from others: it is greatly more marked when the solid than the hollow stethoscope is used. I have, however, not found any condition of lung uniformly attended by, or uniformly free from, this sort of resonance called autophonia by Hourmann; nay more, it may be so strong over an *abdominal* tumor as to cause pruritus of the ear applied to the stethoscope.² I consequently, in the present state of knowledge, attach to it no clinical value. I have known this resonance of ægophonic quality in pleuritic effusion.

§ III.—RESONANCE OF THE COUGH.

I.—IN HEALTH.

446. If the stethoscope be applied over the larynx or trachæa of a healthy person while coughing, the act of expiration is found to be accompanied by a sound of hollow character, varying in respect of graveness and intensity with the voice of the individual; the observer is not conscious of any sensation of succussion in the site of its production. Ausculted on the surface of the chest, the cough in health furnishes a quick, short, commonly dull and indistinct, somewhat diffused sound, produced at a distance, without hollow or tubular character, not attended with any distinct sensation of succussion in the interior of the thorax.

¹ *Annales de Chimie et de Physique*, t. xxxvi. pp. 243 and 254.

² Dujardin, *Enlarged Spleen*, U. C. H., Males, vol. v. p. 198.

II.—IN DISEASE.

447. *The modified states* of the pulmonary cough, which occur in disease, are the *bronchial, cavernous, amphoric*.

448. *Bronchial cough*, when well marked, is a sound of harsh character; is attended with a sensation of very marked succussion in the chest, and a slight degree of impulsion towards the ear of the observer; is very rapidly evolved, and more concentrated under the instrument than the natural sound.

449. *Cavernous cough* is characterized by its perfect hollowness and metallic character. The sensation of production in an excavated space of limited size, the strong impulsion and transmission of the sound through the stethoscope with a force sometimes painful to the ear, are quite distinctive of this species of resonance. Cavernous cough may be pure, or associated with cavernous rhonchus; if fluid be present in the cavity to a moderate amount, it will not interfere with the production of the characteristic cough, and the forcible agitation the liquid matter undergoes during the act will of course be attended with rhonchus.

450. *Amphoric cough* is a loud resounding sound of metallic character, conveying the notion of production in a large space more or less empty; it is not forcibly transmitted through the stethoscope.

451. The varieties of thoracic cough are heard in the same cases as the corresponding varieties of respiration; they are of little utility in diagnosis. In pleuritic effusion, the quality of the cough is sometimes ægophonoid.

§ IV.—PHENOMENA COMMON TO THE RESPIRATORY SOUNDS, TO RHONCHI, AND TO THE RESONANCE OF THE VOICE AND COUGH.

452. Differing from all the morbid conditions hitherto considered, the phenomena termed amphoric echo and metallic tinkling, attend the acts of breathing, of coughing, and of speaking. These phenomena are fundamentally one and the same,—the echo of various sounds, reflected by the walls of a capacious hollow space within the chest, under circumstances modifying the force, concentration, quality, and pitch of that echo. Metallic tinkling is the term originally applied by Laennec to a clear, ringing, highly metallic, single sound, of very high pitch, not dissimilar to that produced by gently striking a hollow glass vessel of globular form with a pin. Its quality may, however, be more or less purely metallic, and its pitch fall, and its clearness diminish, the tinkling character gradually disappearing *pari passu*, till it gradually merges in the low-pitched sound of buzzing amphoric echo. In different cases, or at different times in the same case, this transition may be detected: and there is a certain stage of the transition in which it is difficult to determine whether the term metallic tinkling or amphoric echo be the most applicable. The metallic quality, though less clearly and sharply defined is yet very obvious in amphoric echo,—which may

be imitated with some success by speaking, breathing, or singing into an empty water-bottle.

453. Metallic tinkling, occurring in connection with respiration, coexists commonly with (or rather echo-like, follows), inspiration, being prolonged somewhat into the succeeding expiration; it is very rarely limited to the latter. Generally speaking, it alternates irregularly with an amphoric state of the respiratory sounds, the one unnatural state giving place to the other, after a variable and for a variable number of respirations. It appears to be produced either deep within the chest, or near the surface: and is rarely persistent for any considerable number of respirations. Amphoric echo may attend both sounds of respiration, or be limited to either.

454. Metallic tinkling of systolic cardiac rhythm may sometimes be heard in pneumothorax with perforation. This phenomenon, assimilable to cavernous rhonchus, produced in a cavity by the heart's action [339], I have only known to occur on the left side. Whether it is to be regarded as a metallic echo of the heart's systolic sound, or as a result of the movement of the air within the pleural sac, through the heart's impulse, I am unprepared to say.

455. Generally audible at the central height of the chest, laterally or posteriorly (whence they may be propagated with gradually diminishing intensity to the surrounding parts), metallic tinkling and amphoric echo may be heard in every part of the thorax. The most clearly marked and intensely developed metallic tinkling I ever heard, was chiefly audible under, and a little outside, the nipple: the case was one of tuberculous perforation of the pleura.

456. The mechanism of metallic tinkling and amphoric echo has been long sought after with all the eagerness of curiosity; but observers are far from having come to a uniform conclusion on the subject. I believe, as just mentioned, that the two phenomena are one and the same, fundamentally—echoes of different properties from the walls of a large space, more or less favorably disposed for reflection and concentration of sounds, produced either within the area, at the outlet, or in the close vicinity, of that space. It appears, too, that the low-pitched buzzing echo only requires the presence of air in the hollow space, though water, in moderate proportional quantity, may be present therein; while the high-pitched tinkle requires fluid for its production—not that such tinkle is physically impossible unless fluid be present, but that in the chest, the conditions, independent of fluid, which are capable of generating it, do not co-exist. In experimental support of this statement, it may be observed, that if we blow, cough, speak, or sing, into an empty glass decanter, a low-pitched, buzzing, amphoric echo only will be produced; metallic and ringing in quality, it is true, but never of the tinkling pitch.¹ Let a little water now be placed in the decanter, and the result will be exactly the same, so long as the fluid is not agitated. But agitation of the fluid changes the character of the echo. Thus, let drops of water, slowly, and at distinct intervals, fall on the surface of the fluid in the decanter, and the ear, applied to the surface of the vessel, recognizes the most perfect imitation of metallic tinkling; just as in certain instances the phenomenon occurs within the chest, independently of respiration, rhonchus, voice, or cough, when a patient, with a very large cavity, or with hydro-pneumothorax, suddenly changes from the recumbent to the sitting or erect posture,

¹ The fundamental and consonating note of such vessels is always of low pitch.

and when, in all probability, a drop of fluid is precipitated from the roof of the cavity to the fluid on its floor. Or, again, breathe into the water by an elastic tube, and the bubbling will be found to produce a perfect tinkle.¹ It is probable, too, that sounds, generated in fluid, on the close confines of a cavity, itself free from fluid, may be echoed with metallic tinkle by that cavity. Metallic tinkle, so far as the human chest is concerned, seems to be essentially the echo of a bubble, or at least of a sound generated within liquid.

457. The morbid states in which these phenomena have been observed, are hydro-pneumothorax with and without bronchial communication, simple pneumothorax, and large tuberculous excavations in the lung-substance. In the first case, where the pleural cavity contains air and liquid, and opens into the lung, both kinds of echo may occur with respiration, rhonchi, speech, and cough. If respiration produce in any way single, isolated bubble-sounds, either by the bronchial fistula opening below the level of the liquid or otherwise, metallic tinkling will occur; if there be no bubble-sound, amphoric echo only will be heard; hence, if the fistula open above the level of the liquid, there will be amphoric echo, unless the fluid be by some means or other simultaneously agitated. Rhonchi produced in the communicating bronchial tube or tubes, will be echoed with tinkle, if their component bubbles be separately, and, as it were, intermittently evolved; if otherwise, amphoric echo will be the result. The influence of speech or cough will similarly vary. Fournet has endeavored to show that the occurrence of one or the other variety of metallic sound, tinkling or amphoric, will also be found to depend upon the freedom and rapidity with which the escape of air through the fistula occurs. If it make its way from the fistula by rare, slow, and successive bubbles, tinkling will be evolved; if the bubbles be numerous and closely following each other, amphoric echo will be the result. This idea seems to me well founded; if the drops of water be allowed to fall rapidly into the decanter, in the experiment I have already referred to, the sharp tinkle passes into the low-pitched and confused amphoric echo. Fournet further holds that (as the level of the fluid is in some cases capable of being changed with the position of the chest, and hence the relation of the fistulous opening to that level altered), the same opening may at one time be the possible source of metallic tinkling, at another, of amphoric echo. Again, if the size of the opening increase much, amphoric echo will take the place of tinkling; and, *vice versa*, if its calibre be diminished by obstruction with pseudo-membrane or otherwise. Both phenomena will cease, he holds, if complete closure of the opening be effected. It is, however, matter of certainty that either kind of echo may occur independently of communication between the pleura and bronchi; this last statement is consequently incorrect. In the second case of non-fistulous hydro-pneumothorax, the agitation of the fluid by coughing or by movement, or the fall of drops of fluid from the upper to the lower parts of the pleural cavity, and perhaps even the echo of rhonchi in the adjacent bronchial tubes, will cause tinkling. Thirdly, metallic echo, and even tinkling, both vocal and tussive, we are assured by some observers, have been heard in cases of simple pneumothorax, in which there was neither liquid effusion, nor perforation of the pleura. Low-pitched echo may intelligibly be produced under the circumstances; but the absence of fluid, especially where vocal sound is the alleged cause of the phenomena, makes it desirable that, in respect of tinkling, the observation should be repeated. On the rarity of simple pneumothorax it is needless to insist. Fourthly, large dimensions are an essential character of pulmonary cavities, that give either variety of metallic echo: all the four modes of production of both varieties may come into play within them.²

¹ The experiments of Dr. Bigelow (Brit. and For. Med. Rev., vol. vii. p. 569), made *post-mortem* on a patient with hydro-pneumothorax, gave similar results.

² I must admit, however, in respect of the necessity of the presence of fluid as a condition of metallic tinkling, that I have met with one or two cases where I was not perfectly sure, though true metallic tinkling existed, that liquid was present.

458. That the metallic phenomena should be, as is the fact, best heard in connection with coughing and speaking, is just what might have been anticipated: these acts require greater force of respiration than ordinary breathing; they are, therefore, on the one hand, capable of propelling air through a passage which would have resisted its progress under a less impulsion; and, on the other, they themselves being more sonorous, more readily lead to audible echo. Forceful and deep respiration will produce somewhat similar effects.

§ V.—SOUNDS AND MURMURS OF THE HEART, AS TRANSMITTED THROUGH THE SUBSTANCE OF THE LUNGS.

459. In order to avoid repetition, I must refer the reader to the Volume on "Diseases of the Heart," for an account of the mode and extent of propagation of the heart's sounds in the normal state of the thoracic organs: there, too, are described the changes in transmission of its sounds produced by disease of the heart itself and of the great vessels. We have here only to do with cases where, the heart and great vessels being healthy, morbid states of the lung and its appendages, by changing the conducting power of the media intervening between that organ and the surface where auscultation is performed, pervert the natural mode of propagation. Now, inasmuch as the physical sources of sound in the heart are fluid and solid only, and aëriform matter has no direct connection with them, the displacement of air in the lung, either by fluid or by solid matter, would be favorable in theory to the conduction of the cardiac sounds through the pulmonary substance: while increase of air within the thorax would have the contrary effect. And so the positive intensity of sound produced in the heart remaining unaltered, its relative intensity, as discovered at different parts of the thoracic surface, might be changed.

460. Experience supporting, in the main, this theoretical consideration, teaches us that whenever the cardiac sounds (the heart itself, the great vessels, and chest-walls being healthy), are found to be of greater intensity at any given point of the thorax, than at some other point nearer that organ, the lung, pleura, or mediastina have either in the former situation undergone some change, rendering them unusually good conductors of sound, or, in the latter situation, undergone some alteration diminishing their conducting power. The anatomical state in the first class of cases will be one of condensation or induration; in the second, of rarefaction.

461. Increased intensity of transmission of the heart's sounds is thus observable in pneumonia, chronic pulmonary consolidation, tuberculous disease, extensive pulmonary apoplexy, and œdema, dilatation of the bronchi, cancer of the lung, and solid accumulation in the pleura or mediastinum. The influence of pleuritic effusion will vary with its amount; the sounds, as a rule, will be better heard through a small extent of badly-conducting lung, than through a large mass of better conducting fluid. Hitherto phthisis has been almost the only affection in which this means of diagnosis has been commonly applied. If the heart's sounds be more distinctly audi-

ble under the right than the left clavicle, and if the excess be sufficiently marked to leave no doubt as to its reality in the mind of the observer, the circumstance, in conjunction with the locality of its existence, affords presumptive evidence of tuberculization. Generally speaking, other signs of a more direct character are observed at the same time; but in certain cases of incipient and rather deep-seated tuberculous deposition, it is often a source of satisfaction to have this additional sign to apply to. Its absence would not, however, by any means impugn positive evidence of consolidation derived from other sources. Whatever be the cause of the sign, it is for obvious reasons more readily substantiated at the right than the left side.

462. Diminished intensity of transmission of the heart's sounds, on the other hand, accompanies highly marked emphysema. The importance of this fact is habitually acknowledged in respect of the præcordial region, where the sounds may be almost completely muffled by an intervening thick mass of rarefied lung: but the sign may be established elsewhere. Thus, in a case of intense emphysema of the left lung, to which the disease was limited almost completely, and especially marked at the posterior aspect of the chest, I some years ago detected that the heart's sounds were considerably more distinct posteriorly on the right than the left side. As there was no evidence of induration of the right lung, and as the sounds there were not louder than is sometimes observed in healthy individuals, the difference on the two sides could only be ascribed to diminished conducting power on the left. This sign, in the rare cases where it could be established, would appear to warrant the diagnosis of general emphysema of the substance of the lung in its deeper parts, as well as on its surface—a point of some importance; for diagnosis, as well as anatomical investigation after death, generally aims too exclusively at the detection of superficial emphysema. The influence of pneumothorax varies; as a rule, it impairs the force of the sounds, but sometimes they seem to echo in the pleural cavity, as they do in a flatulent stomach, and so become intensified: I have observed this variation within twenty-four hours.

463. When the conducting influence is a weakening one, the observer should specially notice the second sound of the heart: when an intensifying one, the first.

464. Whether the heart's sounds may be modified in the course of transmission in virtue of any other principle than conduction, will be elsewhere considered.

465. The conduction of cardiac *murmurs* is modified on the same principle. But does any condition of lung generate either cardiac or vascular murmur, independently of disease of the heart, or of those conditions of the blood, spanæmic and other, which render its movement soniferous? It is by no means very uncommon, as Dr. Stokes was the first to state, to observe a sharp blowing mur-

mur in the subclavian artery where the apex of the lung is consolidated by tubercle—a murmur completely wanting in the heart, aorta, carotid, or opposite subclavian. Dr. Stokes ascribes it to falling in of the infra-clavicular region, to consolidation of the lung, and to sympathetic irritation. He has found it remittent occasionally, and removable by leeching or by an attack of hæmoptysis. My observations agree almost completely with those of Dr. Stokes. But the *nature* of the consolidation is a matter of indifference; and I think this murmur is of rare occurrence, unless there be systolic murmur at the base of the heart. It is sometimes connected with a murmur at the second left, or pulmonary, cartilage, evidently seated in the artery of that name; is more common on the left than the right side; is greatly increased in force by suspension of the breath; sometimes disappears and reappears in the course of a few minutes; is sometimes removed by change from the sitting to the lying posture, and *vice versâ*, or even by brisk rotation of the arm. In quality the murmur varies from soft blowing to a sharp whistling. It may continue for years, and seems more frequent in men than women. The pressure to which the vessel is submitted from the indurated and commonly contracted lung, especially when coupled with the least spanæmic tendency of the blood, seems its essential cause—though the condition of the circulation in the part may impede or promote its formation.

466. Dr. Latham points out soft, blowing, systolic murmur, limited to the pulmonary artery, as a frequent concomitant of tubercles in the lungs. I have met with it occasionally unassociated with subclavian murmur; but of this more hereafter.

SECTION VI.—SUCCUSSION.

467. It has been seen that the succussion of certain contents of the chest, produced by the heart's impulse, and by the act of coughing, may give rise to physical phenomena of diagnostic import. And it was known to Hippocrates that if the chests of certain patients laboring under thoracic diseases be shaken, a "sound may be heard on the affected side." Hippocrates, however, erroneously supposed empyema to be the disease giving rise to this sound: his pathology was defective, but his observation correct: and the phenomenon retains to the present day the name of Hippocratic, or thoracic, succussion-sound.

468. The *succussion* necessary for the production and detection of this phenomenon may be performed by pushing the patient's trunk abruptly, but with gentleness, forwards and backwards, while the observer's ear is applied to the chest; or the patient may himself move his chest once or twice in the manner indicated. The sound resembles closely that perceived on shaking a decanter partly filled with water close to the ear. Like that, it is a gurgling splashing noise, the precise tone of which varies with the density of the fluid,

and the proportional quantities of fluid and of air present. It differs in point of intensity according to the suddenness and force of succussion; but may be so easily produced as to be detected on the least movement of the patient, or during coughing. It may be audible at a distance from the chest, and be heard while the splashing movement is felt by the patient himself, and is, or is not, accompanied with metallic tinkling. Its duration varies greatly; it may last for years, though this is very rare: in such chronic cases it is perceived by the patient as he walks down stairs, rides on horseback, or moves the trunk abruptly. It is not invariably a persistent condition when once developed; within twenty-four hours it may be present and cease to be producible, to recur again within a short period.

469. Produced by abrupt collision of air and liquid in an echoing space of large dimensions, the sound under consideration may be detected in hydro-pneumothorax, with or without bronchial fistula, and is occasionally to be heard in tuberculous excavations of unusually great size. Commonly audible over the general surface of the affected side, it may be limited to the anterior regions.¹ The sign is, however, by no means always to be discovered in hydro-pneumothorax: and one reason of its absence, thickness, and proportional excess of purulent fluid, was mentioned by Hippocrates,² it is certainly true that the thinner the liquid the more readily is the sound produced.³

SECTION VII.—DETERMINATION OF THE SITUATION OF CONTIGUOUS PARTS AND ORGANS.

470. The object of attempting to determine the situation of other parts than the lungs themselves, when the diseases of these organs are the subject of investigation, is, as might be anticipated, to infer from any change in that situation the existence of some pulmonary affection capable of producing it. Experience has shown that such displacements do occur; and further, that when present they are among the most conclusive, as they often are the most readily ascertained, signs of the associated pulmonary affection.

471. The organs and parts liable to undergo displacement in consequence of pulmonary disease are—The Heart, the Mediastinum, the Diaphragm, the Liver, the Spleen, and the Stomach. The existence of displacement of these parts and organs is determined by means of various other methods of physical diagnosis, by inspection, by application of the hand, by percussion, and by auscultation; very rarely by mensuration.

472. The Heart may be removed from its normal position by Detrusion, Elevation, and Procidentia.

¹ Louis, *Phthisie*, éd. 2, p. 412. Paris, 1843.

² Laennec, by Forbes, Amer. edit. p. 541.

³ Healey, U. C. H., *Females*, vol. x. p. 91; the splash imperfectly sonorous during life, the pus very thick at *post-mortem* examination.

473. *Lateral detrusion*, for obvious reasons more readily detected when occurring towards the right side, is there commonly associated with procidentia; on the left, with some degree of detrusion, backwards and upwards. The progress of the displacement to the right side is usually gradual from its commencement till it has attained its greatest amount, when the organ pulsates between the fifth and seventh ribs to the right of the sternum. On the left it may be pushed almost under the axilla, its point being at the same time raised the width of an intercostal space, or thereabouts, and carried backwards towards the scapula.

474. Pleuritic effusion and hydro-pneumothorax are the affections which drive the heart sideways to the maximum amount; simple pneumothorax is a rare cause; hæmothorax is rarely copious enough; and hydrothorax, being generally double, does not displace the heart in this precise manner. Intra-thoracic tumors and aneurisms,¹ variously placed, sometimes produce this effect; hypertrophy, as well as emphysema, of either lung, are among its occasional causes,—hernia of the intestines through the diaphragm into the left pleura is an infinitely rare one. Besides, the heart may be *drawn* as well as *pushed* sideways—a mode of displacement that occurs in some cases of rapid absorption of pleuritic effusion, of consolidation with marked contraction of the substance of either, but especially the right, lung, of pulmonary cirrhosis, of pure atrophy, and also of great diminution of bulk from tuberculous disease of the same organ.² The practical interest of this matter is mainly connected with pleurisy.

475. The heart can scarcely be pushed forwards by any lung-affection, except emphysema; and various more prominent conditions, such as the distension of a thick stratum of lung in front of the organ, tend to mask this displacement. Intra-thoracic tumors and aortic aneurisms lying behind the heart, push it forwards, and, especially in the latter disease, give rise to very peculiar signs.

476. *Elevation* of the heart above its natural level, a displacement of very rare occurrence as a consequence of pulmonary disease, though sufficiently common in cases of abdominal tumor³ and ascites, is sometimes seen as an effect of diminished bulk of

¹ To an enormous extent in Moriarty, U. C. H., Males, vol. xii. p. 5.

² I have twice, at the Consumption and University College Hospitals, seen the heart permanently beating in the right thorax, where no pleuritic effusion on either side had ever existed, as far as could be made out by present signs or past history, where the liver and spleen lay in their natural positions, and where great tuberculous excavation and destruction of the right lung seemed to have *drawn* the heart in that direction, aided by perhaps the *detruding* influence of hypertrophy of the left lung.

³ I have known the heart permanently raised an intercostal space by the splenic enlargement of leucocythæmia. Case of Dujardin, U. C. H., Males, vol. v. p. 192, June, 1850; also C. Hayes, U. C. H., Males, vol. x. p. 212. Enlargement of the liver from abscess will also raise the apex;—case of Fairbanks, Clin. Lect., Lancet, loc. cit. 1849.

the apex of the lung. Such diminution only occurs in tuberculous disease, and is produced by atrophy of the lung-substance, closure of air-cells, and contraction of exudation-matter, or by lessening area of cavities. I have never observed the apex raised higher by this cause than the fourth rib and third interspace; but in ascites, both in the male and female, and in ovarian dropsy, I have known it impossible to feel any impulse lower than the second interspace.

477. In *procardia* of the heart the organ is below its natural level, and carried somewhat towards the median line; the impulse then is much more decided at the epigastrium, especially between the ensiform cartilage and left false ribs, than in the cardiac region. The common pulmonary cause of this displacement is double emphysema, of which it furnishes one of the most characteristic signs. It rarely exists to an appreciable extent in double bronchitis, if there be no emphysema; neither does double hydrothorax commonly induce it. The advance of tumors in certain situations may of course conceivably carry the heart downwards, but clinically this influence is rare.

478. The *mediastinum*, at its lower part, is of course carried to the right or left by such morbid states of the lungs or pleura as produce lateral displacement of the heart. Superiorly, above the third rib, the mediastinum may be encroached upon by the lung, without any displacement of the heart, and be sometimes pushed more or less to the opposite side. Emphysema of either upper lobe will produce this effect, and if both organs are implicated, the mediastinum may be, as it were, obliterated by its pleural borders being brought into close juxtaposition; the approximation of the edges of the lungs may take place so high as the sternal notch: the percussion-sound will of course be of unnaturally full and pulmonary tone at that point. Tumor connected with the upper part of the lung, circumscribed empyema, tuberculous accumulation in the pleura, and acute hepatization, may cause encroachment on the mediastinum, with morbid percussion-sound: tuberculization of the lung itself never, except perhaps quite at the outset, produces this effect, the disease tending to diminish the bulk of the organ—hence occasionally a valuable aid in diagnosis. It is unnecessary almost to add, that mediastinal tumors alter the relationships of the mediastinum; and that diseases of the great vessels, and of the heart likewise, deeply affect them.

479. *The Diaphragm*.—In the *normal* state, the upper edge of the arch of the diaphragm reaches, in the adult, the level of the fourth interspace on the right side, that of the fifth rib on the left, while the central tendon lies a little lower than this. The right side of the chest is consequently somewhat shallower than the left. In children the entire diaphragm rises somewhat less within the thorax. Full eating, and flatulent distension of the abdomen, temporarily raise it somewhat. The influence of tight-lacing will vary with the

fashion of the day: if the waist be "worn high," the constriction will depress, if "low," will raise, the diaphragm.

480. The position of the right wing is ascertainable by percussion of the liver anteriorly; where the sound becomes grave and of pulmonary quality on forcible percussion, carried from below upwards, lies the upper border of the liver, and by inference, the convexity of the arch of the diaphragm. The cessation of vocal fremitus, where the liver is uncovered by lung, will corroborate the results of percussion, and supply a measure of the depth of liver overlapped by lung. The main guide to the position of the left wing will then be the fact that in health it always lies a little lower than its fellow; while the position of the heart's apex and the special resonance of the stomach will afford corroborative evidence. It has, besides, been shown by Edwin Harrison, that the exact situation of the vault of the diaphragm may, in many cases, be rapidly determined by inspection and application of the hand. The mode of proceeding varies according to the shape of the thorax, which is, with reference to this investigation, of two kinds:—1. If the width of the chest be greater just above, than precisely on, the level of a line drawn transversely across from the lower part of the ensiform cartilage—in other words, if a slight lateral depression correspond pretty accurately to that level—a very simple method is described by this observer for discovering the position of the upper edge of the diaphragm. Let the hand be passed from below upwards along the side of the chest, with its inner edge kept closely to the surface and the palm somewhat everted, and that inner edge will sink into a narrow sulcus situated somewhat higher up than the lateral bulge just referred to. This sulcus, which may or may not be on the same level on both sides, indicates the precise height of, and corresponds to, the vault of the diaphragm. 2. If the width of the chest be less immediately above, than on the level of, the ensiform cartilage, this rule will not apply: however, the position of the left half of the septum may then be detected by the beat of the apex of the heart; and the right half is at least not lower than its fellow. In the main these guides are correct; but exceptions occur. Thus age, by enlarging the bulk of the lung through distended atrophy, or by diminishing that bulk through simple atrophy without distension, changes the position of the wings of the diaphragm, without affecting that of Harrison's sulcus. The sulcus is impressed on the side in youth, and remains unaltered in age. So, too, I have found that, where prolonged tight-lacing had displaced the liver and diaphragm, the sulcus had, for the same reason, ceased to correspond with the upper part of the arch.

481. In *disease* the wings of the diaphragm may be both raised; both depressed; or one only may be depressed or raised, its fellow remaining *in statu quo*; or one may be raised and the other depressed; or the central tendon may be specially depressed.

482. In order to determine with precision the nature and amount

of disease effecting these changes, I have been in the habit for some time of noting the position in the dead body of both wings of the diaphragm, before the chest is opened, and find in my hospital-books thirty-three cases proper for analysis in this point of view. The highest position observed in these cases was the second intercostal space,—the lowest, three inches below the false ribs; the relative frequency with which the arches reached different heights of the thorax was as follows:¹

	Right.	Left.
Second space	1	1
Third rib	—	—
Third space	8	1
Fourth rib	7	5
Fourth space	8	4
Fifth rib	6	13
Fifth space	1	7
Sixth rib	1	1
Below false ribs	1	1
	—	—
	33	33

Hence it appears that in three-fourths of the cases the right vault lay *above* the fifth rib, while in two-thirds of the whole the left lay *opposite* or below it; and further, that the right wing in disease most commonly lies between the third interspace and fifth rib (in $\frac{2}{3}$ of the cases); whereas the habitual range of the left wing is from the fourth rib to the fifth interspace (in $\frac{2}{3}$ of the cases).

Next, setting aside two cases of empyema, and one of ascites, I find that the right wing lay higher than the left in twenty-one persons; the left higher than the right in two; while both were on the same level in seven. Excluding the same three cases, the amounts of difference between the height of the two wings varied thus:—

	Right wing, above left.	Left wing, above right.
By half a rib or space	12	2
By a rib or space	5	
By a rib and a space	3	
By two ribs and a space, or two spaces and a rib	1	

Hence in nearly half the cases, where the right wing lies higher than the left, the excess of elevation only amounts to about half an inch.

483. But what are the morbid conditions connected with these variations in the position of the diaphragm? The case of elevation to the second interspace was one of enormous ovarian and ascitic accumulation of old standing; both wings were equally raised: those of great depression (the diaphragm being highly convex downwards) were examples of profuse pleural accumulation, solid and fluid, and fluid and gaseous. These are the kinds of affection which seriously modify the position of the septum. A case, where both arches lay opposite the sixth rib, was one of vesi-

¹ It is to be remembered, that after death the collapse of the lungs draws the diaphragm slightly, but very slightly, upwards.

cular emphysema, uncomplicated with any other change of consequence. In the other cases a variety of conditions existed of opposing tendency; but a fair consideration of all leads to the conclusions—that rarefying diseases of the lung mechanically depress the diaphragm on one or both sides; that chronic condensing, because contracting, diseases raise it by a force of suction; that pleuritic adhesions, considered independently, have rather a depressing influence than otherwise: and lastly, that the discovery during life of any disease, even if it be highly marked, which tends *per se* to modify the position of the diaphragm, does not justify the assumption that it has so modified it in the particular case; for some counteracting, though less obvious, influence may be at play.

484. Now it follows from the last proposition, that the position of the arches of the diaphragm in disease can only be ascertained by direct observation. Harrison's sulcus, remaining as it does a fixture, tends to deceive rather than enlighten; and, though the possibility of such effect, in cases of old-standing disease, is conceivable, I have never actually found a *new* sulcus corresponding to the altered site of the diaphragm. The vocal fremitus and the results of percussion are in truth the only real and trust-worthy guides to the plane of union of the chest and abdomen.

485. Extensive double emphysema, pericarditic effusion, and hypertrophy of the heart, lower the central tendon.

486. The *liver*, *spleen*, and *stomach* may likewise be raised above, or depressed below, their natural level, by conditions altering the position of the diaphragm; and thus become affected with *Elevation*, or *Procidentia*. These alterations of position are more readily detected in the case of the liver than of the other organs named; and have for this reason attracted more attention on the right than left side. Great distension of the stomach with gas will carry its tympanitic or amphoric percussion-note actually as high as the axilla.

SECTION VIII.—PRESSURE-SIGNS.

487. I propose under this head to place before the student a succinct account of certain physical effects, produced on the wall of the thorax, on its contents, or on parts adjoining; and which are clearly due to pressure exercised from within the chest. Some of the most positive and easily ascertained evidences of intra-thoracic disease, are furnished by these pressure-signs.

488. They are divisible into two classes:—those where pressure, acting from the centre towards the periphery, exhibits its effects on the wall of the chest (eccentric, centrifugal, or outward pressure-signs); and those, where the compressing force, playing in the direction of the chest's centre, physically interferes with internal parts (concentric, centripetal, or inward pressure-signs).

489. *Outward pressure-signs*.—Here range themselves expansion [31] and bulging [32] of the chest-wall, or above the clavicle; protrusion of the intercostal spaces; dislocation of the clavicle for-

wards; detrusion forward of the sternum and costal cartilages, locally or generally; pressure on the vertebral column, and eventually, through destruction of a portion of this, on the spinal cord; downward detrusion of the diaphragm; and intercostal paralysis from pressure on the nerves of that name.

490. The conditions causing this variety of sign, are as follows:—Enlargements of organs, as hypertrophy of the heart and of the lung; loss of elasticity of the lung, combined with atmospheric pressure acting from within outwards, as in emphysema; accumulations of gas, as in pneumothorax; and of fluid, as in pleuritic and pericardial effusions; solid formations in the mediastina and pleuræ; aneurisms of the great vessels; infiltrations, plastic and solid, of the parenchyma.

The evidences of pressure produced by these various diseases, as well as the mechanism of the pressure itself, vary greatly and will be described with the history of the individual diseases themselves.

491. *Inward pressure-signs.*—Inward or centripetal pressure may act on the heart, especially the right auricle; on the aorta, innominate, either subclavian, or pulmonary arteries; on the vena cava, superior and inferior, the innominate veins, the pulmonary veins, and the azygos; on the trachea, bronchi, and lung-substance; on the vagus, recurrent, phrenic nerves, pulmonary plexus, and the sympathetic at the root of the neck; on the œsophagus; and on the thoracic duct.

492. Centripetal pressure acting on the right auricle diminishes its capacity, lessens the quantity of blood reaching the lungs, and adds in one form to the dyspnœa induced by other causes. Influencing the pulmonary artery, its effects are in essence the same, but obstruction of this vessel more effectually loads the entire venous system tributary to the right heart. Compression of the aorta gives rise to certain physical signs, especially arterial thrill and systolic (possibly even diastolic) murmur; but I have not actually known it carried far enough to obstruct the calibre of the vessel seriously. Influencing the innominate or either subclavian artery, it weakens the corresponding carotid and radial pulses. Pressure on the superior cava or innominate veins distends the internal and external jugular, subclavian, axillary, superficial thoracic and superior epigastric, facial, frontal, and even dorsal veins; and produces a tumid spongy fulness of the base of the neck,¹ swollen livid discoloration of the face and lips (which look in extreme cases distended almost to bursting), and œdema of face, arm, and affected side of the thorax or the chest generally. The sinuses

¹ The capillary vessels, as well as the radicles of the veins, are distended in parts of the neck presenting this spongy appearance. Were the veins alone implicated, there would be discoloration of skin, which does not necessarily exist at all, and there would be nothing of the slightly erectile feel in the part, which is well known to the clinical observer. Doubtless, actual mechanical production of one variety of the state I have described under the title of Angeiectoma (Cyclop. of Anatomy, art. Products, Adventitious, p. 127) takes place.

of the dura-mater become clogged, and heaviness, stupor or actual somnolency ensue. Besides, the venous congestion of the brain entails cephalalgia and failure of motor and sensory power in the limbs generally: but I have never seen, even in cases of venous distension, so great that rupture of the cervical and facial veins might be supposed capable of occurring under the slightest over-strain, any approach to epileptiform seizure—a fact of obvious practical import in connection with the alleged influence of so-called cervical “phlebismus,” as an element of the epileptic fit.

493. Encroaching on the inferior cava, pressure entails distension of the abdominal veins, congestion and enlargement of the liver, congestion of the kidneys and slight albuminuria, various gastric disturbances, anasarca of the lower limbs and abdominal walls, and eventually ascites. But as matter of actual experience, it is remarkable how seldom intra-thoracic growths press in the right direction to entail this particular set of effects—and so infinitely rare is it for aneurism of the thoracic aorta to produce them, that should anasarca of the lower extremities appear in a case of the kind, some other cause must be sought for the occurrence.

494. Obstructive pressure of the pulmonary veins leads to dyspnoea, hæmoptysis, œdema of the lungs, and hydrothorax.

495. From the special tendency of tumors to form about the right bronchus, the vena azygos must frequently be pressed upon, and its obstruction must interfere with return of blood from the vertebral sinuses, and cause congestion of the cord; now such congestion was in all probability the source of torpor, formication, and feeble motor power in the lower extremities in a case of mediastinal tumor seen some time since with Dr. Bascome.

496. Forcing the trachea backwards, or to either side, pressure induces stridulous breathing and weakness of voice (traction of the recurrent nerve may have something to do with both these symptoms); its effects on the main bronchus have already been referred to, and sequential to these, exaggerated respiration may be established in the other lung. Pressure on the lung-substance may force even the persistent air [122] completely from all the texture concerned.

497. Acting upon the vagus and phrenic nerves, and pulmonary plexus, pressure variously impedes and perverts respiration, and similarly disturbs cardiac action; involving the recurrent nerves, it variously modifies the voice and obstructs respiration.

498. In cases of aneurism of the arch, and also of intra-thoracic tumor, contraction of the pupil on the affected side is occasionally observed.¹ It seems certain, as suggested by Dr. Gairdner, that

¹ The earliest instance of the fact recorded in this country was in the case of Mack, U. C. H., Males, vol. ix. p. 211, April 23, 1853 (edition of 1854, p. 759). A case of the kind, I have since learned, had, however, been seen by Dr. MacDonnell, of Montreal, as early as 1850. The wonder is the phenomenon had not been observed long before, as the experiments of Petit and Mollinelli, on the sympathetic of dogs, as early as 1750, showed such an effect might be looked for.

this must be a result of pressure on the sympathetic, whereby paralysis of the dilating influence of that nerve on the iris is induced, and so the antagonistic contracting influence of the third pair allowed full play. It is remarkable enough that the pupil thus statically changed is not of necessity dynamically interfered with: I have found it act as briskly as its fellow.¹ With the progress of a case of aneurism, the pupil which has been distinctly smaller may become of natural size;² but whether because the sac has, from taking a new direction for its enlargement, ceased to press on the sympathetic, or because it acts irritatingly and so excites the dilating fibres of the iris, I am unable to say.

I have known unilateral deafness occur on the *affected* side in cases of aneurismal tumor of the arch; unquestionably another pressure phenomenon.³

499. If the œsophagus be pressed upon, dysphagia may ensue, not necessarily, however, unless the obstruction be very great, as will hereafter be fully shown. The dysphagia of aneurism and tumors within the chest is often rather an effect of irritation of the motor nerves of the pharynx or œsophagus than of direct mechanical destruction.

500. If the thoracic duct be pressed on, unusually rapid emaciation will theoretically ensue: but actually observed cases are wanting.

501. The essential causes of the entire class of inward pressure-signs are tumor and aneurism, and to a slight extent enlargement of the heart. It is a clinical fact of deep signification that gaseous and fluid accumulations do not induce them: it is to be presumed, because the pressure of those materials is equably spread in all directions towards the periphery of the sacs in which they collect; whereas tumors grow "where they list," and hence, as it were by accident, specially towards limited spots of surface.

SECTION IX.—PHYSICO-CHEMICAL CHARACTERS OF THE AIR OF EXPIRATION.

502. The variations in the physico-chemical characters of the air of expiration are of occasional diagnostic signification—and would prove so much more frequently, had they been more fully studied.

503. The temperature of expired air in health has been calculated at 99.5° Fahr. by Valentin, at 98.6° by Moleschott—the surrounding atmosphere being of medium temperature. In estimating its rises or falls in disease, the number of respirations per minute must always be taken into account; as the longer inspired air stagnates in the chest, the warmer will it make its exit: the temperature of the expired air and the frequency of breathing are, as a rule, inversely as each other.

¹ Case of Mack, loc. cit.

² Covey, U. C. H., Males, vol. xii. p. 31, June, 1855.

³ Moriarty, U. C. H., Males, vol. xi. 1855.

504. The temperature sinks in pneumonia both from the diminution of surface, apt for chemical action, and the increased frequency of respiration. In various other pulmonary diseases, a similar fall in the thermometric heat of the expired air occurs through the same mechanism—for instance in asphyxiating bronchitis.¹ In various general diseases, implicating the blood, the expired air is more or less cool—strikingly so in cholera Asiatica.

505. The expired air rises above the natural temperature in acute febrile (non-pulmonary) diseases, during their period of sthenic reaction.

506. The quantity of watery vapor held in solution by the air of expiration varies—from the experiments of Moleschott it appears sometimes to fall below, sometimes to reach, the saturation-point.

507. It is said that the expired air in the algid stage of cholera sometimes becomes visible, with a surrounding atmospheric temperature producing no such effect on the breath of healthy individuals. This would prove an excess of watery vapor.

508. The air and moisture of expiration in the state of health are odorless at the moment of their exit; if they be kept in closed vessels, however, putrefaction occurs, and ammonia is evolved.

509. In disease very sensible peculiarities of odor are observable in saccharine diabetes, a sweet hay-like smell; in pyohæmia a mawkish sweet odor *sui generis*; in Bright's disease, a special modification of urinous odor;² in phthisis, a faint nauseous odor is frequent, and when plainly present is actually not without diagnostic signification.

510. The share of carbonic acid in the air expiration is said to be increased in intermittent fever, scurvy, and purpura; also in the phlegmasiæ generally, with the exception of those directly implicating the organs of respiration and circulation. The proportion falls in pneumonia, pleurisy, pericarditis, phthisis, variola, measles, erysipelas, roseola, scarlatina, erythema, dysentery, chronic diarrhœa, typhoid fever, and suppuration. Bronchitis is said to be without influence on the amount expired.³

These vague results, many of them self-contradictory, have little claim to the attention of clinical observers; they are treated with considerable scorn by Lehmann.⁴ Confidence, on the other hand, appears due to the careful experiments of Hannover, from which it follows that the excretion of carbonic acid increases very materially

¹ Murphy (asphyxiating capillary bronchitis), U. C. H., Males, vol. x. p. 159, Jan. 1854. Temperature of ward=57° Fahr.; of surface of right cheek, 96.50°; under tongue, 97.33°; of expired air (thermometer held close to the lips) 68°.

² If this odor be deficient in the breath of a patient suffering from the class of symptoms called uræmic, Frerich's hydrochloric acid test will also, as I have found by a considerable number of trials, fail to show the presence of ammonia in the expired air.

³ Vide Becquerel and Rodier (Pathological Chemistry, by S. T. Speer, M. D., p. 418).

⁴ Physiol. Chemistry, by Dr. Day, vol. iiii. p. 380.

in chlorosis, a new element of confusion of our physiological ideas, however; for here is precisely the affection in which the ratio of red disks falls lowest. Hannover has also estimated the carbonic acid in phthisis [1384].

511. The quantity of carbonic acid exhaled, instead of maintaining the normal average from 3 to 5, may, in certain of these diseases, rise to 8 or fall to 1 per 100.

512. In the state of disease it is very probable considerable variation exists in the amount of oxygen lost in inspiration; and chemists conjecture that probably the ratio of health between the liberation of carbonic acid and the absorption of oxygen may subsist in disease, so that from the excess or deficiency of carbonic acid the proportion of oxygen might be inferred, but nothing seems to have been practically established in the matter.

513. Nor have any useful data been obtained concerning variations in the amount of nitrogen expired in disease.

PART II.

DISEASES OF THE LUNGS AND APPENDAGES.

SECTION I.—THORACIC PARIETES.

I.—PLEURODYNIA.

514. THE term pleurodynia, still applied in its etymological sense by some persons to all varieties of pain in the side, is now, by almost universal usage, limited to actual rheumatism of the walls of the chest, affecting especially their muscular and fibrous textures. Rarely occurring simultaneously on both sides of the chest, most common on the left, and in the infra-axillary and infra-mammary regions, its essential feature is pain, more or less acute, sometimes of agonizing severity, increased by deep inspiration, by coughing, by movements of the trunk, and even of the arm, by decumbency on the affected side, and by pressure both on the ribs and in the intercostal spaces.

515. Unless it coexist with acute articular rheumatism (and, as far as I have seen, the combination is excessively unusual), pleurodynia is unaccompanied with fever.

516. The play of the chest on the affected side in *calm* breathing is interfered with. The movements of expansion and of elevation are diminished in freedom, and their rhythm becomes jerking: in the female, as a natural result of her relatively slight inferior costal action in health [49], this is somewhat less perceptible than in the male, especially when the affection occupies its ordinary seat—the lower regions of the chest. The natural relationship of the abdominal and costal movements in *forced* breathing becomes perverted [60, 66, 120]. The respiration sounds are of intermittent weak type, and jerking rhythm; there is no friction-sound to be heard. If the patient can be induced to expand the chest fully, the percussion-sound proves natural; even when the side is most inactive it is difficult or impossible clinically to discover the altered resonance, theoretically to be expected.

517. *Diagnosis*.—Pleurodynia derives its chief importance from the occasional difficulty of distinguishing it from other affections.

518. Pleurodynia closely simulates the congestive, or dry, stage of pleurisy. The presence or absence of friction-sound is not, on the first onset of acute infra-mammary pain, of as much use as

might be anticipated in the distinction of the two affections;—for, on the one hand, friction-sound may be wanting on the invasion of pleuritic inflammation;—and, on the other, the jerking rhythm of pleurodynic respiration may so closely imitate the grazing variety of that sound, as to leave a cautious observer in doubt. Excessive suddenness of seizure, the pain having come on, like that of lumbago, from an abrupt movement, while the patient is not only free from actual pyrexia, but from any sense of general illness, will point very distinctively to pleurodynia. But with pain, apparently rheumatic, there may be a chance coexistence of febrile action, cough, and slight bronchitis; the diagnosis is then extremely difficult, and a positive opinion should be refrained from, until, a certain number of hours having elapsed, the friction-sound of prominent pleural capillaries or of exudation-matter, if the case be one of pleurisy, will have established the fact with all attainable surety.¹

519. The pain of pleurodynia sometimes extends so low down, as to implicate the abdominal wall, and lead to the suspicion of peritonitis. The absence of rigors and severe febrile symptoms generally, as also of vomiting, of anxious facies, and other signs of deep constitutional shock, will distinguish the former from the latter disease. In both the abdominal walls are tender to the touch; but in rheumatism, the tenderness is more superficial, and raising of the skin between the fingers more painful than in peritonitis. Besides, the thoracic pain is more strictly limited to one spot, and relatively more increased by voluntary movements, than the peritoneal.

520. The outbreak of herpes zoster is often preceded by severe pain in the side, before the slightest indication of the coming eruption can be perceived. The burning character of this pain is insufficient for its positive distinction. There is sometimes, however, marked cutaneous hyperæsthesia, without cough or dyspnoea, commonly with slight pyrexia, and movement is less painful (it may be painless) than in pleurodynia.

521. *Treatment.*—As a rule, pleurodynia is easily and rapidly curable; but I have known it linger on in a quasi-chronic form.

522. In plethoric people the duration of the attack may certainly be shortened by moderate cupping or leeching. Usually removal of blood is uncalled for. Friction with anodyne and stimulant liniments; the warm, vapor, or hot-air baths; rest, with colchicum in small, and bicarbonate of potash in free, doses; quickly effect a cure.

¹ In a case seen with Dr. Neil Arnott, the diagnosis was rendered difficult by the impossibility of making a physical examination of the chest, so exquisite was the tenderness. But, on the other hand, the very intensity of the pain and tenderness argued in favor of pleurodynia rather than pleurisy; and the event proved that the pleura had escaped. In this instance there was articular rheumatism also.

II.—THORACIC MYALGIA.

523. The muscles of the chest-wall, especially both pectorals, sometimes become the special seats of pain. This pain may be wholly subjective, or be a genuine hyperæsthesia, excited by pressure, and manipulation of various kinds, and accompanied with exaggeration of "muscular sense."

524. Males are more subject to this muscular pain than females, as far as I have seen. Its causes are obscure; in some cases where no exciting influence, such as over-exertion of the muscles in rowing, gymnastic exercises, *et alia similia*, can be traced, it seems dependent on a form of hysterical diathesis. In a case of this kind, some while since, under my observation,¹ the pain and tenderness were so constant and so great as to render application to business an impossibility.

525. Myalgia of the walls of the chest generally, or of one side of this, or of some particular muscles, may exist, while the lower extremities are paralyzed to the will, the cutaneous surface of these devoid of sensation, and their muscular substance anæsthetic, though capable of being excited to contraction by direct percussion, and by reflex stimulation from the skin.²

526. The absence of physical signs, pleural or pulmonary, in the site of tenderness, will prevent this affection from being mistaken for any intra-thoracic disease. The pain under action may, however, be sufficiently great to interfere with expansion as well as to weaken, and modify the rhythm of, the respiration sounds.

527. Myalgia is not necessarily accompanied with cutaneous hyperæsthesia; as, conversely, the latter may exist to an exquisite degree without any muscular tenderness. Neither is there, of necessity, any "spinal irritation."

528. When myalgia has arisen from over-work of the muscles concerned, it will gradually disappear under the influence of rest. In the idiopathic hysteriform variety, nervine tonics, antispasmodics, and local anodyne applications, followed by stimulating douches, will effect a cure.

III.—INTERCOSTAL NEURALGIA.

529. The intercostal nerves are occasionally the seat of neuralgia, scarcely ever affecting both sides of the thorax (I have seen this but once), and generally more common on the left than on the right side, the pain usually involves the nerves from the sixth to the ninth—in rare instances a single trunk only.

530. The pain of this neuralgia is severe, varies in precise character, as that of similar affections elsewhere, occurs paroxysmally, follows the course of the affected nerve, or seems to pass directly

¹ E. H., Male, visiting as an out-patient, U. C. H.

² Cozens, U. C. H., Males (Paraplegia; from acute, lapsing into chronic, softening of the cord), vol. xvi. p. 261.

backwards from the edge of the sternum to the vertebral groove, and is frequently accompanied with pain in the branches of the brachio-cephalic plexus—sometimes in the gastric filaments of the vagus.¹ In the intervals of the sharper pangs paræsthesiæ, such as numbness, coldness, formication, are occasionally felt.

Generally speaking, three tender points (as was first, I believe, shown by M. Valleix) may be detected by pressure in the course of the affected nerve or nerves—one in the vertebral groove, another about the axillary region, a third in front towards the terminal ramusculi. There is sometimes general cutaneous hyperæsthesia in the region implicated, and gradual but firm pressure over a broad surface gives relief.

531. The physical signs are the same as those of pleurodynia; impaired thoracic movement, with weak jerking respiration—the percussion-signs being negative.

532. Hysterical and anæmic women are the most frequent subjects of this neuralgia; it is not by any means a constant attendant on spinal irritation. Not unoften mammary neuralgia supervenes as a sort of further development of the affection:¹ and then local lobular swelling either takes place in the gland, leading to a form of chronic simple induration: or, as I have more than once seen (illustrating the old principle, *ubi dolor, ibi fluxus*), suppuration may actually ensue. The obstinate pain, which sometimes occurs as a sequence of herpes zoster, seems to be an intercostal neuralgia.²

533. The complaint derives its interest, in respect of pulmonary pathology, from the possibility of its being taken for an evidence of pleurisy, and from its being pretty frequently associated with phthisis. Its relationship to pseudo-anginal affections of the heart will be considered with the description of these.

534. The three painful points in the course of the nerve indicate the true nature of the disease, distinguishing it from pleurodynia, myalgia, costal periosteitis, and all pains of intra-thoracic origin.

535. The *prognosis* is uncertain as to duration, relapse, and recurrence: in my experience both the latter events have been common. Months may elapse before cure is solidly established. The anæmic form is the most easily got rid of.

536. *Treatment*.—If the tenderness be extreme at any one of the three points referred to, a few leeches are requisite; subsequently flying blisters, will, as concerns local measures, be sufficient. But sometimes, after a sharp attack, a minor amount of pain recurs from time to time, which is best relieved by the endermic use of

¹ Benyon, U. C. H., *Females*, vol. viii. p. 225; Martin, U. C. H., *Females*, vol. ix. p. 190.

² I have known this pain resist every conceivable remedy for upwards of three months, and profoundly affect the general health. Admitting it to be an intercostal neuralgia (an idea, however, not unopen to objection), what is the mechanism of this? Romberg's suggestion, tracing it to morbid changes in the bloodvessels of the intervertebral foramina influencing the contiguous nerves, seems to me rather fanciful than satisfactory.

morphia, or by inunction with ointments containing belladonna or aconite, or in severer cases their alkaloids. The internal treatment will vary according to circumstances. If the neuralgia appear a mere subsidiary phenomenon of phthisis, there is no necessity for altering the treatment designed for the main affection; if, on the contrary, it become for the time the dominant source of suffering, quinine, arsenic, and iron, combined with purgatives, are, as in the case of other neuralgiæ, advisable.

IV.—INTERCOSTAL NEURITIS.

537. Inflammation of the intercostal nerves, with vascular injection, and considerable enlargement of their substance, has been described by M. Beau, as an attendant on pleurisy both in its acute idiopathic, and chronic tuberculous forms. The pleuritic "stitch" in the side he looks upon as the result of such neuritis. Further observations on this subject are called for: that "stitch" may have existed without anatomical evidences of neuritis being detected after death, is indubitable.

V.—VARIOUS PARIETAL DISEASES.

538. A number of affections of the walls of the chest produce physical signs that might, without due caution, be confounded with those of intra-thoracic diseases. A mere reference to some of them—such as may serve to put the physician on his guard—is all that can be ventured on here.

539. Thus costal periosteitis (whether of rheumatism or tertiary syphilis¹) with its tenderness, local percussion-dulness, and somewhat weakened subjacent respiration, might very readily be mistaken, at the apex of the chest, for consolidating pulmonary disease beneath, unless the ribs were carefully examined. Carcinomatous infiltration of a rib, especially if there be no external prominence, may in like manner deceive.² Abscess of the sternum,³ or situated between the periosteum and the anterior,⁴ or at the posterior,⁵ surface of that bone, may simulate, according to its precise site and characters, mediastinal abscess or tumor, or aortic aneurism. Subcutaneous emphysema and anasarca sometimes give rise, through the movements of respiration, to rhonchoid noises simulative of true bubbling rhonchus and friction-sound.

¹ Morie, U. C. H., *Females*, vol. x. p. 152.

² Jennings, U. C. H., *Females*, vol. xv. p. 65. I have seen two contiguous ribs united in this manner.

³ Reilly, U. C. H., *Males*, vol. vii. p. 305.

⁴ Mottlee, U. C. H., *Females*, vol. v. p. 36.

⁵ Buckley, U. C. H., *Males*, vol. ix. p. 248, 310.

SECTION II.—BRONCHIAL TUBES.

I.—INFLAMMATION.

540. Inflammation of the bronchial tubes, or bronchitis, the most common of pulmonary diseases, occurs, idiopathically, in the acute and chronic forms.

(I.) ACUTE BRONCHITIS.

541. Clinically, as well as pathologically, acute bronchitis differs so materially, according as the disease implicates merely the larger and medium-sized tubes, or involves the capillary ramifications and confines of the air-cells, that the two varieties must be separately considered.

A.—Bronchitis of the Larger and Medium-sized Tubes.

542. This variety of the disease is anatomically characterized by injection of the mucous membrane, capilliform generally, maculated occasionally, and rarely visible to the naked eye beyond the third or fourth divisions. Commonly strips of good length, say, from half to three-quarters of an inch long, may be separated by careful manipulation; but in rare instances they are short from slight softening. The membrane is in exceptional cases thickened, and the submucous tissue infiltrated with soft exudation-matter. Epithelial desquamation occurs in patches: true ulceration never. The form of the tubes is unaltered: they contain aerated mucus, exudation-matter non-moulded,¹ pus and epithelium—the whole free from blood. The pulmonary tissue is natural. Such changes as exist equally affect the tubes of both lungs.

543. The invasion of the disease is commonly marked by coryza, sore throat, and slight hoarseness, chilliness, scarcely amounting to rigors, with lassitude, aching pains in the limbs, and frequent pulse. The occurrence of coryza is significant of the primary character of the disease—tuberculous bronchitis very rarely originates with this symptom.

544. The pyrexial symptoms may either precede, or closely follow on, the appearance of local disturbance—in the former, they are as a rule notably more severe than in the latter case.

545. The disease being established, more or less discomfort and pain are felt behind the sternum—a sensation of heat, soreness, or rawness of the bronchial surfaces, increased, perhaps, to acute pain by coughing, and attended with a sensation of oppressed breathing. The respiration is increased in frequency, slightly out of proportion with the pulse—in several cases, notably so. The cough, an essential feature of the disease, at first short and dry, or nearly so, is

¹ Rymes, U. C. H., Males, vol. xi. p. 157, Nov. 1854—Chronic and acute phthisis with general bronchitis.

loud, hoarse, and ringing, occasionally paroxysmal, and severest after sleep. After the lapse of one or two days, when it becomes loose, it is attended with expectoration of frothy mucus, watery in the main, ropy in some measure, of saline taste, faintly yellowish, yellowish green, or grayish yellow color, free from blood visible to the naked eye, varying greatly in quantity, and gradually becoming muco-purulent. The sputa run together into a single mass, except in rare instances, when they present the nummulated form, with perfect opacity: I have seen this, even in children, in the bronchitis of measles. Referred sometimes, by the patient, to the sternal region, the cough is more frequently brought on by a tickling feel about the trachea and larynx, where the sufferer will consequently obstinately contend his whole ailment lies.

546. Microscopically, the clear sputa of bronchitis consist of hyaline fluid, mucus-corpuseles, and small-sized tessellated, cylindrical, and ciliated epithelium;¹ the opaque variety, of exudation-cells and masses, epithelium, pus-cells, and some rare blood-disks. Saliva and epithelium from the mouth are accidental admixtures.

547. The urine is of febrile type;² the existence of any particular heat in micturition (pointing to the coexistence of vesical catarrh), or of seminal emissions, as referred to by Laennec, has not pressed itself on my attention.

548. Lasting from four or five days to two or three weeks in cases of complete recovery (which make the vast majority), attended with febrile action of sthenic or asthenic type, the acute disease may besides terminate in its chronic form, or actually prove fatal. The variable length of the attack in the first class of cases depends sometimes on the extent of surface involved; probably sometimes on the depth to which the disease reaches in the bronchial walls; but also in many cases on the existing diathetic state, inasmuch as with the same general and physical signs, and under the same treatment, cases vary pretty widely in their duration. The chronic disease supervenes more especially, where the deep tissues of the tubes are involved by the acute attack.

549. Death, solely occurring in infants, in aged persons, and in those constitutionally debilitated by excesses, injuries, or disease, is even in these classes excessively rare; acute bronchitis, really destructive of life, belongs to the next variety.

¹ The quantity of epithelium found in the frothy fluid in the tubes after death is always greater than in the sputa during life; in accordance with the general law of desquamating diseases, of which perhaps the most remarkable example is furnished by the greatly less proportion of separated epithelium contained in the alvine discharges of Asiatic cholera during life, than in the contents of the bowel after death.

² Water and urea decreased, uric acid increased.

B.—*General and Capillary Bronchitis.*
(olim *Peripneumonia Notha.*)

550. Even in this variety of the disease the proper tissue of the minor and capillary tubes suffers less than that of the larger: still, redness, irregular thickening, and in some cases softening, in yet rarer ulcerations, or at least deep abrasions (probably a distinction without a difference) may be detected with the naked eye in the smallest bronchi thus traceable. The tubes are very generally dilated uniformly, or more rarely unevenly; they contain even to their very extremities muco-pus, thin and fluid or lumpily inspissated, sometimes actual exudation-matter, more or less closely adherent—the latter in the form of casts, never of any great length, and either solid or tubular.

551. The lungs, extensively or even generally air-distended, are sometimes acutely emphysematous; hence general excess of bulk. But here and there the surface is depressed in the site of collapsed lobules, or irregular islets of the lung, airless and quasi-solid, yet capable of insufflation from the trachea, unless the inspissated muco-pus or exudation-matter in the communicating tubes be very abundant. True pneumonia, lobular or diffused, is of purely exceptional occurrence;¹ the parenchyma is often even unusually pale. Minute accumulations of pus, looking intra-parenchymatous, but really traceable to the interior of the air-cells and ultimate tubes, are sometimes found towards the surface of the lung.² The bronchial glands are often inflamed—injected, large and soft.

552. The causes of idiopathic capillary bronchitis are essentially the same as those of the less severe variety—exposure to extreme absolute cold, or sudden transition from a heated to a relatively cold atmosphere. Why some persons should have the grave, others the mild disease is unexplained. I have not been able to trace the former to any diathetic influence. Capillary bronchitis is most common in infancy and childhood, next most frequent in old age, rarest in young adults.

553. *Symptoms.*—Capillary bronchitis being generally preceded by inflammation of the larger tubes, the symptoms of invasion are not so decided and severe as might otherwise be expected. Rigors are rare; vomiting rarer. Still the capillary tubes may suddenly become involved, even after a lull of symptoms of the milder disease; and though even under these circumstances the rigors of an acute seizure may be wanting, the severity of the general symptoms from the first shows the gravity of the attack. On the other hand, I have known well-marked rigors, vomiting, and headache occur at

¹ This is especially true in the adult; but, even in the infant, the frequency of lobular pneumonia has been greatly exaggerated by some writers, in consequence of their mistaking collapsed for inflamed and hepatized lobules.

² These are the "purulent granulations" of Rilliet and Barthez; for the form of the disease attended therewith, they propose the rather contradictory title "vesicular bronchitis."

the outset—a combination of serious diagnostic importance, as will be seen in the history of ACUTE PHTHISIS.

554. Essentially asphyxiating in its effects, as the anatomy of the disease prepares us to expect, capillary bronchitis is attended with variable congestion of the external surface, lividity of the lips, cheeks, tip of the nose (the ground-tint of the face being pale), external ears, finger-ends, and with fulness of the jugular veins, indicating obstructed circulation through the right side of the heart, sequential to that of the lungs. The pulse and respiration are both extremely frequent—the latter out of proportion to the former, but, as far as I have seen, never to the extent observed in some cases of pneumonia. Dyspnœa, habitually carried to orthopnœa, and paroxysmal; sense of oppression and stuffing in the chest; cough at first almost perpetual, with exacerbations from time to time, in exceptional cases infrequent; post-sternal pain, sharp, aching, sore, slight, or null; expectoration sometimes muco-purulent, yellowish green, or bright green, opaque, very abundant and free, at other times viscid, ropy, glutinous, containing exudation-matter in patches¹—the whole attended with feeble reaction, hot, warm, or about natural temperature of the skin, which is sometimes moist, but free from sudamina, with anxious countenance, and extreme general restlessness—constitute the ordinary symptoms.

555. The urine is small in quantity, of strong urinous odor, deep color, and high gravity. Temporary slight albuminuria may occur. The very highest amount of asphyxiating disturbance of respiration does not entail as a necessity the presence of sugar.² Dr. Garrod relates a case in which he detected a little sugar; but the absence of this after recovery does not appear to have been ascertained.³ I have found oxalate of lime during convalescence.

556. In cases tending to a fatal issue, exhaustion soon ensues. The pulse, if at first of some power, rapidly loses its strength, becoming excessively frequent, 120 to 150, but free from irregularity; the respiration, varying commonly from 36 to 50, maintains its relative frequency almost until the closing struggle.

557. Pulse-respiration ratios of 3.0, 2.5, or 2.25 to 1, are not uncommon; but sometimes, even so much as forty-eight hours before decease, the frequency of the respiration falls, while that of the pulse continues to rise: under these circumstances I have known a ratio of 4.5 to 1 (that of health) coincide with a pulse beating 144 per minute.

558. As long as his strength permits, the patient sits erect or bent forwards; but the body gradually yields, and it is not uncommon to find patients, while still perfectly conscious, lying sideways

¹ I have seen white patches of the kind in the sputa of a patient aged sixty; in infancy it is not very uncommon, when under the influence of emetics, or otherwise, expectoration has been obtained.

² Murphy, U. C. H., Males, vol. x. p. 160. No albumen or excess of urates present to interfere with ordinary tests.

³ Ranking's Retrospect, vol. xx.

or forwards, with the head lower than the shoulders. In rare cases, a posture of this kind is adopted from the very onset.¹

559. The sputa gradually diminish in quantity, from failure of power to expectorate; the skin, generally livid or cyanotic in tint, falls in temperature, and becomes covered with cold clammy perspiration, sometimes rather copious, rarely attended with formation of sudamina; the expired air grows cool [504, note]; the feet and hands swell—in protracted cases the anasarca rising to the trunk (and this independently of heart disease); fitful dozes lapse into a state of somnolence, constant, except from momentary interruptions by the cough; muttering delirium, in some instances slight convulsions, precede a comatose state, which is the immediate forerunner of death. The fatal termination is sometimes hastened by the accidental blocking-up of a large bronchus with secretion.

560. The *prognosis* of capillary bronchitis is very serious. Robust adults may, it is true, generally be saved by active measures; but of young children and aged persons (even though free from chronic bronchitis) attacked, it has been calculated from three-fourths to one-half perish.

561. The indications of fatal tendency in individual cases are, suppression of expectoration, without improvement in other symptoms, increasing viscosity of the sputa, excessive frequency of pulse and respiration, failure of heat, clammy sweats, and somnolence. Maintenance of the head on a low level from the first, in a case otherwise grave, I believe to be of evil augury.

562. That slackened and comparatively quiet respiration does not in itself justify a favorable prognosis, where other symptoms remain unrelieved, is inferrible from what has already been said.

563. In fatal cases, the disease generally terminates in childhood by the sixth or eighth day, in the adult drags on to the tenth or twelfth. If the alimentary canal chance to be affected at the same time—if there be gastric or intestinal irritation, the vital powers fail with even unusual rapidity. I have known life destroyed *in forty-six hours* in a middle-aged adult, who had in previous years had more than one severe seizure. On the other hand, the tenacity of life sometimes exhibited in the worst cases is most singular; I have seen a patient, whose every hour appeared likely to prove his last, linger on for a fortnight. And in very rare instances such protraction may end in recovery, even after the surface has become thoroughly asphyxial, the act of expectoration grown impossible, the cold clammy sweat, commonly precursory to death, existed for hours, and scarcely the slightest reflex action of the eyelids can be induced by touching the conjunctiva.² Convalescence sets in, in cases of recovery, between the tenth and twentieth days.

564. Relapse is less common than recurrence. The latter may take place within a brief period after perfect recovery from a pre-

¹ Murphy, loc. cit. p. 157.

² In a case of this kind, seen with Dr. D. Fraser, very little stimulus was taken.

vious attack, and destroy life rapidly—and this apparently without re-exposure to the original cause.

565. *Physical Signs.*—The physical signs of both the varieties of simple acute bronchitis may, conveniently, be considered together.

566. Little of a practically valuable kind is discovered by inspection in slight bronchitis: the form of the chest is not visibly altered; and, unless there be emphysema present, the perversion of movements is insufficient to attract the eye. If the disease be severe, the costo-abdominal expansion-movements assume the characters of healthy forced breathing [52]; the costal increase in amount, the abdominal decrease.¹ Where the dyspnoea is extreme, the lower end of the sternum and connected cartilages sink in with inspiration. The expiration-movements are slow, labored, and inefficient.

567. The hand, applied to the surface, occasionally detects distinct rhonchal fremitus—its presence furnishes a rough guide to the seat of the rhonchus, as it will scarcely be transmitted to the surface, if a deep bronchus be the source of vibration. It may be more distinctly perceptible during inspiration than expiration, or *vice versâ*. Dr. Stokes believes that it is more marked in the child and female than in the adult male, and at the middle and inferior parts of the chest than the superior. I have found it very remarkably developed in infants of from six to twelve months old. The state of vocal fremitus varies; it sometimes exceeds the average of health.

568. The percussion-sound may present itself in three different conditions: not appreciably changed from the type of health; pulmonary in excess; or impaired in resonance. The first condition is the rule; the two latter are of exceptional occurrence.

569. I have known exaggeration of pulmonary tone, increased duration, and slight fall of pitch (Type 2 [197]) of the percussion-note maintain itself in the central regions of the back—nay, even at the base²—in general asphyxiating and capillary bronchitis, through the whole course of the disease, and even within a few hours of death. Besides, the area of grave pulmonary resonance extends in front a little further downwards than natural—a fact easily ascertained over the liver—and expiration has less effect than in health in diminishing the superficial extent and amount of that resonance. The lung is held to a certain extent in a state of mechanical distension, from diminished elasticity of its tubes and substance, from imprisonment of air by glutinous bronchial secre-

¹ In extreme cases, however, the respiration-movement may be almost wholly abdominal: *e. g.* Murphy, U. C. H., Males, vol. x. p. 158—"In inspiration abdomen suddenly expands, remains so for an instant, then as suddenly falls back; manner of respiration and noise accompanying it remind one of the breathing of pavours in the street."

² Murphy, U. C. H., *loc. cit.*, p. 158. This excess of pulmonary tone may hold on to the last even where heart disease of asphyxiating character coexists—*e. g.* Browne, U. C. H., Females, vol. xvi. p. 29.

tions, and sometimes by the actual development of acute emphysema. It is a mistake to suppose that, as a rule, any ordinary amount of local lobular collapse will counterbalance the influence of these distending agencies on the percussion-sound.

570. On the other hand slight decrease of resonance with all the characters of Type 1 of morbid percussion-sound [195] may be sometimes detected, especially at the postero-inferior parts of the chest. But this condition of sound in simple bronchitis is singularly rare; and when we reflect that considerable turgescence and thickening of the mucous membrane over a large extent of surface form part of the anatomical features of the disease, the usual normal state of resonance affords fair ground for surprise. The fact of the existence of such resonance is important; as it will commonly enable us to infer the idiopathic character of the disease, and conclude without hesitation that it does not depend upon or attend tuberculous deposition.

571. The imperfect resonance in exceptional cases is variously produced. Sometimes depending upon accumulation of bronchial secretion, it is then chiefly observed at the base and posteriorly, and occurs more especially in persons of debilitated constitution, or in those laboring under prostrating diseases—as, for example, typhoid fever—of which the bronchitis is only a secondary condition. In these cases there is often some congestion, or more rarely œdema, of the lung, which takes its part in producing the deficiency of tone. Occasionally the deficiency of resonance seems traceable to *collapse of the general mass of the lung*, consequent on pressure on a main bronchus by enlarged bronchial glands,¹—the bronchitic secretion contributing its share, at the same time, of defective resonance. But, without meaning to deny the possibility of the fact, I must observe I have never yet seen *local collapse of lobules* on an extensive enough scale in simple *adult* bronchitis (antagonized as it is by the distending influence of the disease) to justify me in looking on it as a sufficing cause of modified percussion-note.

572. Reference has already been made [211] to the occasional occurrence of a pseudo cracked-metal resonance in the bronchitis of young children especially. I would add, to what is there said on the subject, that unlike the true cavernous sign, this simulation of it is changeable in place.

573. By auscultation, we learn that true respiratory sound, weakened, sometimes, even to suppression, in the tissue communicating with the affected tubes, is exaggerated on its confines and elsewhere—hence, especially so in the upper parts of the chest. The respiration, coarse and noisy, often more closely resembles dry rhonchal, than true breathing, sound; whence I have been in the habit of calling it “sonorous respiration.” The sounds, dry and harsh in quality, are accompanied, and it may be masked more or less perfectly, by sonorous, sibilant, clicking, and bubbling rhonchi, in

¹ Ransom, U. C. H., Females, Nov. 1848.

various combinations—the former often of musical quality. Expiration is much prolonged and labored. The vocal resonance is not perceptibly affected as a rule; but in some cases, probably from nasal character in the laryngeal voice, acquires a sniffling quality.

574. As a general fact, the sonorous and sibilant rhonchi are most marked and constant in the dry stage of bronchitis; the bubbling in that of secretion. But both orders of sound are frequently combined in the latter stage; and in some cases secretion occurs so rapidly that bubbling rhonchus is audible from the first. When the secretion is very abundant, distinct agitation of the fluid in the tubes may be caused by the action of the heart. As was first observed by Dr. Stokes, each pulsation of the heart then causes a corresponding rhonchal sound, continuing when the breath is held.

575. In idiopathic capillary bronchitis, in addition to the signs belonging to bronchitis generally, auscultation discovers fine bubbling rhonchus at both bases posteriorly; coarser rhonchus higher up. If abundant and minute in its bubbles, this rhonchus indicates very positively that the capillary tubes are inflamed; but as fine bubbling sometimes occurs inferiorly to a limited extent in cases running a mild course, gravitation of fluid from the larger tubes above to the smaller below, is probably sufficient to produce it on a minor scale: if confined to one base, or to one or both apices, the bronchitis it depends on is generally either of emphysematous or tuberculous origin. Tolerably fine bubbling may occur in large-sized tubes.

576. In intense bronchitis of both lungs, especially where any slight emphysema pre-existed, the bulk of the organs may be sufficiently increased, to push the heart slightly downward, and to the right; the organ then beats mainly at the left costal angle [25]. The diaphragm and subjacent viscera are likewise depressed to a trifling amount. Coarse respiration and noisy rhonchi may suddenly disappear from a given spot, returning after a brief interval. Laennec plausibly referred the fact to obstruction of a tube with glutinous secretion; it is noteworthy, however, that the respiration-sounds may return without expectoration having occurred.

577. *Diagnosis.*—The diagnosis of bronchitis of the large tubes is sufficiently simple—dry, passing into moist, bronchial rhonchi, post-sternal soreness, expectoration non-sanguineous, first clear then muco-purulent, accompanied with slight febrile reaction, identifying the affection. It is well to observe here, that the mere existence of dry rhonchi is not necessarily significant of bronchitis; those rhonchi may doubtless, in emphysematous and asthmatic persons, be produced by spasm of the minor tubes.

578. Capillary bronchitis in the adult is distinguished from diffused pneumonia by the normal or exaggerated resonance of the chest, by the coarseness of its moist rhonchi, and their existence at both bases, by the presence of dry and clicking rhonchi, by the

absence of tubular breathing, the comparative coolness and more asphyxial tint of the skin, by the less perverted pulse-respiration ratio, the severer subjective dyspnoea, and more marked objective evidences of labored breathing, the deficiency of rigors of invasion, the absence of pleuritic stitch, and the non-sanguineous expectoration.

579. From the lobular pneumonia of childhood the distinction is less easy. Infantile lobular collapse will impair the percussion-tone as much as lobular hepatization. Besides, the primary rhonchus of pneumonia in infancy is comparatively coarse, that of capillary bronchitis comparatively fine; and assistance from the sputa fails, as they are almost invariably swallowed. In capillary bronchitis, however, the moist rhonchus is generally much more diffused than in pneumonia, and tubular breathing does not occur; the skin too remains free from acrid heat, often becomes temporarily moist; the general anxiety is greater, the dyspnoea more urgent, and the appearance of the skin more asphyxial.

580. The diagnosis of capillary bronchitis and acute phthisis is considered with the latter disease.

581. At the outset of a pyrexial attack with bronchitic symptoms, in infancy, it often proves difficult, if not impossible, to determine whether the irritation of the bronchi is idiopathic, or a part of the initiatory symptoms of an eruptive fever. The absence of rigors, vomiting, marked coryza, and lachrymation will help to distinguish the case from measles; while the deficiency of anginal symptoms or of severe lumbar pain will be simply useful as respects scarlatina and variola. But often certainty is unattainable, till the day of eruption has come and passed.

582. Typhoid (Peyerian) fever seen within the first few days, before the appearance of its special eruption, might be, and actually has been, mistaken for acute bronchitis. But the cough and dyspnoea, which lead in such cases to the error, prove to be excessively slight in proportion to the extent and loudness of the dry, or it may be moist, bronchial rhonchi; the expectoration is sometimes tinged with blood, through coexistent epistaxis; the dull leaden hue of the typhoid facies differs strikingly from its livid tint in severe primary bronchitis. Besides, rigors, vomiting, cephalalgia, abdominal pain, common initiatory symptoms in typhoid fever, are almost unknown in bronchitis [543]. In the very rare instances in which they mark the invasion of capillary bronchitis, the whole special symptomatology of the latter disease stands out from the first in such strong relief, as to make error next to impossible.

583. *Treatment.*—The treatment of acute bronchitis in the adult, sufficiently simple in its general indications, is often beset with difficulty at the bedside.

584. It may first be inquired, whether such extrinsic influences having played on a given individual, as would commonly cause in him, as in other persons, an attack of bronchitis more or less grave

and having besides produced its earliest indications, can the actual development of the disease be prevented? In other words, may "a cold," having begun, be stopped *in limine*? The popular faith in all countries answers Yes. That a spirituous and diaphoretic drink, taken in time, will stop the disease in the coryzal stage is matter of almost universal credence; and the scientific opinion of Laennec accords with the vulgar belief. Nor have I seen any proof that if the alcoholic stimulus fail prophylactically, it renders the subsequent inflammation more severe.

585. *First Stage*.—The disease being established, removal of blood by venesection is held to be advisable to the extent of eight to twelve or fourteen ounces, where an extensive surface is involved, where the constitution is strong, and the febrile action positively of sthenic type. Rarely is repetition of general bloodletting called for by the peculiar character of the symptoms; and, while the abstraction of large quantities of blood, with the view of putting an immediate close to the disease, is perfectly chimerical, such sacrifice of the fluid is useless for an object assigned by some writers—the *prevention* of pneumonia, seeing that in the adult idiopathic inflammation of the tubes does not pass on to the parenchyma.¹ If there be strong apprehension from the past history, or from existing symptoms, of the capillary tubes becoming extensively involved, plausible grounds exist for repeating venesection, especially if the blood previously drawn have proved highly hyperinotic: but it must not be forgotten that, though we may thus control the congestive stage of the capillary disease, there is no evidence of our being able to prevent its occurrence; and the patient will require all attainable strength for the almost inevitable asphyxiating stage. The determination of the amount of blood to be drawn in these cases is the real clinical difficulty in their management; and as, unfortunately, numerical evidence is wanting on the point, the physician must in each case trust for guidance to a careful appreciation of all its circumstances. *Cæteris paribus* venesection may with propriety be pushed further in country than in town-practice; and I must say that in my own sphere bleeding from the arm in cases of bronchitis grows year by year a rarer event.

586. In cases of medium severity, or even in violent bronchitis attacking persons of feeble power, cupping between the scapulæ, to from four to eight ounces, or the application of from eight to fifteen leeches to the upper-sternal, infra-clavicular, or axillary regions, will suffice in the way of a first bloodletting—to be repeated, should relief to the breathing, as shown especially by the number of respi-

¹ M. Bouillaud has, it is true, shown by his system of *saignées coup sur coup* that large quantities of blood may be abstracted in bronchitis without immediate ill effects—Parisians born and provincials emigrating to the capital being the persons operated on. But on the other hand, he has not shown that the mortality or duration of the disease are lessened by this plan—while concerning subsequent spæmia he is prudently silent.

rations per minute, have distinctly followed the first abstraction, and have proved only temporary. Dry cupping of the chest will sometimes with propriety be substituted in weakly persons, or the exhausting apparatus of M. Junod may be applied to one or both lower extremities.

587. There are observers who believe in the utility of emetics at the outset—maintaining they control the violence of the inflammation by decreasing the force of the pulse, and disgoring the bronchial capillaries. I have constantly known the first doses of tartarized antimony, given on the contra-stimulant plan, produce vomiting; but I have no evidence that the emetics *per se* were specially serviceable. The medicine has, indeed, appeared to me quite as, if not more efficacious, where tolerated, than where it seriously disturbs the stomach or bowels. And given in this way, although not demonstrably so efficient in bronchitis as in pneumonia, tartarized antimony I hold to be the most effectual agent known in controlling acute sthenic bronchitis. In divided doses of from four to ten grains in the twenty-four hours, it appears to hasten resolution very sensibly in the milder cases, and advances the secretive stage in the severer. If the tendency to depression under the influence of the antimony be very marked—marked enough to excite fear that the vital powers may be too much lowered—calomel and opium may be employed instead. I entertain no question as to the superiority of tartarized antimony under ordinary circumstances.

588. Alkalies are theoretically indicated, where the sputa are viscid, and contain exudation-matter; and when the blood is notably hyperinotic. I have, however, little experience of their efficacy in this inflammation.

589. *Second Stage.*—Free secretion from the tubes being established, and the febrile action lowered, the application of a full-sized blister to the sternum, or between the scapulæ (here, in consequence of gravitation, it draws off most fluid), becomes most serviceable; mustard poultices may, even from the first, be employed. Diaphoretics and expectorants, containing liquor ammoniæ acetatis, vinum ipecacuanhæ, paregoric, and similar agents, are now advisable, and these may gradually be replaced by preparations of a more stimulant character, such as tincture of squills, and the ammoniated tincture of opium of the Edinburgh Pharmacopœia. Dilute hydrocyanic acid and the tincture of lobelia inflata, especially if there be spasmodic tendency in the cough, and the fear of serious depression be past, are useful adjuncts. If the abundance and fineness of the moist rhonchi indicate tendency to bronchial accumulation, emetics now become of signal service, by mechanically clearing the tubes. The sulphate of zinc, as entailing little or no constitutional depression, is the best agent of the class, and may, in urgent cases, be repeated thrice in the day.

590. In a yet more advanced condition of the disease, if there be

inclination to lapse into a chronic state, carbonate of ammonia, senega, the balsamic medicines, copaiba, gum ammoniacum, and compound tincture of benzoin, are distinctly serviceable in moderating the amount of secretion, facilitating its discharge, and so relieving dyspnoea.

591. Throughout the whole course of treatment, gentle laxatives should be freely used. It would be difficult to prove, it is true, that the duration of the disease is prolonged by confinement of the bowels, but most certainly fulness of the abdomen increases dyspnoea and discomfort in the chest. On the other hand, I have never seen any utility in severe counter-irritant purgation.

592. The temperature of the room should range from 64° to 66° or 68° Fahrenheit, or even higher under special circumstances, such as previous residence of the patient in a warm climate. The moisture of the atmosphere may be regulated according to the patient's feelings by evaporating water from a dish near the bed; I have known violent paroxysms of cough and dyspnoea relieved by this simple plan. Occasional free ventilation of the room, the patient's head being protected at the time, is essential to his early recovery, he wants all obtainable oxygen. Flannel should be put on next the skin if not previously worn.

593. *Asphyxial variety*.—If the disease have actually assumed an asphyxiating character, when the patient is first seen, no matter how that character have been produced—that is whether by implication of the capillary tubes, by very extensive seizure of the minor ones, or by moderate inflammation occurring in an æsthenic state of the system—depletory measures must be employed with the extremest caution. This is the more true, as it is especially in aged persons the disease is liable to pass suddenly from a very mild state, apparently not requiring medical management, to one of the gravest character. The abstraction of a few ounces of blood may, under such circumstances, be followed by vital depression, which very manifestly hastens the fatal issue, and is perhaps occasionally its real cause. At least such is the conviction to which I have been led by observation. But this conviction is not shared by all, especially in the case of general capillary bronchitis. Thus I find Valleix¹ maintaining that “abundant and repeated general bleeding, emetics in large doses, cutaneous revulsives, and strong purgatives, must be employed with perseverance” in this form of the disease. Such treatment would, I believe, prove actively destructive if adopted in London.

594. According to the plan on which I proceed, local dry cupping, or the application of Junod's apparatus to the limbs, counter-irritation of the chest by mustard poultices and blisters, in association with, internally, stimulant expectorants, especially the sesquicarbonate of ammonia, in doses of from three to ten grains every

¹ Bull. Gén. de Thérapeutique, Avril, 1847.

second or third hour, combined with squill, serpentaria, and senega or ammoniacum, constitute the staple of the treatment. I have pretty extensively employed muriate of ammonia in doses of five to twenty grains, but am persuaded it is a less active agent than the sesquicarbonate. Chlorate of potass, in doses of from five to twelve grains every hour, sometimes appears to act favorably in warding off seemingly imminent asphyxia, but is on the whole of much inferior efficacy to the latter salt of ammonia. The patient's strength must be supported by strong beef tea and jellies; and wine or brandy given in frequent doses to sustain his calorific power.

595. In the more serious cases of bronchitis, it is exceedingly probable, the muscular coat of the tubes loses its contractile force. Now that coat appears, in the calm, and still more in the forced expiration, of health, to possess the power of reducing the tubes to less than their medium size; the elasticity of the inflamed bronchi must likewise be impaired according to one of the acknowledged laws of inflammation. Now thus are easily intelligible the tendency to dilatation of the tubes, the labored expiration, and the accumulation of secretions, characteristic of the acute disease. And hence, more particularly as bronchial paralysis and air-distension of the lung are known to follow section of the par vagum, it seems right that, as a final resource, galvanism, in the course of that nerve, should be tried in cases of asphyxiating bronchitis. I must, however, admit I have tried strychnia at a pretty early period of the asphyxial stage, and in sufficient quantity to produce well marked "physiological" effects, without favorably influencing the respiration.²

According to Breithaupt,³ chloroform-inhalation becomes of great value where the dyspnoea is severe from obstruction of the air-cells.

596. In infants, as M. Valleix has shown, life may sometimes be saved under the most desperate circumstances by passing the finger backwards to the epiglottis, and bringing away viscid secretions choking the air-passages. Prolonged insufflation of the lungs has also been employed with success, even where the infant had already fallen into a state of apparent death.⁴

(II.)—CHRONIC BRONCHITIS.

597. Chronic bronchitis, like the acute disease, varies greatly in severity.

598. *Symptomatic Varieties.*—I.—In one class of cases slight cough, with yellowish-white muco-purulent expectoration, moderate in quantity and easily voided, attended with little or no post-sternal

¹ Vide an interesting paper by Dr. Radclyffe Hall, "On the Action of the Muscular Coat of the Bronchial Tubes in Respiration."

² e. g. Murphy, U. C. H., loc. cit.

³ Med. Times and Gaz., May, 1856.

⁴ Union Médicale, Avril, 1852.

soreness or pain, affecting but very slightly the general health, appetite, and flesh, appearing in winter, and ceasing on the approach of the mild season, constitutes clinically the whole of the disease: this is the slightest form of "winter cough."

599. II.—In a second class of cases the cough is more violent, and more constant, severest in the mornings; the expectoration scanty and adhesive, or easy and copious—under the latter circumstances consisting of large nummulated masses, floating, semi-sinking, or sinking in water, non-aërated or scarcely aërated, ash-colored, yellowish-green, deep-green, or in very rare cases of a tint almost like Scheele's green, remaining separate, or forming a single liquid collection, slightly streaked occasionally with blood, when the cough is excessively violent, and especially if the left side of the heart be obstructed in the slightest degree, but never accompanied with actual hæmoptysis,¹ of peculiar nauseous odor, sometimes fetid, smelling like wet mortar, or putrescent matter—in rare instances, especially where the bronchi are dilated, evolving the same fetor as in gangrene of the lung. Such fetor may exist without destruction of substance visible to the naked eye; whether (I have not actually seen this) microscopical sloughs are separated in such cases, or whether rapid decomposition of the secreted fluids takes place immediately on their production, I am unable to affirm; the reality of gangrenous odor in the secretion of an unbroken surface is difficult enough of admission.² The varieties of tint are inexplicable by any character discernible either with the unassisted eye or microscope.

600. Microscopically, the sputa consist of epithelium, pus-cells, exudation-cells, and a few blood-disks. Exudation-matter in patches, sometimes exhibiting inclination to the moulded form, may occasionally be seen, on carefully disentangling the sputa, under water, either with the help of a common lens, or even with the naked eye.

601. There is no great pain, heat, or soreness in the chest, except after fits of coughing, when it is mainly post-sternal. The respiration ranges scarcely out of proportion with the pulse in frequency—both being raised, slightly as the habitual state, materially during and shortly after paroxysms of coughing, above the individual standard of health. The appetite fails, the sleep becomes broken, and flesh wastes very perceptibly: I have known as much weight lost during the first three weeks of an annual recurrence of chronic bronchitis, as during the same period in the average of cases of

¹ "Expectoration of blood, in persons laboring under chronic bronchitis, with or without emphysema, but without notable disease of the heart, justifies in itself a suspicion of the existence of latent tubercles." Author's Report on Phthisis, as observed at the Brompton Hospital; Brit. and For. Med. Chir. Rev., January, 1849.

² The odor is probably often merely simulative of that of gangrene. An analysis in the Edinburgh Laboratory, conducted at the request of Dr. Laycock, shows the presence of butyric and acetic acids and methalymine. (Med. Times, May, 1857.) But the precise chemical products probably differ in different cases.

consumption in active progress;¹—but in bronchitis the weight ceases to diminish after a certain time; in phthisis its diminution, though fluctuating according to laws as yet unestablished, holds on in the main.

602. Should an acute attack or severe exacerbation of the disease, particularly if it involve the capillary tubes, occur in a person afflicted with this serious variety of the chronic form, the expectoration becomes in part more viscid, transparent, and highly frothy for a variable number of hours or days; then, relapsing into the simply purulent state, grows so excessively abundant as in itself to account partly for the rapid debility that ensues. The labored respiration, hurried somewhat out of proportion to the pulse, lividity of the lips, malar bones, chin, tip of the nose and finger-ends, coolness of the hands, feet, and, it may be, of the extremities generally, clammy perspiration, sometimes rather copious, coolness of the expired air, inability to lie down, sensation of pulmonary oppression and want of air, all point to the asphyxiating character of the attack. Fitful dozes give but temporary relief to rapidly progressive exhaustion, and leading to accumulation of secretion, increase the suffering felt on waking. Here is a condition of extreme danger, principally observed in the aged (*senile* bronchitis and peripneumonia notha), and one of the most frequent causes of their death.

603. III.—In a third class of cases, the prominent feature of the disease is a peculiar flux from the bronchi,—whence the name *bronchorrhœa*. In this variety paroxysms of cough and dyspnoea, which may be of almost daily occurrence, or even more frequent, are relieved by copious expectoration of a thin watery fluid, or of a ropy, gluey, transparent substance, like raw white of egg mixed with water,—a quarter of a pint of this may be secreted in the course of half an hour on the decline of a paroxysm. Though sometimes fatal to old people, from their want of power to throw off the accumulated secretion, this form of disease seems occasionally useful, when slight, in relieving pulmonary congestion dependent on obstructive or regurgitant disease of the mitral orifice, and should not, under these circumstances, without mature consideration, be, at least completely, removed,—granting, *argumenti gratiâ*, we possess the power to effect such removal.

604. IV.—There is a fourth variety of chronic bronchitis, to which the rather contradictory name of *dry catarrh* was given by Laennec, characterized by exceedingly troublesome cough, oppression of breathing, tightness of the chest, and sometimes extreme dyspnoea; expectoration being totally deficient, or consisting of semi-transparent, small, gray, pearl-like, roundish particles. An attack of ordinary bronchitis, with muco-purulent secretion, may

¹ This important fact is a sufficient commentary on the published assertion, that the diagnosis of phthisis may be made with the balance.

occur in such cases, and put a period for a time to the chronic disorder. Pathologically dry catarrh seems to consist in active congestion of the tubes; clinically it is allied to, and often associated with, vesicular emphysema.

605. *Physical Signs.*—The physical signs of chronic bronchitis are essentially those of the acute disease. There are certain modifications worth attention, however, especially as no single specific sign, distinctive of the two forms, exists.

606. Taking the results of a mass of cases, the percussion-sound can scarcely be said, as a rule, to differ from that of health. If, on the one hand, congestion and thickening of the bronchial walls, coarctation of the tubes, and collapse of lobules or larger portions of lung tend to impair its fulness of tone, on the other, the existence of air distension and emphysema tend to augment the average resonance. Local accumulation of secretion and obstruction sometimes render spots more or less toneless one day, which the next recover their normal resonance. But it must be remembered, that the percussion-sound at the posterior bases, in cases of chronic bronchitis with acute recrudescence, may acquire all the characters of the dull type [195]; and the respiration become high-pitched, and of bronchial or even diffused blowing quality. I have known this state mistaken both for pneumonia and for pleuritic effusion. When, as sometimes happens, one side only is thus impaired in resonance, the error is very easily committed, and probably furnishes a clue to the alleged enormous frequency of fatal pneumonia among the aged population of certain localities.

607. Chronic bronchitis tends to distend the lungs *generally* (though from bronchial obstruction in some spots, it may have the reverse effect on them *locally*), and hence to widen the chest, and even depress somewhat the heart and diaphragm. But it is very difficult to demonstrate to what amount bronchitis alone is capable of carrying these changes; it is so constantly associated with their more active and positive cause—emphysema [477].

608. The respiration-sounds vary in force and quality widely in different parts of the same lung. The quantity of the respiration falls on the whole greatly below the average; harsh and coarse, the loud inspiratory and expiratory sounds audible in some spots differ wholly in character from those of true exaggerated respiration, are probably produced in the capillary and larger tubes, and resemble dry rhonchi in properties (sonoro-sibilant respiration). Full respiration will sometimes become audible, after free expectoration, in a spot where a moment before none, or next to none, could be caught. True blowing respiration is never heard in bronchitis. The rhonchi are those of the acute disease; the vocal resonance variable,—either feeble, or weakly, or strongly, bronchophonic.

609. *Anatomical Characters.*—Anatomically, the disease is known by discoloration of dull red tint, grayish or brownish, of the mucous membrane, evenly or patchily arranged, with a congested,

widened, and sometimes varicose state of the fine and capillary vessels, unevenness of the mucous membrane and epithelial abrasion. The walls of the tubes are thickened and hard, from infiltrated induration-matter, which sometimes extends beyond them, and encroaching on the adjacent lung-substance, obliterates its capillary vessels. The pressure of this matter diminishes the calibre of the tubes, both directly and indirectly by circular constriction; and actual obliteration of the finer bronchi may occur, where in addition exudation-matter has hardened in patches on their internal surface. Neither ulceration nor sphacelus, visible to the naked eye, belong to simple chronic bronchitis. The longitudinal and circular muscular fibres are sometimes much hypertrophied. The cartilages of the larger tubes occasionally calcify.

610. In the acute disease the bronchi may, as we have seen, undergo dilatation,—the more readily, the younger the individual. There is every reason to believe that, with the recovery of the tone of the bronchial muscles, the tubes gradually resume their natural form. I have seen cases of intense bronchitis in childhood, lapsing into the chronic state, and attended with signs apparently depending on widening of the tubes, which signs have gradually and totally disappeared. So likewise in the chronic disease, the bronchi sometimes dilate; but, once established, the dilatation remains a permanent evil¹ (*vide* Dilatation of the Bronchi and Cirrhosis of the Lung).

611. *Diagnosis.*—Pleurisy and pneumonia can only be simulated by chronic bronchitis in those comparatively rare cases, where the percussion-sound loses tone at one or both posterior bases [606]. Now the persistence of vocal fremitus will habitually distinguish the toneless sound of bronchitis from that of effusion; the deficiency of true tubular metallic breathing from that of pneumonia. In the latter case, too, the pulse-respiration ratio may be appealed to with confidence; it is never perverted, even in this *accumulative* bronchitis, to the degree that it is in pneumonia: besides, though the vocal resonance may be strongly bronchophonic, it is not tubular, sniffling, and metallic, and there is neither rusty expectoration, nor acrid heat of skin.

612. The real difficulty in diagnosis consists in the distinction between certain cases of chronic bronchitis and phthisis; as the difficulty especially arises, where dilatation of the bronchi exists, I defer to the history of this disease the consideration of the point.

613. *Prognosis.*—Chronic bronchitis is rarely got rid of completely by persons of middle and advanced age, in whom it has recurred for more than one or two winters; in the comparatively young, especially if circumstances allow of their moving to an appropriate climate, it may be radically cured, in some of the number so long

¹ Osmond, U. C. H., Males, vol. iv. p. 343.

as they remain in that climate, in a yet more fortunate few, even when they return to the soil where they were originally seized.

614. Chronic bronchitis can scarcely be correctly said to kill *per se*; but it certainly paves the way for death in multitudes of aged persons—the immediate cause of the fatal event being an acute attack of general or capillary inflammation of the tubes. I am aware that in cases of this class terminating fatally, the result is commonly held to be immediately brought about by pneumonia: a notion derived sometimes from the occurrence of dulness under percussion at one or two bases, sometimes from *post-mortem* examination—sometimes from both sources. I have already pointed out the source of fallacy in the percussion dulness referred to [606]; and I have great doubts of certain consolidations found after death (*peri-pneumonia notha* in more senses than one) being truly pneumonic. It has not occurred to me to meet with such consolidation, except where there was coexistent heart-disease, and more especially of the mitral orifice—consolidation hence mechanically, and not actively congestive. Sometimes there is mere collapse.

615. *Treatment.*—In the treatment of chronic bronchitis, whether accompanied or not with dilatation of the tubes, it is very rarely advisable to take blood from the arm, even during acute exacerbations; the strength fails rapidly in such cases from loss of blood; and to bleeding at the outset, rapid asphyxia at the close, from inability to expectorate, may often be traced. A few ounces, say, in ordinary cases, about four or five, taken locally by leeching or cupping, are as much as may be abstracted without fear. Free dry cupping, with flying blisters applied occasionally to different parts of the chest, are among the most effectual means of counteracting the ill effects of acute exacerbations.

In the purely chronic state, counter-irritation, with tartar emetic, croton oil, or the turpentine and strong acetic acid liniments, is essential in the treatment, unless emaciation be very far advanced, or the skin peculiarly irritable. The inhalation of tar vapor, creasote vapor, iodine, or chlorine, most unquestionably reduces the irritability of the mucous membrane, and the quantity of secretion; the results of M. Cottereau, with chloruretted inhalations, are peculiarly important, and show, as admitted by M. Louis, that singular advantage may be obtained through them, even where the general symptoms closely simulate those of phthisis. Of the remarkably beneficial effects of creasote vapor, in particular, I can speak with confidence; the cases are rare where it fails to agree from the first; but in very irritable constitutions the mucous membrane may gradually be prepared for it by the inhalation of extract of hyoscyamus, or conium. If there be spasmodic tendency, the latter drug may be rendered powerfully antispasmodic and sedative by the addition, on the instant of use, of a few drops of liquor potassæ.

616. The choice of internal remedies will vary with the condition of the discharge from the tubes, and the amount of general reaction. If there be little expectoration, an excited circulation, and a tendency to congestion of the parenchyma, tartar emetic in small doses, ipecacuanha, or colchicum, are the best agents, combined variously with hydrocyanic acid, lobelia inflata, belladonna, stramonium, hyoscyamus, paregoric or similar agents.

617. In a few cases, where great dyspnoea and arrested secretion pointed to the existence of abruptly acute congestion, I have seen mercury very rapidly lower the circulation, and induce free discharge. But, as a rule, mercury has not appeared to me serviceable. If there be but little vascular excitement, squill, senega, ammoniacum, with opium, are preferable combinations. Balsam copaiba and the compound tincture of benzoin may be joined to these stimulants,—the former especially seems to exercise a specific soothing effect on the mucous membrane. Muriate of ammonia has appeared to me useful in two apparently opposite ways,—by promoting expectoration where deficient, by controlling its amount when excessive. Medicinal naphtha will also produce this latter effect; so abruptly, indeed, sometimes, that I have known slight hæmoptysis ensue—only, however, in persons obviously or probably tuberculous.

618. Iodide of potassium, in sufficient doses to produce slight iodism, occasionally relieves the dyspnoea and chest-oppression to a very striking degree;—in such cases does it promote absorption of exudation-matter?

619. From ordinary alkalies I have seen no positive benefit, except where the individual was of rheumatic or gouty diathesis; and then the accompanying bronchitis was not, properly speaking, of the simple variety now under consideration. Where the latter diathetic vice exists, small doses of colchicum are distinctly beneficial. Sulphur in small non-aperient doses is held by some persons to exercise specific influence on the disease: the undoubtedly favorable effect of certain sulphurous mineral waters seems to explain this belief.

620. Various forms of dry inhalation are recommended. I have certainly, in strumous person with copious expectoration, and not advanced in years, seen favorable effects from the inhalation of vaporized iodine, in the manner to be described under the head of phthisis, though never such striking results as in some rare cases of the latter disease.

621. The jellies made from Iceland and Carragheen mosses both soothe the cough and afford nourishment. If emaciation occur, cod-liver oil should decidedly be employed;—many of the good effects of the oil, as observed in phthisis, are yet more readily produced in chronic bronchitis. Bark and the mineral acids are useful in controlling debility, and improving the appetite: if anæmia supervene, iron becomes essential.

622. The diet should be nutritious and non-stimulant. The pitch-water, recommended by Laennec for ordinary drink, mixed or not with milk, is certainly deserving of more extensive use than it has met with in this country—especially if general experience ratify his assertion, that it has occasionally actually cured the disease.

623. During the winter months in this climate, a steady temperature of 63° to 65° Fahr. should be maintained indoors; and the mouth and nose protected by a respirator, or otherwise, out of doors.

624. Where circumstances permit, change to a more genial climate, either for the winter or permanently, coupled with the use of certain mineral waters, furnishes the most effectual means of relief and cure. The mean temperature of the locality chosen should be some degrees higher than any attainable in this country;¹ the principles of correct selection are explained in the Appendix.

625. During the paroxysm of *bronchorrhœa*, the hot bath, or hot air-bath, sinapisms to the extremities, emetics, full doses of lobelia inflata, and, if there be failure of vital power, sesquicarbonate of ammonia and brandy, are the chief remedies.

626. The system of injection of the bronchial tubes with solution of nitrate of silver, is considered in the Appendix.

627. In the treatment of an acute attack, supervening on the chronic disease in a person of advanced years, the caution already given as to blood-letting in simple acute asphyxiating bronchitis, seems to me of yet greater importance. Here it is not the inflammation that kills; it is the vast accumulation of muco-purulent secretion supplied by a congested surface—secretion which prevents oxygenation of the blood, and which the strength of the patient fails to throw off—that really destroys life: the brain and tissues become poisoned, too, with venous blood. Sesquicarbonate of ammonia is, in such cases, required almost from the first: it is best given in combination with squill and nitric ether. If any sinking tendency appear, chloric ether acts as a more powerful general stimulus in these cases than any medicine I am acquainted with: but brandy and wine are more agreeable excitants, and quite as efficacious. Nux vomica and galvanism are worthy of trial as direct stimulants of the muscular coat of the bronchial tubes; and congestion might be relieved by the application of Junod's apparatus to the lower extremities.

¹ This statement accords with general experience; yet, on theoretical grounds, breathing air, for an hour at a time, artificially lowered in temperature to 50° or even 40° Fahr., has been seriously recommended and employed by Dr. Drake, of New York. I am not aware of the system having been tried in this country.

(III.)—VARIETIES OF BRONCHITIS.

628. The varieties of bronchitis may be classified as follows:—

Varieties dependent on—

- | | |
|-------------------------------|--|
| 1. Period of life . . . | Bronchitis at birth; infantile; adult; senile. |
| 2. Nature of secretion . . . | Dry; serous; muco-purulent; plastic. |
| 3. Nature of cause . . . | Mechanical bronchitis; hay-asthma. |
| 4. Amount of prevalence . . . | Sporadic; epidemic (influenza). |
| 5. Association of spasm . . . | Hooping cough; asthmatic bronchitis. |
| 6. Secondary origin . . . | Secondary to— |
| | General diseases. Typhoid and typhus fevers; the exanthemata. |
| | Blood diseases. Syphilis; gout; rheumatism; Bright's disease; glycohæmia; scrofula; jaundice; scurvy; purpura; cancer. |
| | Local thoracic diseases. Tubercle, cancer, chronic inflammation of the lung; heart disease; aneurism of the aorta, &c. |

629. The peculiarities of some of these varieties have already been referred to; influenza and hooping-cough are elsewhere described; a few of the others will be specially considered here.

A.—PLASTIC BRONCHITIS.

630. We have already seen that plastic exudation-matter forms, though to a limited extent, in simple bronchitis; the profuse production of such matter distinguishes one variety of the disease, which is probably, though not demonstrably, dependent on a peculiar diathesis. For, in truth, of particular causes nothing is known. The affection occurs with not very unequal frequency in both sexes, with a slight excess in females, and at all ages. The immediately exciting causes are those of simple bronchitis; why, then, is the secreted product different? There seems reason to believe the disease more common in this country than on the continent.

631. An affection of great rarity, true plastic bronchitis is anatomically characterized by the formation of solid or tubular, stratified or non-stratified, concretions of exudation-matter of low type² within the bronchial tubes, reaching, more or less extensively, from their finest to their largest divisions. The disease has little tendency to spread upwards: the trachea remains unaffected; the voice, though sometimes becoming slightly husky, habitually retains its natural quality and strength. On the other hand, plastic inflammation extends downwards from the larynx to the bronchi in a certain proportion of cases of primary croup and also from the throat and larynx in diphtheria;³ but with these cases we have nothing to do here.

¹ Suggested (from γλυκὺς—ζίμα) as a substitute for "saccharine diabetes."

² I have found them to contain exudation-cells; some nucleated, the majority not so. In the main, the substance is fibrillar or amorphous.

³ Wodger, U. C. H., *Females*, vol. xv. p. 39. In this instance the diphtheritic exudation spread from the throat to the third divisions of the bronchial tubes.

632. Although not unknown as an acute disease, especially in infants, in whom it may run its course, and disappear (as it proves, permanently,) at the end of ten days, or a fortnight, clinically plastic bronchitis is especially distinguished by its chronicity, its frequent acute broncho-pneumonic recrudescences, and its comparatively slight influence on the general health. In one case, which I have long had under occasional observation,¹ expectoration of casts commenced in the spring of 1843, and with occasional brief intermissions, continued up to the time the patient, a young female, was last seen, June, 1857. Between 1850 and 1857, she had married, but without any consequent change in the bronchial disease.

633. *Physical signs.*—The dry rhonchi of simple bronchitis, mixed to a small extent with the moist, may be heard from place to place. But there are also peculiar physical signs; disappearance of all respiratory sounds, in given spots of the lung from time to time, marks complete obstruction of a large communicating bronchus—and dulness, as complete as in pneumonic consolidation, probably from collapse of the lung-substance, may occur co-extensively with the deficiency of respiration, as I had repeated occasion to observe in the instance just referred to. Local pneumonia, attended with pain, rusty, viscid expectoration, true crepitant rhonchus, and blowing respiration, also occasionally occurs in these cases—generally speaking, running its course uninfluenced, at least perceptibly, by ordinary treatment. Where a very large tube chances to be blocked up, asphyxia may be temporarily threatened;² and oppression of breathing, disproportionate to the apparent amount of disease, is always a prominent symptom.

634. *Symptoms.*—The expectoration of the casts is generally preceded by some hours' dyspnoea and hacking dry cough; and during the periods of acute attack, I have found the pulse-respiration ratio vary from 2.2 : 1 to 3.5 : 1. During these attacks, casts of notable size are brought up, generally from three to six or seven times a week—but small fragments are much more frequently expectorated.

635. The expectoration of casts may go on daily without causing any notable suffering—if the size be small, and the processes of detachment and expulsion easy. Unless the sputa be closely examined under water, particles of concretion escape notice amid the viscid mucus with which they are generally associated.

636. Streaks of blood, either on the external surface of the casts, or, more rarely, on their internal surface, if they be tubular, are not uncommonly seen; and spitting of florid blood in streaks, or even in drops, mixed with mucus, for a short while after their expectoration, occasionally occurs. This is especially the fact at the height of the acute attack. As this wears off, the concretions and the expectoration become bloodless.

¹ Moss, U. C. H., *Females*, vol. i. p. 187 (1846), and vol. iii. p. 83 (1848).

² U. C. Museum, No. 2124. Numerous other specimens exist in the collection.

637. Some very rare cases have, besides, been observed, in which copious hæmoptysis had occurred for some time previous to the expectoration of solid casts of the tubes. The nature of these cases, however, requires further investigation. It appears very unlikely that they belong to the same class as true plastic bronchitis; the concretions are most probably simple fibrinous coagula from hæmoptoic blood, itself the result of tuberculous disease. In no case of the kind that I have read the record of, was the absence of tuberculous disease proved; and, on the other hand, the occurrence of moulded coagula in tuberculous hæmoptysis, though, for obvious reasons rare, is sometimes (I have seen it myself) positively observed.

638. *Treatment.*—In the acute disease in childhood the free use of emetics, antimony or ipecacuanha, has been strongly advised; but, so far, advised on purely theoretical grounds; for I can trace no evidence of their special utility in records of observed cases. It seems to me, that in the present state of knowledge we have no trustworthy guide to deviation from the ordinary practice in acute bronchitis. It would be well, as in cases of croup, to keep the atmosphere of the room saturated with moisture.

639. Similarly, during the period of acute seizures in the course of the chronic disease, the treatment, so far as I know, should be conducted on the same principles, as if the secretion-products were of the ordinary kind. I have not seen any benefit derived from mercurial action on the system. Mischief may readily be done by an over-active treatment designed to control an imaginary pneumonia. The young practitioner must not confound the local dulness under percussion, which may come on in a few hours in these cases, as a result of obstruction of tubes, with true pneumonic loss of resonance. The weak or suppressed respiration of the former condition, the tubular blowing of the latter, will distinguish the cases.

640. And in the intervals of these acute seizures can any effectual measures be taken either to prevent their recurrence, or to insure secretion of different type, if the bronchial tubes must needs become, every now and then, inflamed? I believe few affections of the lungs are more difficult to cure permanently than this. Theory leads to the use of iodine by inhalation and otherwise, and suggests a prolonged trial of alkalies and their carbonates as diminishing the tendency to hyperinosis. But I have perseveringly employed these remedies without any enduring effect on the disease. It disappears for a time, to return again without obvious cause—a mode of progress which can only be plausibly referred to the influence of a persistent diathesis. I should have supposed a well-selected climate must have exercised a modifying influence on the distinctive peculiarity of the disease: now, chance brought the young woman, above referred to, to Buenos Ayres (a climate of almost unequalled salubrity in regard of bronchial affections); but

a sojourn there of four months, while it improved her breathing, strength, and general health, did not prevent her from frequently expectorating bronchial casts.

B.—MECHANICAL BRONCHITIS.

641. Under this head fall those well-marked varieties of bronchitis induced by the inhalation of irritating particles of various kinds. The "knife-grinders' rot" is primarily mere bronchitis produced by the entry into the tubes of metallic particles and gritty dust from the grinding-stones. Miners (whether coal or other), not, as was once erroneously supposed, from the inhalation of coal-dust, but really from that of the soot of the oil lamps used in working, where the safety lamp is not employed, are subject to a similar disease; so, too, are quarrymen, cotton-batters,¹ &c. In all these cases the disease (grinders' rot, black phthisis, stone phthisis, cotton phthisis, &c.) is essentially bronchitis at the outset, which becomes chronic, is followed by dilatation of the tubes, and, eventually, inflammatory destruction and excavation of the lung-substance itself. But there is no connection between this destruction and the presence of tubercle—which, if it exist, is purely accidental.

KNIFE-GRINDERS' DISEASE.

642. Here the physical signs are those of bronchitis, dilated bronchi, occasionally of emphysema, of consolidation, and, finally, of excavation. The general symptoms are not proportional in severity to the local disease; whence a distinction between these affections and phthisis. The knowledge of the cause also aids in the diagnosis—though, on the other hand, it may tend to deceive, as these artisans very certainly are not exempted from consumption.

643. Cure is impossible, unless the patient change his occupation. Various mechanical contrivances have been invented for the prevention of the disease. Abraham's magnetic mouthpiece attracts metallic particles, but has no effect on the stone-grit. Dr. C. Holland's revolving fan, acting by a strong current upon the spot where the metallic dust and stone-grit are formed, seems to be more successful.

CARBONACEOUS BRONCHITIS, OR BLACK PHTHISIS.

644. The most interesting variety of bronchitis of the present

¹ It is remarkable enough that the operatives in the cotton-mills near Vienna enjoy better health than the general mass; the annual deaths in the general population being 1 in 27, in the manufacturing class 1 in 30. (Chadwick's San. Rep. p. 114.) Villermé found in France that neither carders, spinners, combers, nor winders, appear more subject than others to particular diseases; but batters of cotton, inhaling much dust and flue, do get the so-called cotton-pneumonia and cotton-phthisis.

class is undoubtedly that observed in miners, and described under the title of "Black Phthisis."

645. Originally observed in coal-miners, this affection was long supposed to be due to inhalation of coal dust. Mr. Graham² was the first, as I believe, to show that, common to miners of all kinds, it really depended essentially on inhalation of the smoke from the lamps suspended from the miners' heads while at work. To this cause Dr. Makellar adds the inhalation, in confined mines, both of the carbonic acid generated in the pit and of that expired by the laborers themselves, and also the inspiration of carbon and carburetted gases, which float in the heated air after explosions of gunpowder required in the works.

646. Anatomically it is found the carbon accumulates in the minute bronchial tubes, and obstructs these and the connected cells; irritation sets up in the parenchyma around; softening sooner or later occurs; the pulmonary tissue breaks up, and cavities, eventually of large size, from union of adjoining smaller ones, form.

647. Not only does this form of irritation not predispose to tubercle, but the carbonaceous disease seems actually to antagonize genuine phthisis. Dr. Makellar not only never found tubercle in the bodies of colliers cut off by the disease, but observed that many of the number had relations, not miners, destroyed by pulmonary consumption [1457].

648. But the lung itself produces carbon, once the impulse has been given by the free inhalation of lampblack. Years after the occupation of mining has been relinquished, the amount of lung involved by carbonaceous deposit continues to increase. The lung becomes, to use the emphatic expression of Dr. Makellar, a "manufactory of lampblack."

649. The carbonaceous matter in advanced cases impregnates the blood: this resembles thick brownish ink, flows sluggishly, and but feebly stimulates the heart and system at large.

650. *Symptoms.*—In the early period of the disease, incessant dry cough, and other bronchitic symptoms attract attention—slight palpitation and acceleration of pulse. The respiration-sounds are loud; dry bronchial rhonchal sounds abound. The percussion is as yet unaltered.

651. At a later or second stage, when softening has commenced, most distressing cough, expectoration of black matter,³ and dull percussion-sound, without bronchial respiration, may be substantiated.

652. In the third stage signs of excavation ensue.

¹ Makellar, Edinb. Monthly Journal of Med. Science, 1846. To this very complete monograph I beg to refer for further information.

² Edinb. Med. and Surg. Journal, vol. xlii.

³ In one case Dr. Makellar continued to collect weekly (for some weeks) nearly two ounces of carbon, precipitating in water from the associated bronchial secretion.

653. Rapidly decreasing frequency of pulse and systemic exhaustion are the most striking general symptoms. The course of the affection is essentially chronic, lasting generally some years.

654. In some rare instances the disease closely simulates true phthisis in its symptomatology. There may be cough and expectoration, dyspnoea, thoracic pain, colliquative sweats, and great emaciation; but in a case of this stamp, seen by Dr. Makellar, a broad distinction was drawn by the fact that the pulse beat but thirty-six per minute.

655. *Treatment.*—Removal from the occupation will save life if the change be effected while the disease has not passed the earliest stage.

656. The attempt to relieve urgent symptoms by venesection has proved a signal failure—such loss of blood producing “general debility and rapid sinking.”

657. The most important prophylactic measure consists in free ventilation of the pits. The use of some other lighting material than oil is also called for. There is reliable testimony that where these precautions are taken, especially the former, the disease is unknown.

C.—HAY ASTHMA.

658. A singular variety of naso-pulmonary catarrh, which has been supposed to follow the inhalation of the aroma of the sweet smelling spring grass and hay (*anthoxanthum odoratum*) is known under the name of hay-asthma, hay fever, or summer catarrh. The complaint occurs only at the periods of hay making, or when the odor of parched grass is powerful; and is of exceedingly rare occurrence. The susceptibility to these emanations, indeed, constitutes a very remarkable example of unalterable idiosyncrasy. Persons who have once suffered, invariably have a return of the disease, if exposed, even in a slight degree, to the specific cause.

659. Besides, the perfumes of various flowers and the powder of ipecacuanha, produce, in persons peculiarly constituted, symptoms very closely similar.

660. It is scarcely correct to term the disease bronchitis; the entire naso-pulmonary tract is, in truth, implicated. Mid-frontal cephalalgia, violent and continued sneezing, irritation in the eyes and nostrils, with flux; soreness and prickling sensations in the throat; dyspnoea, sometimes paroxysmally severe; post-sternal oppression and rawness; dry, harassing cough; and, towards the close of a seizure, thin mucous and watery expectoration, are the symptoms of the complaint.

661. If the affection be left to itself, its usual duration ranges from two to five weeks; but even in cases carefully tended, the symptoms may persist for a month. The annual return of the disease is one of its essential characters.

662. The most effectual means the habitual sufferer can command

of preventing an attack, is by removing at the season to the sea-side—by getting out of reach of the odors of grass and hay. But so exquisitely sensitive to such sensations are some individuals, that a land wind, blowing for a few hours only, will bring on an attack even at the sea-shore. Once the complaint is established, total abstraction of the existing cause will not put an immediate term to the seizure; I have had a very precise narrative of a case, in which the patient retained his symptoms during a passage across the Atlantic.

663. Several years since, a course of sulphate of iron and quinine and the use of the shower-bath, directed by Dr. Gordon,¹ removed the complaint in two persons who had been its annual victims for fifteen or twenty years. During the seizure, small, frequently repeated doses of prussic acid, and the ethereal tincture of lobelia inflata are valuable remedies; there seems, in truth, to be some spasmodic element in the disease. Dr. Elliotson believes he has observed benefit accrue from breathing an atmosphere with chlorine diffused through it—saucers of the chlorides being placed in the rooms of the patient's house, and the face washed with a weak chlorinated solution. I am disposed strongly to recommend a trial of creasote-inhalations, one or twice daily, from their remarkably satisfactory effects in two instances.

664. Are there any drugs having specific influence on the complaint? Dr. Watson recommends arsenic; Mr. Hamerton and Dr. Gream nux vomica. I do not question the occasional utility of either: but I have known arsenic fail egregiously, where it was administered under circumstances peculiarly favorable to fair trial; and I am informed that nux vomica cannot be depended upon. There can be no doubt that all general tonic measures calculated to invigorate the system, and lessen the special susceptibility of the mucous membranes, as advised by Dr. Gordon, are rationally indicated. They will, however, prove wholly incapable, in a good proportion of cases, of averting the returns of the disease.

D.—BRONCHITIS SECONDARY TO GENERAL DISEASES.

665. Symptoms of bronchitic character occur in the great majority of cases of continued fever of "typhoid" type—that is, characterized by alteration of the glands of Peyer.

666. Commonly unattended, as it is, with intra-thoracic pain, or accelerated breathing, and causing little cough and little or no expectoration, it follows, that generally-diffused dry and moist bronchial rhonchi, especially the former, supply under the circumstances the sole evidences of inflammatory affection of the tubes. The actual inflammation is evidently very slight. The disproportion between the amount of rhonchi on the one hand, and of the cough

¹ Medical Gazette, vol. iv.

and dyspnoea on the other, might, according to M. Louis,¹ be fairly used as an element of diagnosis, and argue for the secondary character of the existing bronchitis.

667. In "typhoid" bronchitis of this class the state of the bronchi is unimportant in regard of treatment. But in comparatively rare instances, severe bronchitis, with extensively diffused fine bubbling rhonchus, accelerated breathing, and free expectoration, occurs, throwing into the shade the more ordinary characters of the fever. Counter-irritation and soothing, or eventually stimulant, expectorants are, however, solely required, even in this severer class of bronchitic cases. Singularly enough, there is no special tendency to accumulation of secretion in the tubes.

668. The precise researches of Dr. Jenner show that there is less tendency to bronchitis in the "typhus," and still less in the "relapsing," than in the "typhoid," types of continued fever.

E.—BRONCHITIS SECONDARY TO BLOOD DISEASES.

669. Bronchitis dependent on blood-diseases is characterized as a rule by its pertinacity, and its resistance to ordinary antiphlogistic treatment. The measures adapted for its relief and cure are substantially those most appropriate for the existing diathesis. Need it be said that bleeding and antimony are not the means by which scorbutic or purpuric bronchitis is most effectually to be controlled: that, where jaundice or glycohaemia exist, those agents are inappropriate? Even in gouty and rheumatic bronchitis and in that attending Bright's disease, the antiphlogistic plan is of subsidiary importance, and only directly applicable, where the inflammatory action is of extreme violence and assumes the importance of an idiopathic disease.

670. In bronchitis of blood-origin the sputa very constantly contain some of the *materies morbi* circulating with the blood. Thus in icteric bronchitis the coloring matter of the bile often tinges the expectoration—sometimes deeply enough to be visible to the naked eye, sometimes so slightly as to require micro-chemical examination for its discovery. Blood-disks escape with the secretion of purpuric and scorbutic bronchitis; sugar has been discovered in that of the glycohaemic or diabetic variety;² and it is probable undecomposed urea is sometimes expectorated in uraemic bronchitis.

671. We must content ourselves with these general indications of the peculiarities of bronchitis dependent on blood-diseases, and with a brief description of the syphilitic variety.

F.—SYPHILITIC BRONCHITIS.

672. That the virus of syphilis may affect the bronchi, has been made very evident by the inquiries of Drs. Graves, Stokes and

¹ Affection Typhoïde, vol. ii. p. 283. 1ère édit.

² Francis, Lond. Med. Gaz., Feb. 1847.

Munk. It appears that a certain time after infection, febrile action and bronchial irritation occur in a variable number of cases, as preludes to cutaneous eruption, disappearing wholly or partly when this is established; and, conversely, if a syphilitic eruption suddenly disappear, spontaneously or through treatment, bronchitis may ensue.

673. Under these circumstances, the diagnosis is easy. But persons, poisoned to the secondary and tertiary degrees by syphilis, may have chronic bronchitis, as a persistent state—they may cough, have sero-purulent and muco-purulent expectoration, nocturnal perspiration, and hectic fever, while they rapidly lose flesh and strength; and no tubercle shall exist in the lungs. Yet here is assuredly enough to create a strong suspicion of its existence taken in conjunction with the indubitable tendency of syphilis *plus* mercury to induce the outbreak of phthisis in a person having the requisite constitutional aptitude. How are the cases to be distinguished? By the total want of accordance between the physical signs and the constitutional symptoms; the patient with syphilitic bronchitis has neither consolidation-signs, nor, *à fortiori*, the evidences of excavation. But there is a curious source of difficulty, which sometimes starts up in these cases, and renders doubt imperative: the infra-clavicular ribs and clavicle thicken from periosteitis, and produce dulness under percussion, which cannot with positiveness be distinguished from that of tubercle within the lung. Here the observer must wait for events to clear up the diagnosis.¹

674. In managing this variety of bronchitis, the whole secret consists in having proper regard to the existing diathetic state. Ioduretted inhalations are serviceable.

G.—BRONCHITIS SECONDARY TO CHEST DISEASES.

675. The clinical features of bronchitis thus produced will be sufficiently described with the various pulmonary and cardiac diseases originating it.

II.—ORGANIC CHANGES OF THE BRONCHI.

(I.)—NARROWING AND OBLITERATION OF THE BRONCHI.

676. Narrowing and obliteration of the bronchi, a not uncommon phenomenon in tubes of very small calibre, becomes rarer and rarer in the direct ratio of their increase in width; still

¹ Smedley, U. C. H., *Females*, vol. i. p. 143 (1846). When admitted in 1846, this woman, in addition to secondary and tertiary syphilis, and cancer of the rectum, had bronchitis and very slight dulness, with harsh respiration, under the right clavicle; but as the subjacent bones were obviously thickened, I abstained from giving any positive opinion as to the existence of consolidation of the lung. The chest-symptoms totally disappeared for the time under treatment. I have frequently seen the patient since; consolidation-signs, growing at each interval more marked, had become positive at both apices when I last (winter of 1850) saw her.

obliteration, even of the main trunk, has occasionally been witnessed.

677. Obliteration sometimes exists in the same tube as globular dilatation,—immediately beyond this on the side furthest from the trachea.

678. The obstruction may depend on *intrinsic* or *extrinsic* causes. Among the former rank thickening of the mucous membrane; stagnation of secretions, especially of the plastic kind (under both these circumstances the obstruction is of acute and inflammatory mechanism); great thickening of the bronchial walls with induration-matter or fibro-plastic substance; and, lastly, accumulation of cancer or tubercle in their interior. Among the latter class of causes, acting by *extrinsic* pressure, appear adjacent emphysema, adjacent tuberculous deposit, plastic contractile exudation-matter, infiltrated cancer or chronic solid pleural formations. Enlarged bronchial glands, aortic aneurisms, and mediastinal tumors frequently produce partial, and have sometimes effected complete, closure of a main trunk by pressure.

679. If serious obstruction of a large bronchus, by its own secretions, occur suddenly, or even with notable celerity, dyspnoea, proportional to the size of the implicated tube, follows. And as this accident has chiefly occurred in cases of bronchitis either capillary [559] or plastic [633], where the efficient breathing surface had already been seriously diminished, risk of fatal asphyxia is incurred, unless the patient retains strength sufficient to enable him to expectorate the stagnating matters: the relief experienced after such expectoration is almost assimilable to that following tracheotomy for obstructed larynx.

680. But if the obstruction be on a small scale, or if a large tube suffer only from slow, gradually increasing obstruction, there will be no positive subjective or objective symptoms to indicate the occurrence. Such dyspnoea, as is really dependent on obstruction of the kind, appears explicable by other conditions; and neither cough nor pain in the chest, to an amount unusual to the patient, are induced.

690. The physical signs may or may not be satisfactory. Obstruction of the main tube entails collapse of the entire lung, as is well shown in one of Sir R. Carswell's published drawings;¹ while obstruction of minor tubes, as insisted on by Dr. Stokes, produces local and limited collapse,—the surface of the lung in the affected parts appearing sunken in below the plane of the surrounding pleura. Now, in both these varieties, percussion-dulness, proportional to the superficial area and depth of the collapse, might be expected to exist. But in the local variety, emphysema tends to

¹ Fasc. Atrophy, pl. iv. fig. 3. The lungs are those of a monkey; the cause of obstruction, extensively tuberculized bronchial glands. Atrophy of the pulmonary substance from inaction would doubtless ensue after a time.

spring up on the confines of the collapsed spots, and give rise to its own special exaggerated resonance. While, in the case of serious reduction of calibre of the main tube by tumor or aneurism, I have not actually ascertained the reality of the impaired resonance theoretically to be expected (but, in truth, there are here many conflicting elements at work); on the other hand, I have found, and been aided in diagnosis by, the inability of the patient by the greatest inspiratory effort to extend the area of pulmonary percussion-sound [227].

691. The respiration is weakened, or, it may be, almost suppressed, and harsh. Sonoro-sibilant rhonchi are audible.

692. The main interest, in the present state of knowledge, of obstruction of a large bronchus, arises from the light it may throw on the diagnosis of thoracic aneurism and tumor.

693. The treatment of the affection is altogether that of the disease of which it is a sequence or effect.

(II.)—DILATATION OF THE BRONCHI.

694. Although we have no evidence that dilatation of the bronchi ever occurs as a primary condition of those tubes, and though, even as a secondary and consecutive change, it is on the whole a rare affection, still its study is of very considerable importance. For it appears in association with grave forms of pulmonary disorder, increases the danger of these, modifies their symptoms and signs, and frequently creates difficulty in their diagnosis.

695. *Anatomical characters.*—Dilated bronchi assume three different forms, *globular, uniform, and nodulated.*

696. (a) In the *globular* variety the dilatation is of rounded form, varying in size from a small nut to a large walnut, commonly communicating, on the tracheal side, with a portion of tube either of extremely or slightly widened calibre; while on the other side the continuity of the tube is lost, either from excessive narrowing or actual obliteration.

697. The walls of such dilated portions of tube, commonly thick, and exhibiting the several characters assigned to tubes affected with chronic bronchitis [609], are, on the contrary, in rare instances, thin and almost transparent.

698. The ordinary contents are muco-pus, or very pure pus in small quantity, the latter sometimes peculiarly fetid. They may be perfectly empty.

699. The distinction of a globularly dilated portion of bronchus from a tuberculous cavity is commonly easy. The broken, irregular, bridled surface of the latter; its investment with patches, more or less extensive, of exudation; the non-continuity of its walls with those of connected bronchial tubes; the irregularity of its form; the consolidation of the surrounding tissue, all contrast strongly with the converse conditions in a globularly dilated portion of tube. But in certain cases these marks of distinction may fail; a tuber-

culous cavity may have a perfectly even surface, almost perfectly globular shape, and the tissue around may be normal in consistence.¹ Under such circumstances the detection or non-detection of the microscopical elements of bronchial texture can alone settle the question. Aid may be derived from the presence of tubercle in other parts of the lung;² and also in the wall structure, which is the subject of debate.

700. Globular dilatations are generally few in number, but one or two specimens in one or both lungs: the number may be more, however. The surrounding tissue is either slightly condensed by pressure, hardened by chronic pneumonia, rarefied by emphysema, or perfectly natural.

701. (b) In the *uniform* dilatation a considerable number of bronchi is generally involved—the tubes, pretty evenly widened, after the fashion of the fingers of a glove (sometimes the widening actually increases at each remove from the main bronchi), abruptly terminate at variable distances from the periphery of the lung. The walls are invariably thick, sometimes cartilaginous. This is the form especially associated with cirrhotic infiltration of the lung.

702. (c) The *nodular* variety is a compound of the two others—general dilatation of the tubes with local slight globular fulnesses from place to place.

703. *Mechanism*.—As far as I am aware, M. Andral stands almost alone in the opinion, that dilatation of the bronchi may be a primary morbid state depending on a form of hypertrophy, and antecedent to cough or other bronchial disturbance of function.³ If such mechanism be ever real, its occurrence must at least be infinitely rare. Under ordinary circumstances in acute (and yet more in chronic) cases the elasticity of the bronchial tubes is destroyed, and their muscular contractility impaired [595] by inflammation; they hence yield *quassi*-passively to the distending influence of cough in expiration and of accumulated secretions. If there be much indurated tissue around the tubes, the deficiency of elastic reaction in the indurated substance facilitates the occurrence of dilatation (*vide* CIRRHOSIS OF THE LUNG).

704. Though commonly of slow, dilatation may be of rapid, development. In capillary bronchitis (primary, and attending influenza) the change is accomplished in the course of a week or two. And even where no such active influence is apparently at

¹ Facts, all of them, illustrated by the case of Denet, U. C. H., Males, vol. xiv. p. 255.

² Some writers speak of considerable quantities of tuberculous matter being occasionally found in dilated bronchi. I cannot help believing they have been misled by genuine tuberculous excavations of the exceptional characters just described.

³ M. Louis adopts a somewhat analogous view, that the dilatation is frequently the result of a force, such as presides over the development of hollow organs generally, in virtue of which they widen without the intervention of mechanical causes of any kind. (Mém. de la Soc. Méd. d'Obs., t. i. p. 254.)

work, general dilatation of the tubes may certainly be effected in the course of a month.¹

705. The conditions of disease to which dilated bronchi may form an adjunct are: bronchitis acute and chronic; emphysema; constriction of the tubes themselves; acute and chronic pneumonia; cirrhosis of the lung; phthisis; and chronic pleurisy with retracted side.

706. In the present place I shall consider the disease clinically, solely as an attendant on chronic bronchitis—in its other associations it will be found described with the primary diseases concerned.

707. *Physical signs.*—The bulk of a lung having a few of its tubes globularly, or many of them uniformly, dilated, may not be appreciably changed. Coexisting air-distension and emphysema on the one hand are counter-balanced on the other by condensation of lung-substance. If such condensation exist to a notable amount, instead of any tendency to local bulging, there may be distinct depression of the corresponding chest-surface. General falling in of the side is never observed in this form of dilated tubes.

708. Generally speaking, the vocal fremitus is increased in intensity, and may be greatly so; rhonchal fremitus, likewise, is sometimes very strong.

709. I have not actually met with dilatation of the tubes, or even of a single tube, if considerable in amount, without morbid percussion-note. Either there is high-pitched toneless sound [Type 1. 195], commensurate with the extent of attendant condensation; or some form of tubular resonance. In certain published cases, where the resonance is alleged to have been “clear” (and, by intended inference, healthy), the so-called clearness was doubtless of the latter unnatural quality: I have known it very purely amphoric. Still, were a globular dilatation very deep-seated, I can conceive the percussion-results being unaffected.

710. The respiratory sounds are simply harsh, or high-pitched and bronchial, or, more commonly, of diffused blowing type. When one or more tubes are largely dilated, the respiration may be loud, ringing, and distinctly cavernous in quality; and, under the same circumstances, the ordinary dry or moist bronchial rhonchi may be superseded by the dry or moist cavernous varieties. The vocal resonance varies: totally deficient in some cases, temporarily, or, to all appearances, persistently; in others it is strongly bronchophonic, and may even assume pectoriloquous quality.² The heart's sounds may be transmitted with undue intensity through the seat of dilatation.

711. *Symptoms.*—The addition of dilatation of the tubes to chronic inflammation of their mucous membrane, seriously increases

¹ See a most conclusive case in Louis, loc. cit. p. 246.

² Osmond, U. C. H., Males, vol. iv. p. 341, &c.

the gravity of the latter disease. Here it is that the expectoration is most abundant, most fetid, most opaque and solid, most thoroughly purulent, and hence most wasting to the system. The aëration of the blood is rendered difficult by the altered structure of the mucous membrane; hence lividity of the face commonly exists to a marked amount. The long continuance of the disease tends to produce enlargement and thickening of the right ventricle, but I have never observed hæmoptysis unless where there was coexistent mitral disease or pulmonary tubercle. Some degree of night-sweating occasionally occurs; and the weight of the individual falls very considerably below the standard of health.

712. *Diagnosis*.—This symptomatic state, far from dissimilar to that of phthisis, may coexist with physical signs, so like those of excavation, that it is next to impossible sometimes to affirm with certainty whether a given case be one of tubercle with cavity or cavities, or of globularly dilated bronchus or bronchi with surrounding induration.¹ The distinction may, however, in the majority of instances, be established by means of the following points. The percussion-sound is invariably morbid above the clavicle in cases of phthisis of the ordinary class; not necessarily so in those of dilated bronchi: hence natural resonance in this spot will argue strongly for the latter disease; but hard, toneless or tubular note will not decide the point against it.² Generally speaking, too, want of tone is more absolute and extensive below the clavicle in phthisis than in the other affection; for, if the bronchi be largely dilated and surrounded with much induration-matter, the resonance becomes tubular or amphoric. The signs of tuberculous excavation are found at the apex: those of dilated bronchus generally lower—say at the union of the upper with the middle third of the chest. When tubercle has reached the excavation stage, flattening of the infra-clavicular region is relatively to that of the side generally, more marked than in bronchial dilatation. I have never known hæmoptysis produced by chronic bronchitis with dilatation alone; if hæmoptysis exist, and there be no evidence of mitral disease, the inference that the excavation is tuberculous becomes matter of necessity. Extreme emaciation, profuse night-sweats, and obstinate diarrhœa, do not, as far as I have seen, come of the bronchial disease alone: all three may, however, be wanting in phthisis. The course of the physical signs will avail us also, if the case continue for a time under observation. In phthisis the signs are, as a rule, constantly increasing in degree and extent; in bronchial dilatation, they may remain for months unaltered in both these respects; dulness under percussion, as remarked by Dr. Stokes, precedes the signs of cavity in phthisis,

¹ Case lxi. of Louis, *Phthisie*, 2^{ème} éd. p. 562, is sufficient proof of this.

² Among Carswell's unpublished drawings (U. C. Mus.) is one of a globularly dilated bronchus, that must have given tubular percussion-note above the clavicle.

and does not occur till after them in bronchial dilatation; to the latter clause, however, I have seen exceptions.

713. In the remarkable case, a moment since referred to [699], the diagnosis, balancing between phthisical excavation and dilated bronchi, inclined to the latter, because the percussion-tone was very slightly changed in character. Tuberculous cavities are surrounded, in truth, as a rule, by indurated tissue, that deeply modifies the percussion-note. But in the case in question, the tissue adjoining the tuberculous excavations was normal—and the distinction of their nature proved almost as difficult after death as during life. The clinical error distinctly deposed in favor of the precision of physical diagnosis.

714. I once met with a case¹ where the conditions of bronchial dilatation were sufficiently defined to justify the diagnosis of that state—and where, after death, both bronchial dilatation and a small recent growing tuberculous excavation were found almost side by side. This compound condition is, probably, beyond the reach of diagnosis.

715. And, in point of fact, the association of dilated bronchi and tuberculization of the lung is by no means uncommon, due admission being made for the rarity, absolutely speaking, of the former. Tuberculous excavations and gray granulations may exist in the same lobe with globularly dilated bronchi;² or the former may affect the upper, the latter pervade the lower, lobe.³ Under these circumstances the dilatations might readily be taken for smooth-walled excavations [699].

716. The fetor of the sputa often suggests the idea of *gangrene of the lung*; nor is the distinction, which is elsewhere considered [1222], always so easy as might be wished.

717. *Prognosis*.—It has been conceded [610] that acute dilatation is probably curable; I know of no even seeming evidence of the curability of the chronic disease. The complaint may, however, endure for years.

718. *Treatment*.—The treatment is a combination of the local measures indicated in chronic bronchitis, and of the general appliances adapted to emaciating diseases, especially phthisis.

(III.)—TUBERCLE OF THE BRONCHI.

719. Tuberculous disease of the bronchi is limited to the finer tubes. The morbid deposit, as Carswell was the first to show, occasionally forms on the free surface of their mucous membrane: but he was in error in imagining this to be its essential seat in phthisis; and bronchial tuberculization, as clinically distinguishable from that of the parenchyma, is unknown.

¹ Ann Harrison, U. C. H., Jan. 22, 1848.

² Osmond, U. C. H., loc. cit. p. 343.

³ Maddox, U. C. H., Males, vol. ix. p. 240.

(IV.)—CANCER OF THE BRONCHI.

720. Primary cancer of the bronchi, or cancer affecting these tubes independently of similar disease in the lungs or mediastina, is not observed. But the following secondary forms of the disease are met with.

721. (1.) In certain cases of cancerous infiltration and ulceration of the pulmonary tissue, those morbid processes spread to, and cause the destruction of, the bronchial tubes involved. (2.) Perforation of a bronchus by a portion of actively growing tumor situated about the root of the lung, has occurred in rare instances; the perforating cancer vegetates freely in the anterior of the tube into which it has made its way.¹ (3.) More rarely still, a detached tumor forms in connection with the mucous membrane of a bronchus, the lung being similarly diseased. (4.) Cancerous substance may be found *in transitu* outwards from a softening pulmonary mass.

722. All these forms of disease derive their practical importance from their connection with cancer of the pulmonary substance, and therefore require no further consideration in the present place.

POLYPI OF THE BRONCHI.

723. True pedunculated polypus, invested by mucous membrane, has in very rare instances been found in the bronchial tubes. The clinical history of such formations is a blank.

SECTION III.—DISEASES OF THE BRONCHIAL GLANDS.

I.—INFLAMMATION OF THE BRONCHIAL GLANDS.

724. Inflammation of the bronchial glands anatomically characterized by enlargement, softness, redness, infiltration with exudation-matter, and sometimes with pus, is a state very rarely observed. Such inflammation occasionally coexists with pneumonia.

725. Mediastinal abscess sometimes originates by inflammation in the substance of these glands; and as this is the only aspect under which I know anything of the affection clinically, I refer for further information to the brief account given in the section on Diseases of the Mediastina.

II.—TUBERCULIZATION OF THE BRONCHIAL GLANDS, OR BRONCHIAL PHTHISIS.

726. Tuberculization of the bronchial glands, an affection, in regard of clinical significance, almost confined to childhood, occurs commonly in the chronic, with infinite rarity in the acute form.

(I.)—CHRONIC TUBERCULIZATION.

727. All varieties of tuberculous deposit appear in the glands; the gray granulation is on the whole a rare, the yellowish mass,

¹ Jennings, U. C. H., Females, vol. xv. p. 65.

infiltrating the tissue, the most common form. Deposition, as likewise subsequent softening, commences indifferently at all parts of the glands; the changes undergone by tubercle are the same here as elsewhere: partial cretaceous transformation is not very uncommon.

Evacuation of softened, or even of crude tuberculous matter, may take place into the pulmonary substance, into the trachea, into a bronchus, or into the œsophagus. A permanent fistula is thus sometimes established between the excavated gland, lined by an adventitious pseudo-mucous membrane, and the tube (Guersent); or, evacuation of the tuberculized substance of the gland having been completed, its thickened involucre becomes incorporated with, and fills up the opening in the bronchial wall. Cretaceous matter may be expectorated from the interior of a bronchial gland through a fistulous communication with the trachea or a large bronchus.¹

728. Tuberculized glands vary in size from the natural bulk to that of a walnut. A few only, or several, may be affected: in the latter case, those adjoining the bifurcation of the trachea may form an irregularly rounded lobulated mass, reaching, even in young children, two, and even more, inches in diameter. The glands adjoining the base of the heart, and those of the posterior mediastinum, undergo similar, though, generally speaking, less marked enlargement. Those seated in the substance of the lung rarely acquire large dimensions.

729. The natural thin cellular involucre of the glands thickens as tuberculization advances, and a more or less dense inclosing cyst, sometimes vascular on its inner aspect, is thus formed.

730. Tuberculized bronchial glands may produce, according to their bulk and the direction of their growth, more or less marked compression, and eventual perforation of various adjacent structures. A general description of these compressions and perforations will be found in Section viii. Part I. (Pressure-Signs), and in the section on Diseases of the Mediastina.

731. An excavated bronchial gland, sunk deeply into the lung-substance, simulates, and has doubtless often passed for, a true pulmonary cavity, a fact first pointed out by MM. Rilliet and Barthez.

732. Tuberculization of the bronchial glands is either associated or not with pulmonary tubercle. In the former, by far the more common case, the bronchial disease may be the chief evidence of the diathesis, or be of altogether secondary importance. In point of time the bronchial glands may be affected prior to, or subsequent to, the lungs, whether the clinical importance of the glandular affec-

¹ Carswell's Illustrations, Tubercle, pl. iv. fig. 4. Perforation is more common of medium sized than of the larger bronchi, or of the trachea.

tion be trivial or most serious. The cervical, inguinal, and mesenteric glands are in some cases tuberculized.

733. The bronchial glands may be greatly enlarged by mere increase of substance, or by infiltrated exudation matter, and contain not the smallest particle of tubercle, while the lungs are highly tuberculized, and the child is clinically phthisical.¹

734. The *symptoms* and *signs* of bronchial phthisis are those of bronchitis, mediastinal tumor, and the tuberculous diathesis, variously and capriciously associated: the symptoms are, locally, irritative and mechanical, and, constitutionally, hectic.

735. The local symptoms of mechanical origin are substantially the same as those of mediastinal tumor in general (*vide* Section VIII.), and depend on pressure, traction, or perforation of the various parts there enumerated. Among the most important of these symptoms are swollen cervical veins, lividity, and œdema of the face, neck, and upper part of the chest—limited to one, or affecting both sides, according as either vena innominata or the superior vena cava is compressed: I have never seen distinct œdema of the arm. Discharge of blood by the mouth or anus is rarely observed. Hæmoptysis especially occurs very seldom in children under the tenth or twelfth year: but the escape of blood into and from the pulmonary texture through pressure is, we have every reason to believe, of tolerably common occurrence; it is swallowed as it reaches the mouth. Spasmodic dysphagia from pressure on the œsophagus has occasionally been witnessed. Heaviness and stupor, from obstruction to the return of blood from the brain are common; and pressure either on the trachea, bronchi, the eighth pair, or recurrent nerves, causes singular modifications of the voice, cough, and physical signs, to be presently described.

736. If the mass of tuberculized glands be large, and press sufficiently on the lower end of the trachea, or on both bronchi, to impede the entry of air, the lower lobes gradually collapse, the chest falls in latero-inferiorly on both sides, and the sternum and costal cartilages come forwards: the infra-mammary and infra-axillary regions expand imperfectly, the infra-clavicular in excess. If the main bronchus on one side only be obstructed, flattening of the surface will be limited to that side [36, 54].

737. The vocal fremitus is often in excess in the inter-scapular region.

738. The essential physical sign, however, is percussion-dulness between the scapulæ; taken simply, by far the most significant of the series. I have known the resonance greatly impaired in front from the base of the heart to the sternal notch,² but this is rare. The percussion-note is highly tubular between the scapulæ in some

¹ The same relationship of a cancerous organ and its connected glands is not unoften witnessed.

² Case of S. T., ætatis 6, seen with Mr. C. Crosswell.

cases. Where a main bronchus has been sufficiently pressed upon to induce general collapse of its communicating lung,¹ the side generally is deficient in tone, especially under broad percussion; but the want of resonance is not so marked as might *à priori* be expected.

739. The auscultation-signs vary widely under different circumstances. (a) If there be sustained pressure on the trachea or large bronchi, sonoro-sibilant or liquid bronchial rhonchus, and weak, almost suppressed, respiration of intermittent type, and of unnatural but variable quality, are heard. At the same time laryngo-tracheal stridor and rattle may be audible at a distance. (b) If there be no pressure, and the glands adhere closely both to the chest wall and the bronchi, high-pitched, hollow, bronchial respiration, large-sized, ringing, liquid rhonchi, and powerful quasi-pectoriloquous bronchophony are audible with varying perfection and steadiness. (c) Lastly, if there be no pressure by the glands, and if no artificial medium of conduction between the tubes and the surface be formed by them, the auscultatory signs will be null, or those of simple bronchitis.

740. This statement of the auscultation-signs is given on the assumption that the child is not pulmonarily phthisical; if the lungs be themselves tuberculous, the signs are of course variously modified according to the stage and amount of parenchymatous tuberculization.

741. The child affected with bronchial phthisis, lies, sits, or leans in all varieties of postures: orthopnoea is the rule in paroxysms of difficult breathing. Often there is no evidence of thoracic pain or tenderness; if there be marked suffering, this depends on some superadded, generally pleuritic, irritation. Cough, an almost invariable symptom, may be totally devoid of significant character; or, hoarse, ringing, dry, occurring in fits resembling those of whooping-cough, but not accompanied with actual hoop, nor followed by ropy expectoration and sickness, it may give clear indication of dependence on irritative pressure of the vagus or recurrent nerves. So, too, the voice and cry may retain their natural characters, or become hoarse, feeble, or even temporarily null. If expectoration occur (the rarity of which in the child need not be insisted on), the sputa are simply catarrhal, muco-epithelial, or purulent and non-sanguineous; in the adult, tuberculous matter in all stages may be expectorated, if a diseased gland open into the bronchial tubes. The respiration, varying between twenty and eighty per minute, may be steadily and uniformly shallow and laborious; or paroxysms of dyspnoea, sometimes coming on by night, accompanied with lividity of the face, anxious countenance, cold clammy perspiration, and all the phenomena of partial asphyxia, may supervene from time to time. In one case of this kind, in a child aged three years,

¹ Carswell's Elementary Illustrations, Atrophy, pl. iv. fig. 3.

the characters of the seizure were very much those of laryngismus stridulus. I have never seen actual convulsions.

742. The general symptoms are usually at the outset without distinct significance. Failure of appetite and loss of flesh, general uneasiness, indicated by peevishness and ill temper, with evening pyrexia, common to so many infantile affections, may either precede for some weeks all local chest-symptoms, or set in simultaneously with these. Eventually the constitutional state becomes that of pulmonary phthisis: hectic fever, with night perspirations (which rarely become extreme), loss of strength, colliquative diarrhoea, and excessive emaciation,—symptoms commonly referable in part, however, to advancing general or pulmonary tuberculization.

743. The course of bronchial phthisis is generally remarkable for an irregularity, traceable, except in rare instances, to attacks of bronchitis coming and going.

744. The ordinary mode of death by gradual asthenia, is sometimes varied by accidental occurrences, such as tremendous hemorrhage from perforation of the pulmonary artery, pneumothorax, or meningeal hemorrhage:¹ (pneumothorax is not necessarily immediately fatal). Or intercurrent pneumonia or bronchitis abruptly brings life to a close; or the tuberculizing process, translated to the meninges, or peritoneum, may kill by its effects in those localities, all pectoral symptoms having disappeared for some weeks before death.

745. *Diagnosis.*—The *direct* diagnosis of bronchial phthisis can only be made through the association of several of the local and mechanical symptoms with those of constitutional character, and in the majority of cases, the disease has far advanced, before such kind of diagnosis becomes possible. The method, more commonly guiding to the detection of the complaint, is *indirect*. Thus, if a scrofulous-looking child become feverish, and cough more or less steadily, and if the physical signs cannot be referred to bronchitis, or pulmonary phthisis, while there is no evidence of mesenteric or encephalic tuberculization, a strong suspicion may be entertained that the bronchial glands are the parts affected. The suspicion will be powerfully strengthened, if even trifling loss of resonance or tubular percussion-note can be detected between the scapulæ, and converted into certainty, if the cough become paroxysmal, and signs of venous pressure supervene. The auscultation-signs vary so much in different individuals, and in the same case even, that they are entitled to little confidence; still their very irregularity aids in excluding other diseases.

¹ I give this cause of death, of which I have not met with an example under the circumstances, on the authority of MM. Rilliet and Barthez. A singular case observed by Mr. Edwardes (*Assoc. Journal*, May, 1854) shows that death may occur from asphyxia, caused by the impaction in the larynx of an entire bronchial gland, that had made its way into the trachea.

746. The paroxysmal attacks of cough simulate those of pertussis: but there is no true hoop, no glairy expectoration, no violent vomiting, the fits are of relatively short duration,—and if the paroxysmal character, which gives rise to the difficulty, exist, it will either from the first or very shortly be attended by some or other of the pressure-signs enumerated.

747. *Prognosis.*—The data for scientific prognosis are as yet wanting. It may, however, be affirmed, that the chances of recovery are directly as the certainty with which we can affirm the absence of tubercle in the lung.

748. *Treatment.*—The treatment, being essentially that of pulmonary phthisis, need not here be dwelt upon. I would simply observe that from the free internal use of cod-liver oil, and of ioduretted applications between the shoulders, with careful hygienic management, complete restoration to health, combined with physical evidence of diminished bulk of the bronchial glands, may sometimes be accomplished. One of the most striking examples I have met with of such recovery occurred many years ago among the out-patients of University College Hospital. Two children, aged about five and seven years, who had just lost their mother from phthisis, were brought to the hospital, one in arms, by their father. Both were in the last stage of emaciation, had mesenteric disease, all the rational symptoms of phthisis, and marked inter-scapular dulness under percussion; they rapidly recovered flesh and strength, and when they ceased to attend, had not only lost all their chest-symptoms, but had become normally resonant, or very nearly so, between the shoulders.

(II.)—ACUTE TUBERCULIZATION.

749. Acute bronchial phthisis is excessively rare. MM. Rilliet and Barthez have, however, recorded one most unquestionable case, in which death took place in six weeks from the first appearance of illness. Paroxysmal cough, occurring five or six times daily was the first symptom noticed; the pulse and respiration were excessively frequent; progressive emaciation and copious perspirations proved the deepness of the constitutional suffering. Not a particle of tubercle was found in the lungs; and a single crude miliary tubercle in the brain, without surrounding softness, was the sole specimen of that product in the body, in addition to those in the bronchial glands.

III.—CIRRHOSIS OF THE BRONCHIAL GLANDS.

750. In cases of pulmonary cirrhosis the bronchial glands may be infiltrated with induration-matter, like the lung itself. The practical bearings of the subject are elsewhere considered [CIRRHOSIS OF THE LUNG].

IV.—CANCER OF THE BRONCHIAL GLANDS.

751. Cancer of the lungs is not uncommonly associated with similar disease in the bronchial glands. Mediastinal cancerous growths sometimes distinctly originate in these structures,—and the disease may, as far as the chest is concerned, be distinctly limited to them, both the lung and mediastinal cellular tissue escaping.

752. Cancerous bronchial glands, unless of sufficient bulk to produce pressure-signs, are beyond our means of discovery: when producing such signs their diagnosis becomes that of mediastinal tumor.

SECTION IV.—DISEASES OF THE PLEURA.

I.—HÆMOTHORAX.

753. Pleural hemorrhage, or hæmothorax, is in the majority of cases *traumatic*, and results from wounds or violent contusions of the walls of the chest, and fractures of the ribs, involving the tissue of the lungs. In some instances injury to an intercostal artery in the operation for empyema has caused serious hæmothorax. But it is not very rare as a *non-traumatic* state. Thus the fluid of pleurisy contains blood in considerable quantities in some cases; but no difference is thereby impressed on the physical signs, or (notwithstanding the opinion of Laennec) perceptibly on the local symptoms or progress of the disease. In various blood-diseases with hemorrhagic tendency, as scorbutus and purpura, if hydrothorax occur, the serous pleural effusion is more or less stained with blood. Carcinoma of the lung bursting into the pleura, or carcinoma of the pleura itself undergoing superficial ruptures,¹ or apoplexy of the lung, making its way through the pulmonary pleura, or rupture of an aneurism, may all produce hæmothorax.

754. Now, in all these *non-traumatic* cases, the effusion of blood is a secondary phenomenon; as far as I know, primary idiopathic hemorrhage into the pleural sac, either active or passive, has not been observed. Two cases recorded by M. Andral,² and occasionally quoted as examples of such hemorrhage, are obviously of secondary mechanism: pleurisy had long existed, and in both instances the patients were tuberculous.

755. The qualities of the blood vary,—brightly arterial, darkly venous, clotted or liquid. Besides, in some cases, the fluid, passing for blood, is merely serosity stained with hæmatin.

756. Whether traumatic, or an effect of internal disease, the sole symptom clearly assignable to hæmothorax is labored breathing,—the mechanical result of pressure on the lung. Various coexisting

¹ Dewing, U. C. H., Males, vol. v. p. 19.

² Clinique Méd., t. ii. obs. xv. xvi.; éd. ii. 1829.

symptoms are the effects of the injury or internal disease, on which the hemorrhage itself depends.

757. The physical signs of traumatic hæmothorax are loss of resonance and raised pitch of percussion-sound, enfeebled or annulled vocal fremitus, weak or suppressed respiration, absence of rhonchus, the vocal resonance being in a variable state, null, bronchophonic, or occasionally ægophonic,—signs coming on suddenly without inflammation and under circumstances of injury to the chest.

758. In cases where extensive accumulation of blood occurs in the pleura from any of the internal diseases named, similar physical signs will be observed—but they may be rendered obscure and uncertain by the primary disease. Hæmothorax of such origin may be abundant enough to drive the heart greatly out of its place. Thus, in a case of aneurism of the arch of the aorta adhering to the left lung, in which an effusion of about two quarts of blood into the pleura of that side produced sudden death, the heart was found lying to the right of the middle line.¹

759. The absence of friction-sound will at the outset distinguish hæmothorax from pleuritic effusion. Hydrothorax is characterized by affecting both pleural sacs almost simultaneously, and hence (no matter how great be the amount of percussion-dulness and fluid accumulation) by its not seriously displacing the heart sideways. The direct physical signs are the same in the two varieties of effusion; and the nature of the pre-existing internal diseases will afford the main safeguard against error.

760. The treatment of hæmothorax only requires special consideration in its traumatic variety. Paracentesis is strongly recommended by surgeons of extensive military experience, at two conjunctures. First, at the outset of the hemorrhage, if the quantity of blood effused be sufficient to threaten asphyxia by pressure on the mediastinum and opposite lung. But as the pressure of the extravasated blood against the bleeding vessels acts probably as a sort of mechanical obstacle to further hemorrhage, a small quantity only of the fluid must be allowed to escape, the operation being repeated when urgent symptoms again set in. Such was Larrey's practice,—and it has been successful.² Secondly, at the end of ten or twelve days, if, in spite of venesection and antiphlogistic treatment generally, signs of pleuritis, followed by effusion, occur, the chest ought to be punctured. The results are certainly more favorable in traumatic, than in idiopathic cases.

II.—PLEURISY.

761. Inflammation of the pleura, pleuritis or pleurisy, runs an acute or a chronic course,—in the latter case the disease may be chronic from the outset, or supervene on the acute malady.

¹ Bell, U. C. H., *Males*, vol. viii. p. 169.

² M. Roux successfully removed three pounds of blood, extravasated in a case of fractured ribs; quoted by Sédillot, de l'Empyème, p. 107.

762. *Anatomical characters.*—*Acute* pleurisy is, anatomically, signified by changes in the serous membrane itself, and in the sub-pleural cellular tissue, and by the presence of abnormal materials in the cavity of the sac.

763. The membrane is vascular,—the injection being of the arborescent and capilliform varieties. True, the vascularity is principally in the subserous cellular tissue, and only seen through the transparent serous covering; but tufts of capillary vessels also elevate the membrane from spot to spot, and shoot into its actual substance. The membrane loses its natural moisture and smoothness, its elasticity, transparency and consistence, sometimes even its natural thickness from separation of epithelium. Under special and rare circumstances it is locally destroyed by gangrene. The state of the nervous filaments (derived from the phrenic and sympathetic) it is with great difficulty substantiated: in some cases they appear free from change; in others, it is affirmed, redness, and even thickening of the neurilemma may be detected.

764. The sub-pleural cellular tissue is either simply injected, or also softened and cedematous,—in rare instances, actually infiltrated with pus.

765. The pleural sac contains solid, liquid, or gaseous new products. The *solid* material consists of exudation-matter, which vascularizes rapidly (sometimes in thirty-six hours), and which may be completely absorbed, or, as is greatly more common, gradually undergo conversion into induration-matter, or into pseudo-cellular tissue, forming the material of persistent adhesions and agglutinations. The *fluid* contents, so-called serous effusion, consist of water holding in suspension exudation-corpuscles, pus-cells, epithelium, and frequently blood-disks, discoverable with the microscope; any one of these products may exist in sufficient quantity to be visible with the naked eye,—flakes of albumino-fibrinous matter and pus in all proportions. The quantity of albumen in solution varies from 31 to 77 per cent.; fibrine commonly exists in this same state also,—the contents of the sac, perfectly fluid when first seen, subsequently gelatinizing from fibrine-coagulation.¹ The fluid may be solely purulent; but this is very rare in simple pleurisy. Unless from the accidental occurrence of sloughing, or special alteration of the fluids, *gas* does not form within the inflamed pleura.

766. *Localization.*—In simple primary pleurisy one side only suffers, as a rule: double pleurisy is, however, in some rare instances, purely idiopathic; while in some diathetic affections, as tuberculous disease, Bright's disease, and scorbutus, both pleuræ

¹ This I have seen take place in pleuritic fluid in from half an hour to an hour after its removal from the chest. Sometimes a second coagulation occurs much later, from twenty-four to thirty-six hours, from the presence of pseudo-fibrine, or "fibrine of retarded coagulation," as it has been called by Virchow. In a case of this kind Schlossberger suggests the retardation may have been due to some urea existing in the fluid. (Edinb. Journ., Oct. 1849.)

are very frequently attacked simultaneously. The surface of either sac may be generally, or only partially, inflamed: in the latter case, the pleurisy is called phrenic, pulmonary, costal, interlobar or mediastinal, according to its precise seat. In some cases corresponding, but limited, portions of the costal and pulmonary pleuræ are affected, and thus arises the circumscribed or locular variety of the disease: two or more such circumscribed pleural collections may form, whence the terms bilocular and multilocular.

767. *Acute Anatomical stages.*—The various appearances, now referred to, are found to occur, as a rule, in fixed sequence; hence have been established certain anatomical stages of pleurisy,—stages the more important, because they correspond with precision to striking changes in the physical signs, and even symptoms, of the disease. These stages are called the dry, the plastic, the effusive, and the absorptive.

768. (a) In the *dry stage*, vascularity and loss of natural humid polish of the pleural surfaces are the only morbid changes. (b) In the *plastic stage*, exudation-matter forms in adherent granules, patches or layers, or loose flocculent masses; sometimes on a sufficiently extensive scale to coat the entire lung. (c) In the *effusive stage*, serosity or purulent fluid, with the characters already described, accumulates, commencing at the base of the chest.¹ From the moment such accumulation sets in, the lung begins to suffer pressure—pressure which may eventually condense the organ into a small elongated flattened mass, lying against the spine. The lung is then either partially or generally airless (even its persistent air [122] being forced from the cells), tough and leathery to the feel, of slaty gray hue on section, homogeneous-looking, and non-granular, and of such density as to sink instantly in water. The forcible contraction of a coating of plastic exudation sometimes aids the fluid pressure in thus emptying the lung absolutely of its air (*vide* CONDENSATION OF THE LUNG). (d) In the *absorptive stage*, the morbid products are more or less perfectly removed by absorption—the lung at the same time gradually recovering its expansibility, or remaining more or less condensed. The latter condition will occur, when the pressure of the lung has been long maintained; and especially when the plastic exudation embracing the organ has passed into the condition of induration-matter;—the expansion-force of inspiration is unable to overcome the solid resistance offered by a lamella of the toughness, firmness, and slow molecular contractility possessed by that species of morbid product.

¹ M. Woillez's division of the effusive stage into two sub-stages, the *laminar* and *gravitating*, though founded so strictly on physical principles, that there is great difficulty in contesting its justness, may be ignored in a practical work, because clinically it cannot be substantiated; at least, I have never succeeded in finding the signs of a thin sheet of fluid equally spread over the entire lung, from apex to base. The time during which the suction of the lung is a force more powerful than gravitation of the fluid must be exceedingly brief.

769. The stages, now passed in review, complete the evolution of the disease in its acute conditions.

770. *Chronic Anatomical stages.*—(a) The exudation-matter of the acute disease non-absorbed, and possessing, as we have seen, either the characters of induration-matter or pseudo-cellular tissue, may form the substance of agglutinations and adhesions. By the former term, we designate that close union of the costal and pulmonary laminae which renders any collision of their surfaces in the movements of respiration impossible, and seriously impedes expansion of subjacent lung-tissue. Adhesions, on the other hand, are pseudo-cellular bands more or less long and loose, variable in thickness and firmness, sometimes distinctly meshed, vascularized or not, joining the visceral and costal pleurae, but interfering only in a slight degree with pulmonary play. Induration-matter may besides embrace a portion of lung, especially the apex, and tightly embracing it, absolutely prevent its expansion, condense, and eventually cause atrophy of its structure.

771. The meshes of adhesions may be infiltrated with serosity (whence very peculiar signs), or with pus. Or calcification, pseudo-calcification, or fat formation,¹ may occur in their substance; or tubercle,² or melanic pigment,³ be copiously deposited therein.

771*. (b) Again, when the lung remains permanently more or less flattened and airless from the cause explained already [768], the thoracic walls undergo proportional retraction or depression, and the affected side ceases almost totally to take part in the process of respiration. Still, as inefficiency of one side may be made up for by extra-activity of the other, so long as the patient has no local suffering, and his general health maintains its past average, this condition cannot *per se* be *clinically* set down as a form of chronic pleurisy. On the other hand a pleural sac in this physical and anatomical state is exceedingly prone to fresh irritation—the serous membrane itself, and even the vascularized exudation-matter, may inflame subacutely, or even suppurate from time to time, or tubercle be deposited within the diseased sac: under these circumstances there is indubitably one form of *chronic* pleurisy present.

772. (c) Further, absorption occasionally fails to take place in the ordinary way in the acute disease; or secretion continues relatively so active, that the pleural sac remains persistently more or less distended with fluid (*empyema*). In this unfavorable state of things, more particularly observed in diathetic states—such as those of phthisis, Bright's disease, and carcinoma—the lung, reduced to its minimum bulk by pressure, eventually loses substance by a process of atrophy. The fluid is under such circumstances gene-

¹ Ellis, U. C. H., Males, vol. xi. p. 111.

² Univ. Coll. Museum, Models, No. 5000.

³ Wicks, U. C. H., Males, vol. i. p. 61.

rally purulent;¹ in protracted cases the ribs, sternum, or vertebræ become carious, or the ribs may become the seat of interstitial hypertrophy and sub-periosteal osteophytic growth;² the costal pleura may undergo perforation, and subcutaneous abscess with fistula, eventually opening externally (*parietal fistula*), and daily discharging for months or years, a variable quantity of pus, may form. Sloughing of the pleural induration-matter under the latter conditions occurs from time to time; or this change may affect the pyogenic membrane lining the strata of that induration-matter. Melanic pigment is sometimes found in the actual substance of the pyogenic membrane. Or perforation of the lung from the pleural side may take place, and either close after the evacuation of the fluid in the sac through the air tubes, or permanently remain as a so-called *bronchial fistula*.

773. This brief outline of the anatomical conditions corresponding to the different clinical stages of the disease will render the course of the physical signs intelligible.

774. *Physical signs. Dry stage.*—The movements of expansion and of elevation, from the consensual avoidance of pain, are diminished on the affected side visibly, palpably, and by semicircular and antero-posterior measurement; their rhythm is slightly jerking. The percussion-sound is not perceptibly diminished in resonance; nor, on the other hand, have I found an increase of tone. The respiration is weak, but superficial, and jerking in rhythm. Grazing friction-sound may often be caught, especially about the infra-mammary and infra-axillary regions; in rare cases loud, rubbing friction-sound may be audible over the entire side, without a particle of exudation-matter having been thrown out.³

775. *Plastic Exudation stage.*—The state of chest-movement continues as before; rubbing vibration may sometimes be felt with the hand, but is rarely at this period perceptible to the patient: the vocal fremitus continues natural. The resonance under percussion is somewhat diminished; if it be at all notably impaired, and the sensation of resistance be even slightly increased, the plastic exudation is abundant; deep inspiration will restore the sound its natural

¹ In 162 cases of pleuritic effusion, collected from different sources by Krause (das Empyem, p. 33), the fluid was purulent in 101, yellowish serous in 41, and reddish serous in 20.

² U. C. Museum, No. 4067.

³ I base this statement on the following case: A man, dying of cardiac disease, presented on August 4, "all over the front and side of the left chest up to the first rib, grating and creaking friction-sound, accompanied with marked friction-fremitus; the patient is well conscious of this rubbing, but feels not the slightest pain." On this man's death, which occurred sixteen days later, fluid, which was known to have been meanwhile effused, appeared in the pleura; but the membrane was "entirely free from lymph, except over a spot about the size of half-a-crown at the angle of the seventh rib; this lymph is not rough, and does not look recent. The entire pleural surface is highly vascular, especially along the ribs and at their angles; the vascularity gives roughness to the surface."—J. Wilkinson, U. C. H., Males, vol. ix. pp. 284, 306.

characters. The respiration continues of weak, jerking type; and is accompanied with friction-sound of the rubbing or even grating varieties: ¹ pleural friction of cardiac rhythm [360] may also by possibility be detected. No influence is exercised on the resonance of the voice: if pseudo-ægophony exist, it depends on some condition extraneous to the pleura.

776. *Effusive stage.* (*Without dilatation of the side.*)—The jerking rhythm of the movements visible in the past stages now gradually disappears; and both the expansion and the elevation-classes of movement (the latter are less affected than the former) cease to be visible at the lower part of the side; the infra-mammary and infra-axillary regions become more or less bulged. The intercostal spaces, especially in the infra-lateral regions, may be less hollow, and sink in less with inspiration, than those of the healthy side. Vocal vibration, as a rule, is absolutely abolished, wherever fluid has accumulated to any amount; above the fluid, it continues perceptible: so, too, friction fremitus, if it existed before, disappears wherever the fluid prevents the collision of the layers of exudation-matter; but may remain in full energy above the level of the effusion, or continue in front, while annulled in the back. Mensuration proves the existence of deficient expansion and retraction; but the difference of respiratory play on the affected and non-affected sides is not so great at this period of pleurisy as in more chronic conditions—pain still interferes with the general chest-action, and the non-affected lung has not yet acquired the habit of expanding to its possible limits. Meanwhile loss of resonance with rise of pitch under percussion [Type I. 195] becomes very manifest, with increased parietal resistance, inferiorly; the limits of the toneless and

¹ Friction-sound may not be discovered for any one of the following reasons: 1. Liquid effusion generally occurs with great rapidity; the time during which friction-signs are audible has therefore frequently passed by when patients apply for medical aid; 2. Friction-signs may exist, but escape attention from their slight degree of development; 3. Or from auscultation not being practised immediately over their seat of production; 4. Or from too long a period being allowed to elapse between successive examinations of the chest; 5. In cases of absorption of pleuritic effusion, the development of redux-friction sound will be prevented, if the two pleural surfaces be uniformly agglutinated together; because locomotion of the lung is thus prevented; 6. In all cases of pleuro-pneumonia in which, while the infiltration and enlargement of the lung are sufficiently great to prevent its expansion, resolution of the pleurisy occurs before that of the pneumonia, pleuritic friction-sound (if we believe M. Fournet) cannot be developed. Dr. Stokes has also expressly noticed the rarity of friction-phenomena in pneumonia; "in no case has he found them after hepatization had formed; and their coexistence with the crepitating rale in the early stages is extremely rare." My observation is somewhat at variance with this statement: friction-sounds are occasionally audible directly over hepatized lung, if the consolidation be confined either to the centre or the periphery of the organ; besides, they are often well marked in front about the nipple, while the signs of hepatization are perfect behind; 7. In some, by no means all, cases, friction-phenomena are audible in pleurisy after deep inspiration, when perfectly imperceptible during ordinary breathing. The natural inclination of pleuritic patients to restrain the movements of the chest as much as possible, may then prevent the development of rubbing sound.

resonant parts are distinguished by a tolerably well-defined line—and the area of the dulness, and its line of demarcation, may be changed by altering the patient's posture,¹ but not by the act of respiration [223]. In rare instances the inferior lobe of the lung loses bulk so considerably by pressure, that a fall may occur in the upper limits of dulness, in consequence of the fluid gravitating downwards to fill the otherwise vacant space; hence the area of superficial dulness may by possibility decrease, while the fluid actually increases. Tubular or amphoric resonance is found commonly at the upper front of the affected side [208, 219], and sometimes posteriorly. Auscultation shows that the respiratory sounds, suppressed where the effusion is most abundant—weak, and deep-seated, where less abundant—acquire, above the level of the effusion, exaggerated force, and more or less of harsh, bronchial, or even blowing quality. Friction-sound may still be sometimes discovered above the confines of the fluid; and, when deficient in the back in the sitting posture, may yet be found there, if the patient be made to lie on the face for a while.² This is the most favorable period of the disease for the detection of ægophony, as already [416] fully explained: but the vocal resonance may be strongly or weakly bronchophonic, or may be absolutely null; the cases in which ægophony is actually caught are certainly in the minority—a fact for which an explanation has already been tendered. The heart's sounds are heard with greater intensity through a given thickness of fluid, and of lung solidified by condensation, than through an equal thickness of healthy parenchyma; hence, in right pleuritic effusion, they are more clearly audible than in the natural state, in the right axillary region. Besides, the action of the heart may produce a sort of succession or fluctuation-movement in the fluid, which, if that organ be hypertrophous, is very perceptible at the opposite surface of the chest.

777. *Effusive stage.* (*With dilatation of the side and thoracic displacements.*)—The fluid having accumulated sufficiently to fill all available space in the pleural sac, increased in capacity to a great amount by compression of the lung, begins to push the walls of that sac before it in all directions. The costal parietes, the mediastina, the diaphragm, and the triangular apex of the pleural sac above the clavicle yield before the encroaching liquid, hence various important modifications in the physical signs. The affected side, either expanded generally, or bulged below to a high degree—motionless inferiorly, unless a powerful inspiratory effort be made, when a slow, dragging, upward movement takes place, posterior in time to the expansion of the other side—sometimes

¹ This change in position of the fluid may be ascertained by percussion, even where the quantity is small; thus, where it reaches in the sitting posture only as high as the inferior angle of the scapula; *e. g.* Humbert, U. C. H., Females, vol. ix. p. 14.

² J. Harrison, U. C. H., Females, vol. ix. p. 312.

exhibits a notable change in the state of its intercostal spaces; these may be widened, flattened, or even convex outwards, and in the latter state may exhibit, besides, visible fluctuation. On the other hand, considerable bulging of the walls may exist inferiorly in acute effusion, without any notable distension, or deficiency of inspiratory depression, of the interspaces; the latter may even be more obvious than on the healthy side;¹ nay more, in chronic effusion with considerable general expansion of the side, a fair amount of normal intercostal breathing action may be maintained² [66]. The thoracic surface is felt to be unnaturally smooth; all vocal vibration has absolutely disappeared; and peripheric, more rarely simple, fluctuation may be detected by the fingers in the distended intercostal spaces. The semicircular, antero-posterior, and vertical measurements of the side, and the distance between the nipple and middle line, increase; while the respiratory play falls notably—in fact may be null.³ The dull percussion-sound of the previous period now extends downwards, upwards as far as, and even by possibility above, the clavicle, and passing the middle line in front, encroaches at the upper part of the mediastinum on the opposite side of the chest. The displaced heart also carries its own proper dulness into the new position the fluid may have driven it. All sense of elasticity in the parietes has disappeared; and the outline of the dull sound is scarcely to be altered by changing the position of the patient.⁴ Besides, in the great majority, at least, of cases, the upper part of the chest, especially about the clavicle, first and second ribs, and adjoining part of the sternum, even to the other side of that bone, furnishes tubular or amphoric resonance [219]. I have observed the amphoric variety in cases of latent effusion, where the patient has been walking about, and unconscious of local ailment of any kind. The respiratory sounds, totally suppressed, except close to the spine and at the apex of the lung, possess in those regions a harsh, bronchial, or even slightly blowing quality—a quality explicable by the con-

¹ J. Harrison, U. C. H., Females, vol. ix. p. 312.

² Crowhurst, U. C. H., Males, vol. ix.

³ The respiratory play may be otherwise singularly perverted. Thus, in a case of left effusion (H. Morris, U. C. H., Males, vol. vi. p. 33, January 1, 1851), the seventh and eighth ribs and interspaces below the left nipple sank in during forced inspiration, both visibly and palpably, while the abdomen rose considerably; yet semicircular mensuration indicated at the same spot a respiratory play on the affected side of three-eighths of an inch (Insp. $17\frac{1}{4}$; Exp. $16\frac{1}{2}$ inches). This is a striking discordance between antero-posterior and general expansion movement [112].

⁴ Even at this advanced period of effusion, alteration of the kind is, however, possible. If a patient with fluid enough in the pleura, when he lies on the back, to render the sound toneless to the opposite side of the middle line, be made to lie on the side of the effusion, in the course of a minute or two the sound acquires tone at the mediastinum. I have found this point of considerable utility in certain cases in determining whether there was or was not mediastinal tumor present, in addition to abundant pleural effusion; it cannot, however, be implicitly trusted to, as a tumor may gravitate from one side slightly to the other [224].

densed state of the tissue. In many cases, however, diffused blowing respiration is pretty extensively heard over the diseased side.¹ Friction-sound, in rare instances, still continues audible in some limited spot: the rule is, that it totally disappears. The continuance either of ægophony or any other form of vocal resonance is unusual; but strong bronchophony about the inferior angle of the scapula may coexist with abundant effusion, and annulled vocal fremitus.² The heart's sounds may be heard through the fluid, either imperfectly,³ well,⁴ or with even extra fulness—the reason of these differences not being always apparent.

778. The diaphragm, depressed to a variable amount, carries with it the liver or spleen; with the mediastinum, the heart is pushed to the opposite side. The amount of lateral detrusion of the heart is sometimes very remarkable: in cases of left effusion, the organ may pulsate outside the right nipple; and thirty-six hours will sometimes suffice to produce this amount of mal-position. The visible and palpable impulse of the organ, and the maximum points of its sounds, especially of the first, prove its change of place. Does the displacement exercise any influence on the quality of the sounds? Most unquestionably it does not, in the great majority of cases; my experience on the point perfectly accords with that of Dr. Stokes, who feels convinced that, even when at its height, the displacement “does not cause any alteration in the natural sounds of the organ.” But the rule, I am equally persuaded, is not without its exceptions. Dr. Hope describes the following peculiarity in a case of right lateral detrusion from effusion in the left pleura: “The aorta was felt to pulsate between the second and third right ribs, an inch from the sternum; and here a murmur was heard with the first sound, which has ceased since the heart has been restored to its natural situation by the absorption of the fluid. Is it, therefore, possible that a twist given to the aorta, or pressure of the vessel against the ribs, may be the cause of a murmur under such circumstances?” I once found, for many successive days during the height of left pleural effusion, both sounds of the heart, which was pushed to the right of the sternum, more or less masked by blowing murmurs; these murmurs, when the heart was restored, or very nearly restored, to its natural position, almost completely disappeared—a fact the more remarkable, as, from the slowness of convalescence, plenty of time had elapsed for the formation of the systolic basic murmur of spanæmia. The diastolic murmur disappeared the more perfectly of the two, and must positively have depended, probably through torsion of the aorta, on the mal-position of the organ.⁵ Larrey has related a case

¹ J. Harrison, U. C. H., Females, vol. ix.

² Crowhurst, U. C. H., Males, vol. ix. p. 142.

³ Bernard, U. C. H., Males, vol. xii. p. 205.

⁴ Ward, U. C. H., Females, vol. xi. p. 63.

⁵ H. Morris, U. C. H., Males, vol. vi. pp. 35, 38.

in which extreme feebleness of the pulse in the large arteries coexisted with cardiac displacement; there can be no certainty, however, that there was any mutual dependence between the two circumstances.

779. No matter how copious the effusion, whether acute or chronic, nor how complete the evidences of centrifugal or dilating pressure, signs of centripetal pressure [492] are, as a rule, absolutely wanting,—the trachea, œsophagus and large veins escape serious pressure. Hence the detection of the latter class of signs, in a case of pleuritic effusion, may be accepted as proof of some additional disease, such as tumor or aneurism, within the chest. I have, however, seen a single vein, such as the epigastric, external jugular or mammary, enlarged in calibre in cases of pure effusion. The laws of hydrostatic pressure seem to me readily to explain this exemption of special internal parts from interference.

780. *Stage of Absorption.*—The absorption of pleuritic effusion is effected with results of two different kinds on the form and condition of the chest. The walls may be simply restored to their natural position, or they may sink inwards,—inside, as it were, their natural site. Hence, clinically, we have a period of absorption *without* and *with retraction of the side*: of these the former is infinitely the more favorable.

781. *Absorption without retraction.*—The visible enlargement and bulging gradually disappear, and with them, but very slowly, the obstructed state of the chest-motions; the natural intercostal hollows, deepened, perhaps, by emaciation, are again felt; friction-fremitus¹ and vocal vibration return,—the former often with greater intensity than at the outset of the disease. The various measurements fall to their natural standards. The percussion-sound gradually recovers its natural resonance, first at the upper, then at the lower, regions; in the latter, indeed, it may long, for weeks, or even months, remain more or less toneless in consequence of imperfect expansion of the still collapsed lung, and accumulation of exudation-matter in the pleural sac. The tubular note under the clavicle disappears much earlier,—normal resonance returning long before healthy tone reappears at the base: still I have known it continue for two or three weeks after the patient was practically convalescent. The respiration-sounds, gradually restored, remain for a variable time weak and harsh or bronchial; friction-sound, mixed or not with pleural pseudo-rhonchus [355] or pulmonary pseudo-crepitation [343] reappears for a variable period; ægophony is sometimes caught passingly for a day or so, but the vocal resonance quickly becomes bronchophonic, or may be null. The heart, with the mediastinum, returns to its natural position, sometimes

¹ Redux friction-fremitus may remain for a long time perceptible to the patient himself. John Smith (U. C. H., Males, vol. x. p. 68) first perceived it January 13th, and felt it distinctly, on full inspiration, when discharged at the close of March.

with singular celerity. I once saw a heart beat in its exact normal site, which, seventy hours only before, I had felt pulsating under the right nipple; absorption so rapid, singularly rare under all circumstances, was here the more remarkable, as the patient was tuberculous, and had had several attacks of profuse hæmoptysis.

782. *Exceptional Signs.*—At this period of the disease very singular signs may temporarily occur. Thus, in a middle aged enfeebled male, undergoing absorption of moderate effusion, with probable acute lung-consolidation conjoined, the following facts were noted: "Tubular percussion-sound in the left infra-axillary region; at the inferior angle of the left scapula the voice is strongly resonant, with a whispered echo after each word, exactly as if the voice were reproduced in whisper under the stethoscope; at this point obscure friction-sound, with thin various-sized rhonchal sounds; the respiration here is hollow, of cavernous quality, especially in expiration. Even with whispered voice the pectoriloquous echo is perfect; though the laryngeal whisper is so low as to be scarcely audible by the ear held close to the patient's mouth." Eleven days later the percussion-sound had become pulmonary in the main at the inferior angle of the scapula; little was heard there in calm breathing; under effort, feeble respiration, mixed with friction-sounds and loose rhonchus, became audible; the vocal resonance had lost all the peculiar characters above described, being simple exaggerated, and not hollow in quality. This patient perished of Bright's disease (for which he had been originally admitted) on the 29th of December—that is about five weeks after the percussion-sound had become pulmonary, in the main, about the inferior angle of the left scapula—when the following condition of things was ascertained. "The lower lobe of the left lung so closely adherent in the corner of the pleural sac, that the upper lobe is nearly torn away, in the attempt to remove the whole organ; bronchi large, dilated even in some parts; tissue, especially of the posterior part of the organ, firm, instantly sinks in water without pressure; no tubercle or gray granulation."¹ Now in this case increased conducting power on the part of the solidified lung-substance, combined with dilatation of the bronchi, seems to explain the ringing hollow quality of the respiratory and rhonchal sounds. The vocal whisper within the chest could not have depended on unison-resonance, seeing that it did not synchronize with, but followed, the first resonance; nor upon consonance, for it occurred with various words spoken with not precisely the same pitch: it manifestly depended on echo of the first resonance, which it followed at a certain interval of time.

783. I have, since this observation, met with several more or less perfect examples of the same peculiar phenomena—sometimes in cases of complete recovery from idiopathic pleurisy.²

¹ Fosbury, U. C. H., Males, vol. ix. pp. 350—352; vol. x. p. 132.

² E. Smith, U. C. H., Males, vol. xi. p. 135.

784. *Absorption with Retraction.*—General retraction of the affected side is very much less common than partial depression—the latter occurring probably about twelve or fifteen times as frequently as the former: general retraction is a process requiring much time for its accomplishment. From the inquiries of M. Woillez, partial depression would appear to be more frequent in front on the right side, behind on the left side. The shoulder, the ribs, and the nipple, fall (in some peculiar cases the shoulder rises, however); the scapula becomes tilted outwards at its inferior angle; the dorsal spine curves laterally, the convexity looking, at least in the majority of cases, towards the sound side; and the ribs undergo distortion, their external planes becoming more or less inferior. This altered condition of the ribs lessens the width of the intercostal spaces; and, in cases of very chronic course, hypertrophous and osteophytic enlargement of the ribs still farther decreases that width. The chest-surface laterally is unnaturally irregular and uneven; in front it may be flat, smooth, and even slightly concave, the distinction between ribs and interspaces being completely lost to the eye. Rubbing vibration is rarely to be felt. All the chest measurements (those of the side, generally, as well as the partial class) undergo diminution, with the exception of that between the clavicle and nipple, which increases.¹ The measured chest-play, on the diseased side, may be absolutely, or next to absolutely, null, while that of the other side exceeds the individual standard of health. The percussion-sound, dull with marked resistance, inferiorly, acquires the wooden quality at the mid-height of the thorax, and is often tubular at the apex, in front and behind. If dilatation of the bronchi supervene, the tubular note may be very extensively discernible. The enlargement of the ribs, just referred to, contributes to give an osteal character to the sound, especially laterally. The signs obtained by auscultation, though less striking than these, are sufficiently important: the respiratory sounds, more or less completely suppressed at the extreme base, are superiorly weak, bronchial, or diffused blowing—months may elapse, after retraction has commenced, before respiration is restored to any extent at the base; friction-sound, of creaking or grating type, may or may not be audible; the voice resounds with morbid intensity, especially at the central parts of the side.

785. The vault of the diaphragm and subjacent viscera are sometimes drawn above their natural level,—an elevation not faithfully indicated by changed position of Harrison's sulcus [480]. The site of the heart varies in at least five different ways:—(a) The organ having slowly or rapidly, gradually or suddenly, retraced its steps, recovers either its natural situation, or the immediate vicinity of this: here is the most common case. (b) It remains in the abnor-

¹ This comes of lowering of the nipple—more valuable as a morbid sign on the right than the left side [34].

mal position into which it was forced by the effusion, in consequence of the establishment of adhesions. (c) The tractive force may be so powerful at the period of absorption as to *pull* the organ out of its place in the converse direction to that into which it had previously been *pushed*: an occurrence best observable when the right pleural sac has been affected.¹ (d) It may happen, according to an observation made by Dr. Stokes, that the heart hangs more loosely than natural in the chest, and so falls somewhat to the right or left, as the patient lies on this or that side. (e) Or it may happen, in cases of left effusion, that the heart, originally pushed enormously to the right, subsequently passes to the left, even beyond its natural site,—and still later, regains more precisely its normal position by repassing a very little to the right.²

786. The physical signs now described, are those of the disease from the moment of attack to its final term,—in other words, of its acute and chronic forms.³

Symptoms of Acute Pleurisy.

787. A. *Local*.—Acute idiopathic pleurisy may or may not commence with rigors; they are rarely strongly marked, and I have never known them of the severity frequent in pneumonia. Rigors, or mere chilliness, followed by heat, generally moderate in amount, and certainly not acrid or burning, may be either actually the first symptom, and anticipate local suffering by some hours or even days, or be preceded for a few hours by the characteristic “stitch in the side.” This peculiar pain, dragging and shooting in character, increased by movement, deep inspiration, direct pressure, and percussion, varying in severity from a mere annoyance to a feeling of agony, commonly seated below the nipple, near the antero-lateral attachments of the diaphragm, and under the scapula, rarely extending over the entire half of the chest, sometimes referred solely to the non-inflamed side,⁴ still more rarely limited to the confines of the abdomen, or the abdomen, and this when no physical evidence of local peritonitis exists, felt generally in inspiration more than in expiration, in rare instances solely with the latter act,⁵ is persistent, temporary or intermittent, and sometimes totally disappears, more commonly remits, with the occurrence of effusion.

Tenderness under pressure, traceable sometimes apparently to the subcutaneous muscles, sometimes to the pleura itself, sometimes to the intercostal muscles, or lastly to the intercostal nerves, generally exists.

¹ Griffiths, U. C. H., Males, vol. ii. p. 174.

² Luckett, U. C. H., Clin. Lect., loc. cit. p. 390.

³ Two very rare signs may here be added: perfect *cracked-metal note*, in the first and second interspaces, during the height of effusion and subsequently (Denly, U. C. H., Females, vol. vi. p. 85); and loud rubbing *redox friction-sound*, with four or five jerks in inspiration and expiration, *above the clavicle* (Whiles, U. C. H., Males, vol. vi. p. 122).

⁴ Luckett, U. C. H., loc. cit. Probably from coincident pleurodynia.

⁵ Bassett, U. C. H., Females, vol. vii. p. 229.

788. The immediate cause of pleuritic pain is far from clear. Both costal and pulmonary pleuræ may be vascular in the highest degree, the surfaces free from exudation, friction-sound intense, and yet not the least pain or tenderness exist.¹ There may even be strong friction-fremitus from exudation matter, without a particle of local suffering.² On the other hand, intense pain may coexist with friction-sound, limited to a surface no larger than the palm of the hand.³ Again, there may be intense abiding pain, with sharp stitch on full inspiration, without friction-sound.⁴ Lastly, there may be friction-sound in inspiration and expiration, pain in inspiration only.⁵

789. Obviously, then, friction of inflamed surfaces is not the cause of the pain in question. Besides, pleurisy, even purulent, is sometimes latent; so that instead of regarding stitch in the side, with Cullen, as the essence of pleurisy, we are forced to regard it as an epiphenomenon. Chest-movement fails, sometimes, to produce it; and patients' descriptions of its qualities widely differ. I cannot help thinking its mechanism likewise differs, that it may depend either on inflammation of the pleural nervous filaments themselves [763], on intercostal neuralgia or neuritis, on actual inflammation of the diaphragm, or the intercostal planes themselves, or on mere pleurodynia: the two latter modes of causation would be distinguished by the marked increase of suffering from movement.

790. Increased frequency of breathing is a very constant symptom, perhaps more so even than local pain: it may be unnoticed by the patient, or attended with distressing sense of dyspnœa. The number of respirations very rarely exceeds the third of the number of the heart's pulsations: indeed, I do not remember ever to have observed, in a positively uncomplicated case in the male, a pulse-respiration ratio lower than 2.7:1.⁶ An enormous amount of effusion may coexist with a ratio of 3.5:1. The ratio is more perverted in the sitting than in the lying posture: thus, in a case of copious effusion:—

	P.	R.	Ratio.
Lying,	122	36	3.39:1
Sitting,	128	44	2.93:1

It is important, however, to distinguish genuine dyspnœa from the mere spontaneous hastening of shallow breathing, which sometimes comes of the petulance of pain. The breathing-movements, as we

¹ Wilkinson, U. C. H., Males, vol. ix. p. 284.

² Humbert, U. C. H., Males, vol. ix. p. 14.

³ Young, U. C. H., Males, vol. ix. p. 294.

⁴ Styles, U. C. H., Males, vol. x. p. 304.

⁵ Casey, U. C. H., Males, vol. xiii. p. 99.

⁶ In nervous and hysterical females the ratio may, however, fall lower than this under the influence of painless pleuritic effusion. The temperature of the expired air may fall sensibly below the average of health under these circumstances. Harrison, U. C. H., Females, vol. ix. p. 309.

have seen, are restrained in amount on the affected side; their increased frequency acts as a sort of compensation.¹ The dyspncea is generally more marked at the outset than after effusion has occurred. Cough exists in the great majority of cases, dry (unless there be coexistent bronchitis), short, small, stifled as it were, and frequent; it may, however, be completely absent, though the febrile state be highly marked. During the dry and plastic stages, the patient commonly lies on the sound side or on the back; I have seen exceptional individuals lie by choice on the diseased side, to control movement and stifle pain, as they assured me: generally speaking, this posture increases pain. After effusion has occurred, the patient commonly lies on the back, on the affected side, or diagonally between both, with the head somewhat raised: he may, however, day after day, while copious effusion exists, lie on the sound side.²

791. *B. General.*—The general symptoms are those of a febrile inflammation. The pulse is frequent, sometimes hard and concentrated; the skin, hot, but not acridly or burningly so, at the outset, becomes moist at the effusion-period. There is but slight prostration of strength; and the cerebral functions are very rarely affected. The urine, small in quantity, is of high specific gravity, deep color, and strong odor, may be temporarily albuminous, as in other acute affections, has been found in rare instances impregnated with fibrine, and contains oxalates often at the period of convalescence; but in all this there is nothing distinctive. The blood is hyperinotic,—the fibrine varying from 3.5 to 7 per 1000: as a rule, it ranges lower than in pneumonia. The buffy coat is absent from blood drawn in about one-fourth of cases.

792. *Coexistences.*—Acute pleurisy is often followed by limited plastic pericarditis, or peritonitis, the latter most common on the right side. Pneumonia is an excessively rare sequence, on the affected side especially; indeed, the effect of fluid pressure is to disgorge the lung of its blood in great measure, as well as of its air. The association of pneumonia and pleurisy proceeding *pari passu*, and each modifying the progress of the other, is not common.³ Bronchitis does not often co-arise with acute pleurisy, and is not an obvious effect of it either.

793. *Terminations.*—The terminations of acute pleurisy are by recovery, effected either by resolution or absorption; by lapse into the chronic state; and, under certain circumstances, by death.

¹ This restraint of motion on the pleuritic side is a remarkable instance of consensual action, or of motion regulated involuntarily by sensation. It cannot be imitated by the will, and is therefore involuntary; it depends on sensation, and is therefore not reflex, at least in the Marshall Hall sense of the term.

² Harrison, U. C. H., Females, loc. cit.

³ A slight amount of plastic exudation in the pleura is so common in pneumonia, that pleuro-pneumonia and pneumonia may, in that sense, be used as convertible terms; but pleurisy of clinical importance, and producing effusion, does not occur in more than about one-eighth of cases of pneumonia.

Death is so rare a result of the disease, when attacking individuals free from organic affections, that I have to my knowledge (carefully attending to the point, since my attention was first drawn to it, years ago, by M. Louis) lost but one patient from pure primary idiopathic *unilateral* pleurisy, with or without effusion.¹ And, although, where chronic disease either of the lungs or of other organs pre-existed, death is a more common result, it is still an unusual one. Pleurisy is rarely the immediate cause of the fatal event in phthisis; it is only so by rare accident in chronic bronchitis; and, although both pleuræ suffer in blood-diseases attacking the serous membranes, as for instance, in uræmia and pyohæmia, pleuritis is even here not only an uncommon apparent cause of death, but, when apparently destructive to life, is generally conjoined with pneumonia. I have, proportionately to the rarity of these diseases, found the secondary pleurisy of carcinoma of the thorax and its contents² the most fatal variety.

Symptoms of Chronic Pleurisy.

794. Chronic pleurisy presents itself clinically in three conditions or forms:—(1) With retraction of the side, and the various accompanying physical imperfections already described: (2) With permanent dilatation of the side by sero-albuminous or purulent fluid (*empyema*): (3) With permanent fistulous opening in the pleura, and discharge of pus from the sac.

795. (1) In the first case of retracted side, the rule is, that the general health is below par,—the individual is thin, incapable of much physical or mental effort, and prone to slight passing attacks of inflammation in the affected side. The breath is rather short, and dyspnœa easily evoked; there is frequent pain in the side. But in exceptional instances, hypertrophy of the fellow lung occurs on a more or less extensive scale, and the patient does not, *quoad* facility of breathing (breathing power is another thing), differ notably from healthy persons. He may even maintain vigor and grow fatter than he had ever been prior to his attack.

796. In cases of extreme retraction there is sometimes a tendency to recurring dry inflammation of the other pleura; this is a most perilous state of things: for if effusion occur, asphyxia might ensue before relief could be obtained. I have, however, known friction-sound continue for three months, on the relatively free side, under these circumstances, without any great result ensuing.

797. (2) *Empyema. Symptoms.*—In the second case, of persistent distension with sero-flocculent or purulent fluid—conditions of the

¹ In this case (Ward, U. C. H., Females, vol. xi. p. 62), remarkable in many ways, perforation of the lung occurred through the diseased pleura on the fifty-first day, and cut the patient off suddenly, at a time she appeared to be doing favorably. Aged thirty-three, she was wholly free from organic disease, even in the lungs themselves.

² Dewing, U. C. H., Males, vol. v. p. 19; Unwin, U. C. H., Males, vol. iii. p. 239.

fluid which cannot be distinguished with certainty during life¹—symptoms of more prominent character exist. The patient either lies on the back, or diagonally on the diseased side, with the head slightly raised and bent towards that side, but often acquires the power of lying on the healthy side under the influence of treatment. He rarely suffers from local pain, unless some intercurrent acute inflammatory action arise. His dyspnoea varies in amount; I have never known it seriously pervert the ratio of the pulse to the respiration. The voice is weak; the cough frequent, either dry or attended with expectoration, muco-purulent or purulent. Not only does empyema not give rise in itself to hæmoptysis, but, if established in a case of phthisis, appears to a certain extent prophylactic against the hæmoptysis, which is almost an appanage of the latter disease.²

798. The source of expectoration is various. (1.) Steady and rather abundant expectoration may occur from some coexisting affection of the lungs or bronchi. (2.) Sudden profuse pouring forth of sero-pus by the bronchi takes place through perforation of the pulmonary pleura. (3.) It occasionally happens that the expectoration, without changing in quantity, acquires the precise odor of (as is eventually proved) the contents of the pleura: does exosmosis through the serous membrane take place? I have observed this where perforation followed somewhat latter.³ (4.) Occasionally a sudden gush, to the amount of a pint or upwards, of sero-pus takes place, without our being able to detect any evidence of pneumothorax. Now two interpretations present themselves: either the fluid has made its exit through a perforation without allowing the entry of air into the sac; or a metastatic flux has occurred from the tubes. Both views have their difficulties.

799. Œdema of the affected side of the chest is common; it may extend to the corresponding limbs, and half of the abdomen, leaving the other side of the body almost, or completely unaffected. Clubbing of the finger-ends on the diseased side is sometimes strikingly marked. The face is puffy, and semi-transparent, without

¹ Bulging of the intercostal spaces was once supposed to occur only where the contents of the pleura were purulent; a most unquestionable error, as is now commonly understood.

² "In sixteen well-marked cases of empyema which I have had under my care within the last two years, for periods of three months and upwards, no single example of hæmoptysis occurred. But, more than this, empyema established in a phthisical person, seems to be preventive of hæmoptysis. In seven cases of combined tuberculous excavation and empyema, carefully watched and proved as to the diagnosis, either by dissection or by indubitable signs, no spitting of blood had ever occurred. All these seven persons were males. The pressure exercised on the lung by the contents of the pleura might appear to explain the fact plausibly enough, especially as the excavations were on the same side as the empyema in six of the seven cases; and I have recently seen a curious exemplification of the apparent influence of excessively acute pleuritic effusion in arresting obstinate hæmoptysis. But, on the other hand, in one case, excavations existed in both lungs."—Author's Report on Phthisis, Br. and For. Med. Chir. Rev., Jan. 1849.

³ Ward, U. C. H., *Females*, vol. xi. p. 62.

malar flush; the lips tumid and livid. The external thoracic veins are not enlarged, the eyes are not prominent, there is no dysphagia, and no stridulous character in the voice or cough: in a word, there are no signs of concentric pressure [491]. The opposite lung becomes hypertrophous and emphysematous; sometimes its bronchi, rarely its parenchyma, inflame.

800. The pulse is habitually frequent, quick and small; the patient easily falls into a state of syncope; the skin is hot and dry, the pyrexia of hectic type, whether the contents of the pleura be pure pus or not; anorexia and insomnia combine with other causes to produce serious emaciation.

801. Empyema is greatly more common in males than in females. Of twenty-two cases of which I have records, three only refer to females; Heyfelder¹ found but one female among twenty empyematous patients; Krause (loc. cit. p. 109) has collected from various authors one hundred and thirty-seven cases, of which ninety-six were in males, eighteen in women, and twenty-three in children. Acute pleurisy is also more common among males, but not by any means to the extent here disclosed in respect of empyema; it would follow then that pleurisy has a greater tendency to degenerate into empyema in males than females—a result the less to have been anticipated because tuberculization is more common in the latter sex.²

802. The proportion of cases of acute pleurisy lapsing into the chronic stage is unestablished: it is, on the whole, unquestionably small.

803. *Terminations.*—The terminations of empyema are by death, through slow asthenia; by recovery, through absorption, or through evacuation of the fluid by the bronchi or parietes—the opening undergoing closure after it has served its purpose; or by lapse into the fistulous form of the chronic disease.

804. (3) *Permanent Fistula.*—There may be one or more fistulæ, and the discharge may be trifling in amount, or sufficiently abundant to account in itself for emaciation. In these cases, retraction of the affected side is carried to the extremest amount possible; the measurement between the nipple and the middle line may, as I have seen, fall to one inch and a quarter less on the diseased than the healthy side; while hypertrophy of the opposite lung³ reaches

¹ Arch. de Médecine, 3ème Série, t. v. p. 59. 1839.

² Cruveilhier asserts that puerperal pleurisy is scarcely less common, at the Maternité, than puerperal peritonitis. (Bull. de l'Acad. de Méd., t. i. p. 104. 1836.)

³ The lung in this state, instead of receding, when the chest is opened after death, may actually protrude through the opening. I have known the difference in the semicircular measurements of the sides, equal four inches in a case of the kind. Increase of bulk of the sound lung takes place, with tolerable speed, too; thus (T. Wicks, U. C. H., Males, vol. i. p. 59; 1847) by measurements made at an interval of eight months, and increase (emaciation having all the while advanced), equalling very nearly two inches in the semi-circumference of the side, was substantiated.

its maximum. The symptoms in this variety of the disease are habitually similar to those of the form last described. In rare instances, not only is life prolonged without obvious suffering, but the individual is able, with care, to follow his ordinary pursuits: death in the great mass of instances is the slow result.

805. In the majority of persons the fistulous opening is parietal, sometimes pulmonary, sometimes pulmonary and parietal combined. In rare instances communications form with distant parts by straight or tortuous sinuses, as with the intestine (feces¹ or lumbrici² entering the thorax) or with a lumbar abscess opening in the groin.³ Pus-collections in remote sites sometimes work their way to the pleural sac—as, for example, a pyelitic accumulation;⁴ or disease of a distant organ, as the stomach, may lead to perforative communication through the diaphragm with the pleura, and produce secondary empyema.⁵

806. *Alliances.*—The relations of empyema to other diseases seem to be these. Various diathetic states, the tuberculous, the syphilitic, the purpuric, the cancerous, and that of Bright's disease, appear often to act as its causes, both by leading to, and by preventing direct recovery from, the original acute attack. On the other hand, empyema, especially on the right side, tends to produce disease of the liver, and ascites.⁶ A few instances have fallen under my notice where Bright's disease was certainly, as far as the evidence of symptoms went, secondary to empyema—but whether as an effect or a coincidence seems doubtful.⁷ Bright's disease is often, where it exists, the immediate cause of death.

I have not met with any positive evidence that the lung on the unaffected side is peculiarly prone to pneumonia of an uncontrollable character, as asserted by some writers. Hypertrophy of its substance and inflammation of its tubes, are the only conditions I have observed as unduly frequent.

Diagnosis of Acute and Chronic Pleurisy.

805*. The diagnosis of pleurisy is in the majority of cases sufficiently simple; but at all its periods there is a certain risk of confounding it with other diseases.

806*. In the dry period, *pleurodynia*, an impending attack of *zona*, and *intercostal neuralgia*, with *bronchitis* accidentally coexisting, are the affections most easily mistaken for pleuritic seizure. The rules for distinguishing them have already been given [Section I.]

807. In the plastic stage, pleurisy may, under ordinary circum-

¹ Krause, *Das Empyem*, p. 82.

² Luschka, in *Brit. and For. Med. Chir. Rev.*, vol. xiv. p. 527.

³ Krause, p. 80.

⁴ Rayer, *Mal. des Reins*, t. iii.

⁵ U. C. Museum, *Carswell's Drawings*.

⁶ Wicks, *U. C. H., Males*, vol. i. p. 59; Griffiths, *U. C. H., Males*, vol. ii. p. 174.

⁷ Griffiths, *U. C. H.*, loc. cit.

stances, be distinguished from *plastic pericarditis* by the respiratory rhythm of its friction-sounds. In those comparatively rare cases, where the heart's action produces friction of its own rhythm within the inflamed pleura, while the pericardium is perfectly free from disease, attention to the rules laid down in connection with Diseases of the Heart will generally remove all difficulty in the diagnosis. The course of events will soon settle the question, should doubt remain in spite of the aid of those rules; if the friction of cardiac rhythm be pericardial, the signs of pericardial effusion will, with almost absolute certainty, quickly follow.

808. *Friction in the peritoneum* is, especially at the upper part of the abdomen, with difficulty distinguished, as its rhythm is respiratory, from similar sounds in the lower part of the pleura. Indeed, I know of no positively distinctive character, except the locality of the sound; if this be obviously beyond the confines of the chest, and if there be no such friction in the pleura as to account for rubbing sound being heard under the abdominal walls, as an effect of mere conduction, its origin in the peritoneum must be admitted;¹ both kinds of sound may or may not be accompanied with friction-fremitus.

809. Pleuritic effusion, when acute, may be confounded with *pneumonic solidification*. But in the former the interspaces are either bulged outwards, or move more freely with the respiration-act, than in consolidation of similar superficial extent. In effusion, vocal fremitus disappears; in hepatization, it is maintained at, or raised above, the average of health.² In some rare cases peripheric fluctuation discoverable by flipping in an interspace or striking a rib [83] will settle the difficulty in favor of fluid. The percussion-sound under the clavicle on the affected side in effusion is tubular or amphoric, unless the whole pleural sac be filled with fluid; such quality of percussion is very rare in hepatization, and exists over the most, not the least, solidified parts. Occasionally, too, the exact limitation of dulness to the area of a lobe may be traced by percussion on the surface,—now, such limitation is more likely to depend on hepatization than on fluid in the pleura; but the line of effusion does sometimes coincide with singular precision with that of the upper edge of the inferior lobe. In effusion, there is no

¹ T. Barker, U. C. H., Males, vol. iv. p. 55; Harrison, U. C. H., Females, vol. ix.

² This guide is of comparatively little service, when the left side is affected; the vocal fremitus is naturally so weak on that side: luckily for purposes of diagnosis, mal-position of the heart is most readily affected by effusion into the left pleura. The fremitus-sign is almost valueless in persons with very feeble voices, whether naturally so or from disease. Besides, in cases of *very extensive* and *very dense* hepatization, the fremitus may be impaired in strength, though not to the same extent as with an equal amount of dulness from effusion [77]: vocal fremitus may be caught *along the spine* in some cases of abundant effusion,—and unfortunately in some instances at some distance outwards from the vertebræ. I have often known fremitus feeble and vocal resonance strong over effusion, but have not, to my recollection, met this combination in hepatization.

true crepitant rhonchus: nor have I ever found true tubular, sniffling, metallic respiration: such blowing respiration, as frequently occurs in pleuritic effusion, is of the diffused variety, deep-seated, except close to the spine,—and slight in amount as compared with the amount of percussion-dulness present. Vocal resonance is either null, ægophonic, or strongly, or weakly bronchophonic; in hepatization, it is high-pitched, metallic, coarse, strongly and sniffingly bronchophonic. Those rare cases of pneumonia, where vocal resonance and respiration-sound are completely deficient, will be considered hereafter. If by placing the patient in the prone position, we find the percussion-dulness decrease, the respiration increase, in amount, and friction-sound, before inaudible, appear, the case is positively one of effusion; but if things remain in *statu quo* after such change of position, the case is not necessarily one of hepatization. In effusion, the heart is displaced, and dulness extends across the mediastinum. It is true, the same extension of dulness beyond the middle line occurs to a very slight amount in some cases of pneumonia; but where this is the fact in hepatization, change of position does not affect the mediastinal dulness; whereas it does affect this, as already explained, in cases of effusion. The absence or presence of rusty sputa, of acrid heat of skin, and, above all, the state of the pulse-respiration ratio may be appealed to for further aid; an amount of pneumonic solidification, so great as supposed, will produce a ratio of 2: 1 or 1.5: 1. I have never known such perversion result from mere effusion, and the ratio *may*, with copious accumulation, fall within the natural limits. The amount of diagnostic trust to be placed in the condition of the chlorides in the urine is examined under the head of Pneumonia.

810. A *much enlarged liver*, extending upwards, is distinguished in some instances from effusion by the non-protrusion of the lower intercostal spaces (they are, however, less sunken than those of the sound side), by the normal percussion-sound superiorly, and by the tolerably full amount of respiration audible at the posterior base of the chest. The interlobular fissure of a merely enlarged liver maintains its natural relationship to the middle line of the body; that of a liver pushed down by pleural effusion (as Dr. Stokes has shown) lies at an unnatural angle with this. If an enlarged liver displace the heart, it does so in an upward, not, as pleuritic fluid does, in a sideward direction. Deep inspiration increases the area of normal percussion-sound inferiorly, and also that of vocal fremitus, in cases of hepatic enlargement; it exercises no such influence when loss of resonance depends on effusion.

811. The *spleen*, when sufficiently enlarged to increase the width of the left base of the thorax, raises the heart; does not, like effusion push it aside; extends far into the lumbar region, and forwards to or beyond the middle line of the abdomen, with a firm, smooth, or nodulated surface; affects but very slightly the amount of respiration at the posterior base of the chest, and causes no protrusion

of the intercostal spaces. Splenic blowing murmur may sometimes be caught. Leucohæmia, if present, will confirm the inference otherwise deduced as to the existence of a certain kind of splenic enlargement; but a natural state of the white blood corpuscles will not exclude the idea of enlargement of other kinds.

812. The distinctive marks of *hydrothorax*, *intra-thoracic tumor*, and *cancerous infiltration of the lung*, will be described with those diseases.

813. *Tubercle*, in its ordinary seat, at the upper regions, cannot be confounded with effusion, which accumulates below. If the entire lung be solid from tuberculous disease, softening and excavation signs exist superiorly, and the progress of the signs is from above downwards; in effusion, they advance from below upwards. Loss of resonance never advances to such absolute tonelessness in phthisis as in effusion; some amount of resilience of the parietes remains too. Mensuration proves the existence of diminished bulk in phthisis,¹ of increased width in effusion. The heart, if displaced in tuberculous disease of the left lung, is carried upwards; in effusion of the left pleura, to the right side; in tuberculous disease of the right lung, the heart may be drawn to the same side; in right effusion, the heart is pushed to the left. Tuberculous disease of an *entire* lung does not exist without implication of its fellow; any amount of effusion may exist in one pleura, the other remaining unaffected. In effusion the respiration is null or weak, distant and diffused blowing; in phthisis, superficial, of various qualities, and attended with rhonchi.

814. The signs of the absorption period of pleurisy, in active progress, cannot be confounded with those of any other disease. Pleural pseudo-rhonchus [355] and pseudo-crepitation in the lung, from unfolding of its shrunken substance [343], can with very little care be distinguished from true pneumonic crepitation, either primary or redux.

815. Pleurisy, at the period of absorption with retraction, can only be mistaken for affections attended, like itself, with diminished bulk of the affected side, viz., tubercle, chronic pneumonia, cirrhosis of the lung, and infiltrated cancer. Where tubercle diminishes the measurements of the side, it does so mainly superiorly, pleurisy mainly inferiorly: the respiration-movement is greater in tubercle than in chronic pleurisy with retracted side. In tubercle both lungs are diseased; in chronic pleurisy the organ of the unaffected side may grow extra-healthy, hypertrophous. The signs of softening of the lung are, of course, wanting in the pleural affection. The distinctive signs from the other diseases named are given with the histories of these.

¹ In acute tuberculization with attendant pneumonia, however, this measurement may be increased. Hodson, U. C. H., Males, vol. ix. p. 17.

Prognosis of Acute Pleurisy.

816. Even the Registrar's reports would suffice to show that acute pleurisy, is not the terribly mortal disease schoolmen formerly taught. Thus, while the returns for England and Wales give in two years and a half, taken indiscriminately, 140,096 deaths from phthisis, 47,270 from pneumonia, 19,026 from bronchitis, the quota for pleurisy is but 1994: and these figures of course comprise deaths from bilateral and diathetic pleurisy of all kinds.

That the real guide to prognosis in idiopathic unilateral pleurisy is supplied by the absence or presence of diathetic or other chronic ailment, is inferrible from statements already made [793].

Treatment of Acute Pleurisy.

817. In the acute disease, especially if the pyrexia be of sthenic character, venesection to an amount proportioned to the urgency of the symptoms, and the strength of the individual, should be employed; from a healthy male adult, from ten to fourteen ounces of blood may be taken with propriety. Local depletion by leeches, or better, by cupping, should follow this if the pleuritic pain continue; and in cases of moderate severity, should be the only mode of blood-letting employed. I have not observed any more favorable results in cases where blood-letting was pushed to extremes than where used in moderation: the risk of anæmia and protracted convalescence should not lightly be incurred; and, on the other hand, the time for absolutely arresting the disease in its course has generally passed when the patient comes under observation.¹

818. Next in order, not inferior in importance, to blood-letting (evacuation of the bowels having been quickly effected) comes mercurialization, to a slight amount of the system: the more rapidly this influence is produced the better: and hence, for the first six hours, small doses of calomel and opium (a grain and a half of the former to a sixth of a grain of the latter, or more, if the pain continue acute) should be given every half hour, while mercurial ointment is rubbed, every fourth hour, into the affected side, especially near the axilla. A patient thus treated should be watched from hour to hour almost, and the moment mercurial action exhibits

¹ A boy (Henry Falkness) was admitted in the evening of January 10, 1851 (U. C. H.), with acute pain in the side, and dyspnoea. My clinical assistant, Mr. G. Webster, finding marked friction-sound on examination, ordered twenty leeches to the spot. The next day I could not detect a vestige of friction; effusion-signs neither occurred then nor at any time (the boy leaving perfectly well ten days after admission—he was detained thus long for purposes of observation). About the fourth day a shade of grazing friction-sound was caught in the old spot. Were exudation and effusion absolutely prevented here by treatment; or, was the case one naturally inclined to stop short at the *dry* stage? The friction-sound would formerly have appeared to me to have been too intense for the latter hypothesis; but the case already referred to (p. 208, note) shows that friction of the most marked type may exist without exudation-matter.

itself the mineral should be stopped; ptyalism is not the object to be attained. After some twelve or twenty-four hours, small quantities of tartar emetic, or of James's powder, may be given, in combination with the mercurial, if (what is rare, on the plan described) the administration of this have been required so long to produce its special mode of action. Small doses of opium and ipecacuanha at night allay cough and irritation.

819. As soon as depletion has been pushed as far as is intended, and the pyrexia has more or less completely yielded, a large blister may be applied to the affected side, but not precisely to the mainly inflamed part; its influence over yet lingering pain is sometimes most remarkable, and it probably discharges the sub-pleural vessels, by causing effusion from them, and by loading those of the skin. The application of a blister, directly over the seat of friction-sound, sometimes, it is true, removes this within a few hours, but too rapidly to justify the idea of absorption having occurred: either adhesion takes place, or a small quantity of fluid, thrown out beside and within the layers of plastic lymph, renders their collision comparatively noiseless.¹

820. If, in spite of these measures, fluid continue to accumulate—or if that already thrown out remain stationary—a succession of flying blisters, each of them not kept on for more than six hours—and friction with ioduretted liniments, should be employed externally, while diuretics are steadily administered internally; nitrate, acetate, and bitartrate of potass, squill, nitric æther, juniper, infusion of digitalis (the latter, particularly if the pulse remain frequent), are the agents of this class commonly used. I believe the compound tincture of iodine, in scruple doses, freely diluted, to be a valuable medicine at this juncture. The action of any of these medicines is facilitated by the exhibition of blue pill, digitalis, and squill, every night, or every second night.

821. The diet should be low, and if there be effusion to any amount, much drink should be abstained from; enough will be taken with the saline diuretics employed.

822. The period at which paracentesis may become advisable will by-and-by be considered.

Treatment of Chronic Pleurisy.

823. The chronic disease presents itself practically under three main conditions: first, the thorax is retracted, the lung incapable, the side painful, the general health impaired; secondly, the side is retracted, its walls fistulous, and a more or less profuse discharge

¹ The late Dr. Macartney, of Dublin, taught that flogging sometimes produced pleurisy in schoolboys—an opinion they would doubtless wish were generally made known to schoolmasters: if the fact be so, it would illustrate the local effect of blisters referred to in the text. Upon the more or less close proximity of a blister to an inflamed surface will probably depend its exercising an *antagonistic* or a *sympathetic* effect, in accordance with the principle clearly elucidated by Henle.

of pus is habitual; thirdly, the side is permanently distended with fluid (*empyema*).

824. In the first case, art can do no more than palliate symptoms as they arise, and support the strength on general principles. Fortunately in some such cases all local inconvenience ceases after a time, and moderately good, if not robust, health is obtained. The wasting suppuration in the second case points to the necessity of tonic treatment: quinine, iron, and cod-liver oil, are essential to the support of the individual. Efforts may be made, by injecting the sac with slightly stimulant fluids, to alter the character of its secreting surface, and perhaps even induce its sides to cohere: ioduretted fluids are the best suited for the purpose.

825. In the management of the third condition, that of *empyema*, three indications present themselves: (1) the control of febrile action; (2) the promotion of absorption; (3) the support of the general health.

826. (1.) If antiphlogistic measures have not been put in force with sufficient energy during the acute stage; if febrile action accompanied or not with local pain, exist; and if the constitutional powers appear not to be severely depressed,—general bleeding, to a limited extent, may be cautiously had recourse to. But it is easy to do mischief by venesection; even under the circumstances supposed, an amount of depression will occasionally follow moderate loss of blood from a vein, which may not easily be recovered from.

827. The application of some six or eight leeches once or twice a week to the side, for a week or two, is not open to the same objection; and even where local pain and febrile action are totally absent, much benefit may be obtained by the practice, provided the effusion be not of old standing. Or some three or four ounces of blood may be drawn on each occasion by cupping.

828. Is mercury advisable at this period of the disease? Certainly not, if it have already been used in the earlier stages; certainly not, if there be much wasting of the system, or if there be reason to fear that the fluid in the pleura is purulent. Under other circumstances, a cautious trial of mercury by the mouth and by inunction ought to be made.

829. (2.) Should the disease not yield to these measures, the promotion of absorption is to be further attempted by the use of medicines acting on the secretions; or the use of such medicines may be commenced, while the foregoing plan is pursued.

830. Iodide of potassium and liquor potassæ in full quantity, the former in doses of from five to ten grains, the latter in doses of from fifteen minims to a drachm, thrice daily, especially if care be taken that the stomach is empty when they are swallowed, sometimes very obviously reduce pleuritic effusions. But the total failure of iodide of potassium, even when pushed to repeated iodism, is unfortunately far from uncommon.¹

¹ Crowhurst, U. C. H., Males, vol. x.

831. *Diuretics* should be exhibited in various forms: the salts of potass, especially the bitartrate and acetate (the former in half-drachm doses, or upwards), and infusion of digitalis, may be commenced with. Digitalis both acts more efficaciously as a diuretic, when administered in infusion, and appears less prone to produce those poisonous effects which occasionally result from its accumulative action. The compound tincture of iodine, largely diluted, is now, as earlier, a very valuable agent of this class. The sustained use of *purgatives* is perhaps deserving of trial, if diuretics fail; but their action, being of a more depressing kind, requires to be carefully watched. They should be very cautiously exhibited when the lungs are tuberculous, either because the intestinal walls already contain tubercle, which may thereby be more speedily brought into the stage of softening, and induce ulcerative destruction, with its consequences, of the mucous tunic; or because the irritation, of the bowel in a person already phthisical accelerates the deposition of tubercle there. I have seen more than one case in which uncontrollable diarrhoea, brought into existence under the former circumstances, evidently hastened the patient's dissolution. On the other hand, dyspnoea, which has resisted various other measures for its relief, may occasionally be removed or materially relieved, and this almost instantaneously, by an active hydragogue. I have observed this from the exhibition of elaterium, even where no manifest change in the thoracic physical signs followed. *Diaphoretics* may be employed, particularly if there be occasional febrile action; but neither in these medicines nor in *expectorants*, as promotive of absorption, can any confidence be justly placed. *Counter-irritation* of the affected side has been employed in every variety, from the mildest to the most severe. The only contra-indication to the use of agents of this class, is the presence of fever. No matter what precautions be taken, their very common tendency is to increase this, where it exists, and hence to promote a condition extremely unfavorable to the advancement of absorption. "First remove feverish action, and then counter-irritate," is a maxim of primary importance. The application of *blisters* exercises a very manifest influence on effusions, when had recourse to with the caution just stated. They should be repeated frequently, made of large size, applied in different situations, not kept on longer than is just sufficient to produce vesication, and every means used to secure rapid healing of the blistered surface.¹ Employed in this way for some time—say a fortnight—blisters are often most signally beneficial; and I am the more anxious to state emphatically their utility in these cases, because the incredulity as to their efficacy in *acute* parenchymatous and membranous inflammations, now arising among the profession, might possibly be extended to their action in *chronic* maladies of the kind at present under consideration.

¹ Of all such means, dressing with cotton-wool is the best.

Should any objection to the use of cantharides exist in particular cases, the tartar-emetiic ointment, or a Burgundy-pitch plaster, sprinkled with tartarized antimony, may be substituted; but these are much less advantageous applications. Issues, setons, moxas, and the actual cautery, have all had their advocates and employers in the very advanced stages of the disease. The moxa is probably the most advisable of these, both positively and negatively, and may be had recourse to when the use of blisters has failed to affect the disease. The moxa will be comparatively most beneficial when the effusion is of very long standing, and attended probably with anatomical change in the bones and ligaments.

832. (3.) When the disease has become decidedly chronic, the general health is to be sustained by a succulent non-stimulant diet. Strong broths, meats of easy digestion, jellies, &c., may be taken with a degree of freedom proportional to their observed effects; and to this increasingly liberal diet may be added the use of cod-liver oil and bitter tonics, combined with small doses of nitro-muriatic acid. If these be well borne, the various preparations of iron, especially the syrup of the iodide, should be employed. There is decidedly a stage of the malady, or, perhaps, rather a condition of the organism generally, in which, although some feverish action be present, the patient will be benefited by tonics.

833. Change of air sometimes exercises a very manifest influence on the condition of patients with empyema—primarily, it would appear, on the general health, and, through this, on the effusion. The mere fact of change almost seems to suffice; for there may be no positive superiority in the new atmosphere, in which the improvement occurs, to that for which it has been substituted.

834. The modes of treatment now described sometimes fail altogether. The effusion either remains stationary or increases, and evidently must destroy the patient in the end. Under these circumstances, a resource is still left in the operation of *paracentesis*—a procedure which, no matter how divided opinion may be respecting its general feasibility, has assuredly been sufficiently often either completely successful or productive of marked improvement, to justify its being numbered among the valuable gifts of surgery.

835. It must, indeed, be conceded that this language is scarcely strong enough, if statistics do not greatly deceive; for the results of 132 operations collected from various journals by Dr. J. A. Brady¹ are to be set down thus:—

Recovery complete in	79 cases.
Relief	14 “
Death	37 “
Effects null	1 “
Result unknown . . .	1 “

The only objections of importance to these figures are, that in many instances the career of the patient was not followed sufficiently

¹ New York Journal of Medicine, March, 1856, p. 274.

long after the operation, and that successful cases are naturally *selected* for publication.

836. The quality of the effusion has been held, since the days of Hippocrates, to influence the results of paracentesis—success being less likely to ensue where the fluid has been purulent from the first, than where sero-albuminous. Still, cases, wherein the contents of the sac were thoroughly purulent, have terminated favorably; and it would seem from Dr. Brady's subjoined figures that the point at least requires reconsideration:—

Effusion.	Total cases.	Recovered.	Relieved.	Died.
Pus	52	37	2	13
Serum	59	29	12	18
Sero-pus	8	5	0	3
Unknown	13	10	0	3

837. In respect of quantity, the less abundant the effusion, it is said, the stronger the chances of success. Yet recovery has followed when the fluid measured several quarts.

838. Empyema running a chronic course from the outset, is generally indicative of tuberculous disease of the lungs, and is so far an unfavorable species for operation. Yet, inasmuch as the exudation-matter in such cases is very frequently friable and imperfectly plastic, and the lung therefore less firmly compressed and bound down, than when the solid exudation possesses the opposite qualities, one condition conducive to successful issue—facility of expansion on the part of the lung—is secured; and hence, doubtless, it is that, despite the counterbalancing diathetic evils, great relief and prolongation of life have sometimes been effected in such cases.

839. The operation has been much more successful in young persons than in those of mature years; and somewhat more so on the left, than the right, side of the chest.

840. A notion of the probable result of the operation may be had from the condition of the functions in general; if the conservative functions, digestion and nutrition especially, be only moderately impaired, the chances of the patient's recovery are stronger than under the contrary circumstances. It may, too, be fairly asserted that no combination of ill symptoms renders relief an impossibility. Thus in the case of a youth¹ whose acute seizure took place five weeks before, and in whom general anasarca, exhaustion, and all the evidences, cerebral and other, of partial asphyxia, pointed to certain death within thirty-six hours or so, the operation (the fluid withdrawn was pus of intolerable fetor) prolonged life in relative comfort for twenty days.

841. The determination of the period of the disease most favorable for operating is of the gravest importance. Experience proves, as might have been anticipated, that when performed at an advanced

¹ Seen with Messrs. Harrison, of Braintree.

period, paracentesis is rarely curative, sometimes baneful: the local changes which have then had time to arise in the pleura, pernicious as these are, are even less subversive of success than the deep constitutional distress entailed by the disease. And yet, to this period, puncture of the chest is often, I might almost say commonly, postponed; it can hardly be matter of surprise, that in some such cases it has appeared to do little more than hasten death. There can be no question that the fitting time for operation has come, when a tendency, insuperable by medical means, exists either to increase or to non-absorption of the fluid. The practical difficulty is to determine the precise period at which such tendency may be considered to be developed. On the one hand, perseverance in a given mode of treatment has sometimes proved successful, when everything seemed to foretell its probable inefficacy; and on the other, valuable time may be frittered away, and the period at which paracentesis affords real chance of permanent relief but too easily suffered to pass by, from the procrastination caused by a very natural anxiety to give more gentle measures a full trial. A thorough consideration of the whole history of the case, as also of the existing local and constitutional states, is required to enable the practitioner to seize the propitious moment for surgical interference.

842. Hippocrates was doubtless right in his precept that paracentesis should not be performed before the fifteenth day of effusion; but how soon after does it become permissible? The actual indications for the operation may become as strong in one person at the end of a fortnight as in another after the lapse of three weeks.

843. Sédillot, a warm advocate of paracentesis under a variety of circumstances, has collected cases showing that "in the acute stage, the operation produces an excitement capable of aggravating all the symptoms, causes more or less abundant hemorrhage, and accelerates death." M. Gendrin, at one time uniformly operating in cases of acute effusion, was forced by the "constant death of his patients" to relinquish the practice.¹ On the other hand, Dr. Bowditch,² fortified by the experience derived from having performed, or witnessed, the operation in twenty-five cases, would not wait so long as three or four weeks in acute attacks, provided the effusion continued to augment. As a palliative measure, where pleurisy is connected with tuberculous or other diathetic disease, the operation seems occasionally to have relieved in the acute stage—more frequently to have placed the patient in a worse position than before. Writers speak of its necessity, where asphyxia is threatened by the copiousness of effusion; such form of danger I have, however, never witnessed in the acute stage of the simple unilateral disease.

844. If abundant effusion on one side be associated with single or double pneumonia and general bronchitis, and, depletion having

¹ Sédillot, de l'Empyème, pp. 127, 83.

² Ranking's Retrospect, vol. xix.

been carried as far as permissible, urgent dyspnoea continue, temporary relief at least will be obtained by paracentesis, and time thus gained for the action of remedies. And should effusion occur on the hitherto healthy side, its fellow being seriously retracted by the chronic disease, prompt removal of the fluid by operation is positively indicated.

845. Do statistics help us to a definite opinion on this question of time? Unfortunately of the 132 cases collected by Dr. Brady, there are 55 in which the duration of the disease was unrecorded; and among the 37 cases of deaths, the time of the fatal issue was unknown in 19. However, the following numerical results may be obtained from his facts:—

Duration of disease.	Number of operations.	Number of deaths.	Ratio.
Under two months	34	3	8.8 per 100
Under four months	20	6	30.0 per 100
Under nine months	18	6	33.3 per 100

The authority of figures is then added to that of unanalyzed experience in favor of moderately early operation—nothing more.

846. The operation having been determined on, as a measure of precaution, especially if any doubt exist as to the precise nature of the case, a delicate exploring trocar should be introduced into the pleura: if the expected fluid appear, the operation may be continued with a medium-sized trocar or a bistoury. The trocar is certainly the more advisable instrument, if the intention be to evacuate the fluid by degrees—an intention which we believe Laennec to have been right in commending, when the patient is so debilitated as to justify an apprehension that the complete discharge of the liquid might be followed by dangerous syncope; and when paracentesis is merely performed as a palliative in advanced tuberculous cases. Even when the intention is to remove at once as much as possible of the fluid, the results have on the whole been most favorable with the trocar.

847. The first point to be ascertained, in selecting the place for the performance of the operation, is the adherence or non-adherence of the lung to the chest, and, in the former case, if possible, the precise limits of the adhesions. It is scarcely necessary to say, that the site of these must be carefully eschewed. When the entire side is free from adhesion, the common advice of surgical writers has been, that the opening be made at the most dependent part of the antero-lateral part of the chest. But indiscriminating attention to this advice, given with the sole view of securing free egress for the pleural fluid, has occasionally led to perforation of the diaphragm and abdominal viscera; even the kidney has been extensively wounded by operators whose practice is to adhere too scrupulously to such injunctions. Laennec recommended the fifth interspace, a little in front of the digitations of the serratus magnus muscle, as the fittest site for puncture. The importance of opening

the fifth instead of a lower space, has been justly insisted on by Drs. Townsend and Stokes, who draw a fair analogical argument in favor of high puncture from the elevated position in which the discharge commonly occurs, when spontaneous or preceded by the formation of abscess: the opening has, then, sometimes taken place even above the clavicle. If the ribs cannot be clearly distinguished on account of the presence of marked œdema, some difficulty may arise in fixing upon the spot for incision. Steady and continued pressure with the pulps of the fingers will sometimes enable the operator to discover the edges of the bones in cases where this would on first view have appeared altogether impossible.

848. The place for operation having been duly determined on, a horizontal incision should be made through the integument for the introduction of the point of the trocar. Care should be taken not to carry the instrument too close to the borders of the ribs, lest the corresponding branches of the intercostal artery be wounded.

849. If the operator have been fortunate enough to incise the pleura over the site of the firm, thick, and strongly adherent pseudo-membrane, and in consequence no fluid appear, the line of conduct to be further pursued must vary with his confidence in the correctness of his diagnosis in other respects. If he still remain satisfied of the presence of liquid effusion, the attempt to evacuate this may be proceeded with; if he be apprehensive of having altogether erred, the obvious course is to dress the wound, and avert, as effectually as possible, the ill effects of the unnecessary suffering to which the patient has submitted. In the former case, surgeons have attempted to tear asunder the pleural adhesions, a procedure utterly unjustifiable: the only admissible modes of acting are, to enlarge the existing opening with the bistoury, or to make a new one. The opening may be enlarged, if the free border of the membranous mass interfering with the escape of the fluid be ascertained to be perfectly close to the angle of the existing wound; under other circumstances, a new incision must be made.

850. Two other methods of opening the chest are, 1, by *perforation of a rib*; and, 2, by the *formation of an eschar, either by the actual or potential cautery*.

851. The plan of perforating a rib with a trephine constructed for the purpose, fallen into disuse since Hippocrates, has been recently revived by M. Reybard. The object of this surgeon, in recurring to this antiquated practice, was to insure a solid support for a canula, which he proposed leaving in the pleura, as a sort of drain for, or, at least, means of removing at will, any new accumulation which might arise. A case thus treated, previously operated on in the ordinary way, terminated favorably; and neither caries nor necrosis of the bone appear to have complicated its progress. From this single case it is, however, impossible to draw any safe

inference as to the general expediency of the plan.¹ The "drainage" plan of Chassaignac seems here to be anticipated.

852. Modern surgery repudiates the idea of opening the chest by an eschar produced with the actual cautery; and we can imagine no advantage gained by substituting caustic potass for the trocar or bistoury, while numerous very serious objections to such a procedure manifestly exist. Nevertheless, in cases where an external abscess has formed, and in these alone, the opening in the skin may, if the patient be excessively timorous and impressed with a dread of cutting instruments, be made with a piece of caustic potass.

853. Some writers lay very great stress upon the importance of preventing the occurrence of pneumothorax;—hence the invention of various modifications of the common canula, constructed with the view of insuring the non-entry of air. Some of these have invariably, others occasionally, been found failures. The proposed plan of puncturing the chest under water would entail difficulties and dangers of its own. And though it need not be questioned that the entry of air is for obvious reasons to be deprecated, the great anxiety on the matter is evidently overdone: in numerous instances, where the physical signs of pneumothorax were distinctly detected after the operation, recovery has ensued. Speculative reasons may and have been, by various persons, adduced in numbers in favor of complete evacuation at once or of successive small drainings; the important point to remember is, that with the exception already mentioned [846], experience is in favor of as complete evacuation as possible. Curiously enough, many of the advocates of successive evacuations are at the same time energetic in denouncing the ill effects of pneumothorax; how they reconcile to themselves the recommendation of a mode of operating which doubles, trebles, quadruples, or even still further increases the chances of the entry of air, does not very clearly appear.²

854. The proposal to insure the removal of the entire collection of fluid, by drawing off with a syringe any portion of it which gravitates below the opening, is as old as Scultetus. Laennec advised the use of a cupping-glass and exhausting syringe, with the view of drawing off the remains of the fluid, and facilitating the expansion of the lung.³

855. It is advisable under all circumstances, to close the wound after the operation? If a fine trocar have been employed, the orifice closes without artificial help, and scarcely requires dressing of any kind. If the bistoury have been used, and the contents of the pleura have been completely evacuated, there can scarcely be

¹ Gazette Méd. de Paris, Janv. 1841.

² It has been shown, too, by Barthélemy, that air may be admitted once into the pleura of the horse with impunity; but that repeated admissions cause bad inflammation (Bull. de l'Acad. de Méd. t. i.)

³ A very ingenious instrument for the purpose is made by Coxeter, of Grafton street east.

any motive for leaving the orifice open. If the evacuation have been only partial, still it is better to close the opening than to leave a canula or tent in it, as the constant renewal of the air in the pleura is decidedly detrimental, and may, unlike entry of air at the first, be prevented by immediate closure of the wound. If, however, any species of canula were devised which would admit of the egress of fluid, and successfully oppose the ingress of air, this objection will cease to exist; and the facility afforded by such an instrument for the removal of any newly-secreted fluid, will be an important motive for its employment.

856. The changes induced by the operation are, or may be, of two kinds; *curative* and *pathological*. The former, which are local and general, are as follows: the diminution of the contents of the chest is, of course, attended with decrease in the dimensions of the affected side. In a case observed by Dr. Townsend, the semi-circumference, which reached $16\frac{1}{2}$ inches before the operation, had fallen to $13\frac{3}{4}$ inches on the ninth day after it. The approximation of the pleural surfaces is rendered manifest, sometimes at a very early period, by the occurrence of friction-phenomena; the patient is frequently enabled to lie on either side on the day, or even a few hours, after the operation: his dyspnoea is immediately relieved; the state of anxiety under which he labored disappears; the urine increases in quantity; and a sound sleep, the first, possibly, enjoyed for weeks, commonly follows the evacuation. Even in cases eventually terminating fatally, and terminating fatally through the influence of the operation (a *very* rare event), its immediate results may be of this favorable character.

857. Of the pathological effects, as they may be termed, of the operation, pneumothorax is the most inevitable: the question of its influence on the ultimate issue of the case has already been referred to. The continuance of secretion from the pleural surface for a greater or less period, and hence the constant renewal of empyema, is of very common occurrence. In rare instances, the characters of the newly secreted fluid remain those of that originally evacuated; in the great majority they change, the general tendency of the change being to the purulent character. The alteration from the almost purely serous appearance to the purulent is sometimes accomplished in twenty-four hours. When the fluid has been originally more or less completely formed of pus, but of a laudible kind, its conversion into a purulent matter, of bad quality and fetid smell, is not unusually observed. Under these circumstances, the injection of warm water or some other unirritating fluid becomes advisable. Should there be much appearance of putrescency, a small quantity of very dilute liquor sodæ chlorinatæ ought to be added.

858. Although the notion of giving tone to, and diminishing the irritation of, the diseased pleural surface by injections of tonic and alterative preparations, seems, on first view, of questionable justice; and although the practice has certainly not been attended with suf-

ficiently favorable results to warrant its general employment; yet a fair number of cases are recorded showing that ioduretted solutions at least may, under certain circumstances, not only be injected with impunity, but with the effect of completely curing empyema of long standing. M. Boinet, in particular, relates cases of this fortunate issue.¹

859. In the ordinary course of things, when the case is destined to end by the patient's restoration to health, the wound or wounds in the thoracic walls gradually close, and cicatrization is perfect within a short period; but in some cases the opening, instead of closing, acquires the characters of a fistula, which it retains for a variable period, and daily gives issue to more or less pus.

860. When spontaneous perforation of the costal lamina has occurred, and a portion of the contents of the pleura escaped through the opening into the subcutaneous cellular membrane, forming an abscess there, this should be opened without delay, in order to prevent the occurrence of sinuses and burrowing: so well established is this point, that the operation is under these circumstances termed *paracentesis of necessity*. The prognosis of paracentesis, as far as the operation goes, is, in this exigency, favorable above the average.

861. Cases of *double* empyema are, as a general rule, unfit for operation, unless evacuation be rendered necessary for the prevention of asphyxia. Should particular circumstances arise, under which paracentesis might on other grounds become admissible, an interval of time, varying in length with the condition of the patient, must be allowed to elapse between the two operations.

VARIETIES OF PLEURISY.

862. The varieties of pleurisy may be arranged according to the following plan:—

I.—*Idiopathic.*

Seat	{ Single; double. Unilocular; bilocular; multilocular. Circumscribed; costal; pulmonary; phrenic; mediastinal; interlobar.
Subjective Course	
Mobility	{ Obvious. Latent.
	Pulsating. { Subcutaneous. Intra-pleural.

¹ Arch. de Médecine, Mai, 1853. The proportions of tincture of iodine and iodide of potassium varied, in the cases related, between ten and fifty of the former, and one and four of the latter, to a hundred parts of distilled water. Severe iodism may follow the use of the stronger preparation. The injections may be repeated once, twice, or thrice a week, according to circumstances.

II.—*Secondary.*

Attending general diseases	}	{	Typhoid, typhus, eruptive, and puerperal fevers.
Attending diathetic diseases				Scrofula; Bright's disease; rheumatism; gout; scurvy; purpura; pyohæmia.
Caused by adjacent irritation	}	In the lung	{	Pneumonia; abscess; tubercle; cancer; gangrene; hydatids.
				In the adjoining organs
Traumatic	}	{	Contusions, wounds, and surgical operations in the chest-wall, perforative and non-perforative, with or without entry of foreign bodies; fracture of ribs or clavicle; hæmothorax.
Perforative				Through lung
		Through diaphragm	Cancer of stomach, œsophagus and liver; hydatids of liver; chronic pyelitis.	

863. It appears from this scheme that under a multitude of different circumstances, pleurisy is a disease for which the physician should be on the watch. The peculiarities of some of these varieties have already been spoken of; certain others will be considered with the diseases producing them; in the present place, a few only of the number will be briefly dwelt on.

A.—DOUBLE OR BILATERAL PLEURISY.

864. Although primary pleurisy is essentially unilateral; while the implication of both pleuræ almost surely signifies the existence of diathetic mischief, still bilateral pleurisy does, though very rarely, occur in persons the most thoroughly healthy and the most perfectly free from constitutional taint of any kind. This important truth appears to have escaped the notice of systematic writers.

865. I have seen such idiopathic double pleurisy in young adults of both sexes, as well as in persons advanced in years. In all the cases (four in number) common cold, in connection with emotional excitement, had acted as the exciting cause.

866. The gravity of the seizure is enhanced by (as far as I have seen) the certainty, that the pericardium will become involved: in one of my cases the peritoneum followed. There is obviously a proclivity to general serous inflammation. The lung-substance, wholly free at the outset, sometimes becomes slightly and superficially implicated at the close.

867. The prognosis is most serious: in every instance of which I have had cognizance the result was fatal. Death does not take place with the rapidity that might be anticipated,—a fact which, in the cases I have met with, was clearly referable to the inflammation having remained in the plastic stage longer than is usual in the unilateral disease.

868. In two cases, the most active antiphlogistic treatment, in

two others, mixed mild antiphlogistic and stimulant measures, failed to cure, though they stayed the progress of, the disease.

B.—CIRCUMSCRIBED PLEURISY.

869. The portion of pleura inflamed may be limited: the disease is then said to be circumscribed, and may present itself in different localities.

(1.)—PHRENIC PLEURISY.

870. The pleural covering of the diaphragm may be solely or specially affected. The pain, unusually severe, may be agonizing under the influence of full inspiration, is increased by certain movements and attitudes, corresponds accurately to the anterior insertion of the diaphragm, or extends downwards laterally (the peritoneal coating, as I have once seen, may then be suspected to be inflamed also), and varies in amount inexplicably from time to time. In rare instances the pain has been slight throughout: in such cases does the muscular substance escape? The cough is generally paroxysmal.

871. Hiccup, nausea, and vomiting, though occasionally observed, may be wanting, even though the phrenic peritoneum be implicated. Jaundice, noted once by Andral,¹ where the right pleura was affected, is not assimilable to the jaundice occasionally attending acute pneumonia, and can only be regarded as accidental. *Risus Sardonicus* has not fallen under my notice. Even though the central tendon be involved, pericarditis does not necessarily ensue. There may or may not be coexistent pneumonia, intense congestion, or (with dilated flabby heart) apoplexy of the adjacent base.²

872. Orthopnea with the trunk bent forwards, is on the whole frequent: but, even though the heart be obstructed and the lung congested in addition, the patient from time to time derives most ease from various reclining postures. Excess of upper costal breathing, and of general breathing-action on the unaffected side, is observed.

873. Intense anxiety, and distressing fear of impending dissolution, combined, if the pyrexia be high, with delirium, in some instances give a very grave aspect to the case.

874. I believe it to be impossible to detect friction-sound so long as the exudation is really confined to the phrenic and corresponding pulmonary surface. And life may be prolonged for several days without effusion of fluid. Hence the diagnosis is commonly an indirectly inferential process.

875. The frequency of phrenic pleurisy is obviously greater than is generally supposed; the perpetual occurrence of old adhesions in this situation is a sufficient proof of the fact. The agonizing pain

¹ Clin. Médicale, vol. ii. obs. xix.

² Case of J. S., seen with Dr. Markham.

of some common pleurisies has appeared to me referable to extension of inflammation to the substance of the diaphragm [789].

(II.)—MEDIASTINAL PLEURISY.

876. Inflammation of the mediastinal pleura is often accompanied with serous infiltration of the cellular tissue of the mediastinum itself; pseudo-rhonchus [362] will then be heard along the sternum.

(III.)—INTERLOBAR PLEURISY.

877. Pleuritic fluid accumulation, confined by adhesions between the lobes of a lung, may simulate a solid mass in the pleura or in the lung itself, or an aneurism. Dull percussion-sound, local bulging, weak or bronchial respiration, with vocal resonance, may exist in all three cases. But the pleuritic accumulation lies in the line of the interlobar fissure of the lung; the voice may have an ægophonic twang on its confines; there is no vocal fremitus over it; there is neither impulse nor vascular murmur; and the affection has a commemorative history, different from that of the other diseases named.

(IV.)—LOCULAR PLEURISY.

878. Local sero-purulent collections may form, encircled by a boundary of adhesions in any part of the pleural surface, and several such may coexist, forming sacs perfectly independent of, or communicating with, each other—whence bilocular or multilocular empyema. The adhesions forming the walls of these loculi of course unite portions of lung-substance to the surface; and so give rise to various modifications in the physical signs. The general character of these modifications is, that wherever adhesions exist, blowing respiration is heard; and if a portion of lung, of any size, even though condensed, be agglutinated to the surface, the percussion-sound will have more tone, with sometimes wooden or tubular quality, then directly over the fluid. The state of vocal resonance varies. I have, on the right side, found the vocal fremitus perfectly retained over such portions of lung.

879. Individuals who have been the subjects of extensive loose agglutination, undergoing subsequent attacks of pleural inflammation, present the signs of these multilocular collections in perfection. Isolated patches of surface, simultaneously or successively, and in positions the most unconnected, furnish the signs of exudation, effusion, and absorption, while intervening islets of the chest-wall remain perfectly free from any such signs. In one remarkable case of this kind, four successive attacks of pleurisy, occurring within a period of five months, were thus characterized.

C.—LATENT PLEURISY.

880. Pleurisy is said to be latent when it runs its course without producing decided subjective symptoms—when there are neither

local pain, cough, dyspnoea, nor febrile action. In cases of this kind, effusion may have reached to the clavicle, and driven the heart greatly out of its place, and yet the patient remain utterly unaware that his chest is the seat of disease. He seeks advice, either from a vague consciousness that he is not in his usual health, or for some ailment totally unconnected with the thorax. The physical signs reveal the true condition of things. The necessary treatment, once the disease is detected, is not modified in any important point (except that bloodletting need not be carried at all so far) by this latency of course; the great difficulty often consists in persuading the patient that there is really anything of a serious character to treat. I have repeatedly known persons with copious effusions of this kind follow their usual, more or less laborious, occupations.

D.—SUBCUTANEOUS PULSATING EMPYEMA.

881. Empyema, forcing its way through the costal pleura, may form one or more swellings under the skin, which rise and fall, if the parietal communication be free, with the acts of expiration and inspiration. This respiratory pulsation has long been known. But, some years since, Dr. M'Donnell showed, what had not been previously recognized, that a subcutaneous purulent collection of the kind may pulsate synchronously with the heart, strongly and expansively, and hence simulate an aneurism. The absence of thrill and of abnormal vascular sound or murmur, the presence of the ordinary signs of empyema, and often the situation of the pulsatory prominence, will clear up the diagnosis. For fuller information, the valuable paper of Dr. M'Donnell may be consulted.¹

E.—INTRA-PLEURAL PULSATING EMPYEMA.

882. But an empyema may become pulsatile under circumstances more singular than these, and still more likely to confuse the practitioner—I mean where there is no perforation of the costal pleura, and no accumulation of pus under the skin. I have twice, in cases² presenting all the ordinary physical signs of empyema on the left side, with displacement of the heart to the right, seen the inner part of the infra-clavicular and mammary regions close to the sternum, pulsate visibly, heavingly, and with sufficient force to jog the head at the end of the stethoscope—the aorta, as proved by *post-mortem* examination, being of natural calibre. In both cases, while the side generally was greatly dilated, gentle local

¹ Dublin Journ. of Med. Science, March, 1844.

² The first of these cases was seen (April 3, 1843) in consultation with Sir James Clark and Mr. Kingdon. Shortly after the first edition of this work was published, I had the gratification of receiving from Mr. A. Kempe, of Exeter, the particulars of a case observed by himself, successfully identified through the description in the text. In Mr. Kempe's very interesting case the pulsation was perceptible even at the upper two-thirds of the left back, as well as below the clavicle. I have seen two additional cases of the kind within the last three years.

bulging was manifest in the site of the pulsation. The circumstances that determined the diagnosis in favor of pulsating empyema, were the absence of vascular murmur at the seat of pulsation; the fact that the two sounds heard at this spot were very weak, and gradually increased in intensity, as the stethoscope was carried towards the heart; the absence of thrill below and above the clavicles, and of undue impulse in the latter situation; the perfect equality of the radial pulses; and the total absence of signs of concentric pressure, venous, tracheal, or cesophageal. Taken singly, no one of these characters could be held conclusive, but the entire series formed a most serious body of evidence against the admission of aneurism. In both cases, the pulsation disappeared with the absorption of the fluid, and the return of the heart to its natural position: death arose from independent causes. In these cases the pulsatile character was already present when I first saw them: the diagnosis would be easier, if impulsive action of the kind made its appearance in a case of empyema while under observation; the sudden occurrence and great amount of the phenomenon, unattended with any of the ordinary evidences of aneurism, would guard the physician against error.

883. Pulsation conveyed to empyema, and simulating that of aneurism by its force and heaving character, seems to be merely an excess of the slight fluctuation-movement in the fluid, which is not very uncommon in ordinary cases.

F.—PLEURISY CONNECTED WITH MAMMARY CANCER.

884. Among the most frequent secondary morbid states, in cases of cancer of the female breast, stands pleurisy, with or without cancerous patches under the pleura. Where sub-pleural cancer is not present to act as a direct irritant of the serous sac, it is probable the low inflammatory action, on the confines of the diseased gland, travels through the intervening tissues to that membrane. The frequency with which, in cases of extirpation of the diseased breast, pleurisy on the implicated side proves the immediate cause of death, lends support to this view.

III.—HYDROTHORAX.

885. Hydrothorax, dropsy of the pleura, or accumulation of serous fluid without inflammation-products, occurs actively, passively, or mechanically. Of the *active* or *irritative* kind is the true hydrothorax, occasionally putting the close to existence in cancer of the mamma, and also occurring, instead of actual pleurisy, in some cases of Bright's disease: on the whole, this variety is very rare. In the great majority of cases, hydrothorax is *passive* or *mechanical*, and either occurs as a part of general dropsy, or is produced by obstructed circulation through the lungs and heart, especially through the right side of this organ and tricuspid orifice,

or, sometimes, by that most rare disease, aneurism of the pulmonary artery.

886. *Symptoms.*—In hydrothorax the pain and “stitch” of pleurisy are wanting, and there is no tenderness under pressure. There is less cough, and may actually be none. But the mechanical effects of hydrothorax are commonly more serious than those of pleuritic effusion, for the simple reasons that hydrothorax is generally double, and sequential to more or less serious organic disease, already disturbing the respiration and circulation; pleurisy, on the contrary, generally single and primary. Hence the dyspnoea may be excessive, with constant orthopnoea, and extreme lividity of the face, anxious countenance, clammy perspirations, and coolness of the expired air. If the patient can lie down, he does so on the back, with slight inclination now to one side, now to the other.

887. The physical signs agree in some, disagree in other points, with those of pleurisy. Dulness under percussion, movable in area, with the changed posture of the patient—more readily so than in pleurisy from the absence of adhesive material; distant, weak, or suppressed respiration; bronchophony, occasionally ægophony or complete deficiency of vocal resonance; total loss of vocal fremitus, and occasionally peripheric fluctuation, are common to the two affections. But in hydrothorax there is no friction-sound or fremitus, and both sides are commonly affected, while in pleurisy one only generally suffers. Dilatation of the side and flattening of the intercostal spaces may exist in both diseases, but relatively reach a higher point in the inflammation than in the dropsy. The heart and mediastinum are but little displaced sidewise in hydrothorax, because the disease is generally double; the diaphragm may be very considerably depressed.

888. In rare instances hydrothorax has been known to disappear (as in the analogous case of empyema [798]) by a metastatic serous flux from the bronchial tubes.

889. *Treatment.*—If the dropsy be of the irritative kind, moderate cupping is beneficial, unless some distinct contra-indication exist; under all circumstances, dry cupping is advisable. If there be no marked œdema of the walls, the chest should be blistered. Painting the surface with caustic iodine, or ioduretted frictions, sometimes obviously promote absorption. The internal remedies are diuretics and purgatives.

890. Inasmuch as hydrothorax is commonly either a local manifestation of a diathetic disease, or the effect of irremediable mechanical mischief in the heart, little, as a rule, can be expected from paracentesis, at least in the way of permanent cure. But great temporary relief, and even prolongation of life, may be secured in urgent cases by the operation; and where asphyxia is threatened by double hydrothorax, it appears to me that puncture, on one side, should at once be had recourse to.

IV.—PNEUMOTHORAX AND HYDROPNEUMOTHORAX, INCLUDING PERFORATION OF THE LUNG.

891. By pneumothorax is understood accumulation of gaseous fluid in the pleura; the various modes of its production, real and alleged, may be classified as follows:—

- I. *No communication existing between pleura and external air.*
 - (1) Gangrene of pleura; (2) Chemical decomposition of pleural fluid; (3) Air replacing sero-purulent fluid, suddenly absorbed; (4) Secretion by pleura.
- II. *Communication between pleura and alimentary canal.*
 - (5) Rupture of œsophagus into pleura.
- III. *Communication with atmosphere through opening in chest-wall.*
 - (6) Penetrating wounds of thorax.
- IV. *Communication between pleural sac and bronchi.*
 - a. *Traumatic*:—(7) Tearing of lung-surface by broken ribs; (8) Violent contusion of chest, tearing lung without costal fracture.
 - b. *Perforation, from disease opening the pulmonary pleura from within outwards, or centrifugal*:—(9) Tubercle; (10) Gangrene; (11) Diffuse pulmonary apoplexy; (12) Hydatids; (13) Cancer; (14) Emphysema; (15) Abscess; (16) Rupture in pertussis; (17) Excavated bronchial glands opening into the pleura and bronchi.
 - c. *Perforation, from disease opening the pulmonary pleura from without inwards, or centripetal*:—(18) Empyema; (19) Parietal abscess.

892. As concerns Class I.: Gangrene of the pleura and decomposition of solid or fluid materials within its cavity act, in excessively rare instances, as the causes of non-perforative pneumothorax. It seems admissible, too, as a bare possibility, that, in those very exceptional cases of pneumonia, where true tympanitic resonance exists directly over the hepatized parts, resonance may be caused by air secreted by the pleura [217]. Of any other kinds of simple pneumothorax I know nothing clinically; nor have I ever seen a case justifying belief in the real existence of general idiopathic pneumothorax.¹ It has been taught on the evidence of a case recorded by Itard, that absorption of purulent matter may directly entail exhalation of air by the serous membrane. An old sufferer from empyema died with little pus and much gas (the latter, judging from the signs, of about three weeks' duration) in the pleura. The gas was of excessive fetor, not, however, it is held, from primary decomposition of the pus, but from chemical changes induced in healthy pus by gas originally odorless: this explanation is purely hypothetical.

893. Examples of Class II. are infinitely rare; and Class III.

¹ It has been too much the habit to pronounce pneumothorax idiopathic whenever a superficial examination of the surface of the lung fails to detect an opening in the pleura. A crease in the substance of the organ, or a patch of exudation-matter, will effectually conceal even a good-sized opening from view. The only trustworthy test is afforded by insufflation of the lung from the main bronchus under water. And supposing this test fails, it simply proves the absence of existing free perforation; such perforation may have existed, and have been closed up completely in a few days, as careful dissection of strata of exudation-matter has frequently proved.

belongs altogether to surgical practice. Pneumothorax, depending on internal disease, is in the vast majority of cases produced by perforative diseases of the lung, falling under Class IV.,—and probably in 90 per cent. of instances of pulmonary perforation the affection causing it is tuberculous. It is true that of 147 published cases of pneumothorax, collected by M. Saussier,¹ eighty-one only were phthisical. But tuberculous perforation is, relatively speaking, an every-day affair, which passes unrecorded; perforations from gangrene, vesicular emphysema, hydatids, pulmonary apoplexy, abscess, and other very rare causes, are greedily caught hold of, and registered. The number of the latter published, consequently, gradually swells out of proportion with their real frequency.

894. Of eighty-seven cases of tuberculous perforation, seventy-four collected from various authors, thirteen observed by myself, fifty-five were examples of the occurrence on the left, thirty-two on the right, side. The pleura commonly gives way posterolaterally in the area comprised between the third and sixth ribs. Perforation may occur at all periods of tuberculous disease,—and though commonly connected with the excavating process, sometimes depends on fresh deposition directly beneath the serous membrane: M. Louis records a case, where the pleura gave way, perforated by a small softening tubercle immediately beneath it, in a fortnight after the first appearance of phthisical symptoms. The occurrence is consequently to be looked for, as a possibility, at any period of phthisis.

895. The largest opening I have seen equalled a fourpenny piece in diameter, the actual dimensions having been probably increased in the manipulations necessary for the removal of exudation-matter: the smallest was not larger than a pin's head. The form is rounded or chink-like, and the communication with the air-passages direct or sinuous. The wider and more direct the perforation, the freer on the one hand becomes the entry of air in inspiration into the pleural sac; while the greater the chance on the other hand of some of that, actually effused, making its way back with the reflux of the tidal air. As matter of experience, the sac fills most rapidly, where the opening is small and sinuous: or where exudation-matter, loosely applied to the surface, permits the entry, but effectually bars the exit, of air through the valve-like aperture.

896. The opening may be double.²

897. The gas in pneumothorax, whatever be its chemical composition, acts as an irritant on the serous surface: the pleura inflames; lymph, serum, and, commonly, pus are thrown out, and the compound state, hydropneumothorax, is established. The total quantity of gas and fluid varies greatly; it may be immense. In

¹ Thèses de Paris, 1841.

² Healey, U. C. H., Females, vol. x. p. 166.

one case¹ we collected 119 cubic inches of gas and 214 cubic inches of sero-pus; the amount of the former was sufficient to float the body in a bath, with the affected half of the thorax raised out of the water. In a second,² a greatly distended sac contained but a few ounces of pus; in a third,³ no fluid was discovered. The clue to such differences is to be found in the length of time elapsing between perforation and death—in the first case, about twelve weeks; in the second, nine days; in the third, four hours.

898. In perforative hydropneumothorax, the gas in the pleural sac consists of oxygen, carbonic acid, and nitrogen.⁴ The proportions vary, ranging, according to analyses by Dr. Davy, between 2.5 and 5.5 of oxygen, 6.0 and 8.0 of carbonic acid, and 88.0 and 90.0 of nitrogen. The composition of the pleural gas, then, accords most nearly with that of expired air. How comes this, seeing that the air enters the pleural sac in inspiration? The serous membrane, it has been suggested, acts, as lung would, on the air entering its cavity,—a very palpable error. In point of fact the pleural air, though, physically speaking, inspired, is, chemically speaking, expired, inasmuch as it has passed through the lung. Besides, in virtue of the law of diffusion of gases, the gas in the pleura must be of the same composition as that in the adjoining lung.

899. Where gangrene has occurred, sulphuretted hydrogen and other gaseous products of putrefaction have been found.

900. *Symptoms: Invasion.*—From what has been said on the rarity of various other forms of pneumothorax, it follows that, in actual practice, the invasion-symptoms of pneumothorax are equivalent, provided we exclude traumatic cases, to those of perforation of the pulmonary pleura. And these symptoms are, first, sudden sharp pain in the side, often of agonizing, overwhelming severity; secondly, a sensation of rupture of tissue within the chest, followed by a feeling as if fluid trickled or poured down the side; and, thirdly, intense dyspnoea. If these three symptoms suddenly and unmistakably appear in a phthisical person, the diagnosis of perforation would rarely be at fault; but the second is habitually wanting; and I have known perforation occur, as proved by physical signs and inspection after death, without any one of the three announcing its occurrence. Coldness of the extremities and clammy perspiration indicate shock to the system at large.

901. *Subsequent course.*—Though dyspnoea, more or less grave, is the most enduring symptom of the accumulation of gas, its conditions vary. Once the first agony of the rupture has passed, temporary ease sometimes follows; or steady increase of the difficulty in breathing takes place, from the increasing pressure on, and

¹ Plympton, U. C. H., Males, vol. iv. p. 410; Clin. Lect., Lancet.

² Reilly, U. C. H., Males, vol. xvi. p. 158.

³ Imlach, U. C. H., Males, vol. viii. p. 402.

⁴ Reilly, U. C. H.: no oxygen (Birkbeck Laboratory, University College). Dr. Apjohn once found 8 carbonic acid, 10 oxygen, and 82 nitrogen.

disablement of the lung; or, on the contrary, though gas demonstrably continues to collect in the sac, subjective dyspnoea passes off. I have known the respirations number fifty-two in the minute, without the patient's feeling any of the sufferings of difficult breathing.¹ All expectoration sometimes abruptly ceases.

902. Fluid is sometimes demonstrably present within twenty-four hours after the occurrence of perforation. The precise moment of its effusion varies with the excitability of the individual; none may, as we have seen [897], have formed in four hours. Before its accumulation the patient lies most commonly and steadily on the back, inclining to the sound side with the head more or less raised. The chosen posture may be on the diseased side, once fluid effusion has freely occurred; but the same patient may often change his attitude and mode of decumbency. Orthopnoea may be constant from first to last; and is always observable from time to time.

903. The pulse is excessively frequent; but the respiration relatively more so: I have known the ratio perverted into one of 2.3 to 1. The countenance is pinched, anxious, and imploring; the lips, cheeks, and face generally more or less livid; the sleep consists of fitful dozes at rare intervals; the skin is moist, sometimes bathed in cool clammy perspiration. The voice habitually loses strength greatly, and almost complete aphonia has sometimes been observed. Œdema of the affected side of the thorax is, at the least, very rare, before pneumothorax has been accompanied, and this for some time, with pleuritic effusion. In the case of rapid death already referred to, copious hydropericardium, amounting to nine ounces and a half, obviously hastened the fatal issue; the pneumothorax was on the right side, the lung flattened against the spine. Was this a mechanical dropsy of the pericardium caused by sudden pressure on the venæ cavæ and right side of the heart?

904. *Physical signs.*—(a) *Pneumothorax.*—The physical signs of pneumothorax are very significant. The chest-motions suffer more or less extensively in freedom; they may be absolutely null at the lower part of the affected side: where there is any play, the intercostal spaces deepen during inspiration greatly—or they may do so, independently of action in their own planes, through atmospheric pressure. The vocal fremitus is weakened or annulled; the width of the side increased to the eye and to measure; the interspaces, widened and even bulged outwards inferiorly, may be natural superiorly.

¹ Plympton, Clin. Lect., loc. cit. p. 575. I well remember, too, an ex-dragoon, originally of athletic form, in the third stage of phthisis, as an out-patient of the Consumption Hospital, coming to me one day with somewhat of a more anxious facies than usual, and complaining of a slight pain below the right nipple of some hours' duration. He had walked without difficulty upwards of a mile to the hospital, and yet the right chest was so full of air as to have pushed the heart to the left axilla: all the signs of perforative pneumothorax were perfectly developed, and death occurred within a fortnight from the consequent pleurisy.

The percussion-sound falls in pitch, increases in mass of tone [Type 2: 197], eventually becoming of true tympanitic quality, and retaining this until the accumulation of air becomes excessive [201]. Local pneumothorax, in front of the trachea and large bronchi, may give an amphoric note; so too, however, may general pneumothorax: at least I have ascertained this, where a very small quantity, only, of fluid coexisted [216].

905. If the quantity of air be moderate, the respiration is of distant, weak type—if considerable, suppressed, except close to the spine. The conditions of vocal resonance vary: there may be mere nullity of sound; in some cases the resonance is loud and diffused; and possibly it may be sometimes accompanied with metallic echo. The heart's sounds are, as a rule, obscurely transmitted through the air in the chest; but sometimes (as in the analogous case of air-distended stomach) they are intensified and acquire a metallic quality or ring.

906. The mediastinum, heart, and diaphragm are more or less displaced, and the grave or tympanitic percussion-note may extend considerably beyond the middle line.

907. (*b*) *Simple Hydropneumothorax*.—In these cases the signs are a combination of those of pleuritic effusion and of pneumothorax—the former at the lower, the latter at the upper, part of the side.

908. (*c*) *Fistulous Hydropneumothorax*.—When hydropneumothorax coexists, as is the rule, with perforation of the lung, fluctuation may be felt both by patient and observer, when the chest is abruptly shaken; peripheric fluctuation exists to its maximum amount;¹ while Hippocratic succussion-sound, with its metallic ringing splash, readily produced one day, may be absent the next: these three signs may exist, although closure of the perforation has taken place.

909. By percussion the deficient resonance dependent on fluid, and the tympanitic quality produced by air, are found, according to the posture of patients, the former inferiorly, the latter superiorly: but the exact sites of both may be variously changed (unless adhesion,² which is rare in well marked cases, interfere) by altering that posture. Between the areas of tympanitic air-resonance and the dull sound of the fluid a narrow space may exist, furnishing an amphoric note,³ and also a quivering sensation to the fingers, produced obviously by the momentary displacement of the fluid.

910. The respiration weak, distant, or amphoric, may or may not be accompanied with metallic echo or tinkle; the cough and vocal resonance are similarly echoed: the amphoric quality is most obvious, the nearer the perforation auscultation is performed.

¹ Plimpton's case, loc. cit.

² Singularly arranged in Healy, U. C. H., Females, loc. cit.

³ Plimpton's case.

But it must not be forgotten, that the respiration-sounds in some cases, when the fistula is variably open, amphoric at one time, are simply weak and distant or actually suppressed at another. Under these circumstances a peculiar inspiratory sibilus is sometimes heard all over the side, and probably depends on escape of air through the chink in the lung.¹

911. The heart's sounds, commonly weakened in their passage across the distended pleura, may be intensified by unison-resonance [433], or followed by metallic echo.

912. The various displacements of organs are carried to the extremest possible limit.

913. *Diagnosis*.—The distinctive marks between pneumothorax and highly marked emphysema are considered with the latter disease.

914. *Prognosis*.—The prognosis of perforative pneumothorax is very difficult to establish at the time of its occurrence. It may prove fatal within twelve hours,² a few days, or a week or two—or the patient may completely recover from its immediate effects. The clue to these differences is by no means easily found; for, although in some cases the slight amount of previous pleural adhesions (a state permitting great accumulation of air) and considerable advancement, locally and constitutionally, of the disease causing perforation, appear to account plausibly for a rapidly fatal issue, death has been of tardy occurrence in some cases of the sort, and rapidly ensued where the attendant circumstances were precisely the converse. Nor does an examination of the state of the non-perforated lung aid very materially in settling the question; for, if, while in the main tolerably healthy, peripheral tubercles, even to a small amount, are lodged immediately beneath the pleura, that membrane may give way at any moment, and immediate death ensue; whereas experience proves that in some cases of prolongation of life after the perforation of one lung, the other has been the seat of numerous deep-seated cavities.

915. When the occurrence is not fatal at once, the perforation may either undergo closure by lymph or remain pervious. I have seen two cases of the former kind, in which all signs of air and fluid in the pleura had disappeared in the course of two months after the perforation; here the cure was absolute. Even when the opening remains pervious, the compound disease is not necessarily fatal. Laennec refers to a phthisical case where the signs of fistulous hydropneumothorax continued at the end of six years; and instances have now been collected in some numbers in this country and abroad, positively proving that not only may life be prolonged, but excellent health be enjoyed, while succussion-sound is well audible in the side; still such occurrences are completely exceptional.

¹ Plimpton's case.

² The most rapidly fatal case (in four hours) I have seen was that of Imlach, U. C. H., loc. cit.

916. In some recorded cases of actively advancing phthisis, the first sufferings of accidental perforation having passed, it has certainly appeared, though the signs of hydropneumothorax remained, that the phthisical symptoms themselves underwent improvement. But an occurrence so rare gives no warranty for the fanciful proposal to treat phthisis by producing artificial pneumothorax.

917. *Treatment.*—The treatment of perforative tuberculous pneumothorax is palliative. In cases of severe suffering, if the patient be seen immediately, or shortly after, the pleura has given way, while his agony, both of pain and dyspnoea, exists in all the intenseness of novelty, bleeding suggests itself as a means of relief. The quantity of oxygenating surface has been suddenly reduced, and the sudden disparity between that surface and the mass of the blood might, or must, I think, be somewhat lessened by diminishing the quantity of the latter. Whether this be the explanation or not, venesection does give very notable relief, and renders subsequent inflammation of the pleura less violent. It should then be had recourse to where the patient's strength has not been materially impaired by the previous disease. In doubtful cases, moderate cupping of the side may be substituted; or, if the effects of even this mode of depletion be feared, general dry cupping of the chest. It is singular what relief, both of pain and dyspnoea, is sometimes afforded by the latter process. Repeated flying blisters to the side are also most valuable agents. The bowels must be kept moderately open, perspirable action of the skin promoted, the strength maintained by nutritious animal jellies and broths, or by meat, if the patient's digestive powers be not enfeebled; while inflammatory symptoms are controlled as they arise.

918. Various antispasmodics prove useful in mitigating the dyspnoea—lobelia inflata, cannabis indica, belladonna, stramonium, aconite, and, above all, opium. I have seen musk, in doses of five grains, afford great relief.

919. In tuberculous pneumothorax, paracentesis can only, as a rule, be regarded as palliative, and, what is worse, temporarily palliative. Still, as the operation does not obviously place the patient in any way in a worse position than he had been in before, and as it may give new existence for a while, there can be no objection to its employment, and to its repetition, when physical signs show that the mediastinum and the non-affected lung are seriously encroached upon. I have had it performed twice under such circumstances, and with the effect apparently of prolonging life. In eight phthisical perforative cases, collected by M. Saussier,¹ one terminated by recovery after the operation. Ioduretted injection of the sac deserves trial.

920. It is difficult to lay down a rule for other varieties of per-

¹ Thèses de Paris, loc. cit.

forative pneumothorax; recorded cases are deficient in detail for our guidance, and to me it appears that where recovery has ensued, it would have occurred without the operation. If pneumothorax were suddenly produced in a fit of violent coughing, as in hooping-cough, and the patient had previously exhibited no evidence of organic disease of the lung, I should hold it advisable, especially if the symptoms were urgent, to puncture the thorax. In the case of empyema perforating the lung, I should not consider the fact of perforation an argument in favor of paracentesis.

SECTION V.—PULMONARY NEUROSES.

I.—PULMONARY HYPERÆSTHESIA.

921. The pulmonary apparatus is highly endowed with a special sensibility, as proved by the exquisitely painful sensation produced by want of air. Here is one of the chief sources of suffering in all forms of dyspnœa.

922. On the other hand the parenchyma of the lung is not only, under ordinary circumstances, feebly provided with common sensibility, but even in the state of inflammation is very rarely the seat of pain, at least of pain demonstrably referable to itself. Still, pain has occasionally been noticed in central pneumonia, where the pleura had wholly escaped; and various anomalous, and more or less painful, sensations felt by phthisical patients, deeply within the chest, apparently originate within the pulmonary texture. Certain morbid processes in the parenchyma appear then to excite well-marked tactile sensibility in the terminal filaments of the pulmonary nerves.

923. It seems impossible also to evade admitting, that in certain cases of intra-thoracic pain, occurring in persons free from organic disease, the pulmonary nerves are the seat of actual neuralgia. Such pains, deeply felt within the chest, and shooting in the direction of the pulmonary branches of the vagi and sympathetic, may exist independently of any other deviation from health, not only local but general—the absence of gastrodynia and intercostal neuralgia especially being demonstrable.

924. The only physical condition I have ever succeeded in connecting with these painful sensations, and this only in cases of phthisis, is jerking rhythm of the respiration. The quality of the breathing-sounds also may probably be roughened by such sensations in this class of cases: but neither intensity, nor any other attribute of respiration, is necessarily affected in even the severer examples of neuralgia.

925. Morbid phthisical intra-pulmonary sensations are either greatly relieved or altogether removed by counter-irritation, and emollient anodyne inhalation. They are not so directly, as might be expected, modified by anodynes taken internally.

926. Genuine neuralgic pains within the lungs are occasionally

found amenable to iron, quinine, arsenic, and remedies applicable to neuralgia generally; but, as a rule, they are obstinate.

II.—NERVOUS DYSPNŒA.

927. I mean by nervous dyspnœa painful respiration, characterized subjectively by distressing want of breath, though air freely enters the air-passages—while organic diseases of the lungs, heart, and great vessels, spasm of the bronchia and alterations of the blood (the causes of the various forms of asthma), are demonstrably absent. Limited to females, as far as I have seen, this form of dyspnœa may or may not be accompanied with hysteria.

928. The strong probabilities are, that this peculiar morbid state of the respiratory function originates in perverted innervation—genuine paræsthesia—of the pneumogastric nerves. But so long as the physiological control of those nerves over respiration continues imperfectly understood, caution is requisite in the interpretation of the varieties of dynamic dyspnœa.¹

929. It would seem certain that, while the normal experimental result of irritation of the vagi is inspiration,² there are occasionally disturbing conditions at work, which totally alter the effect of such irritation, and convert it into expiration.³ Herein may lie a clue to the comprehension of many of the anomalies of dyspnœa.

930. In nervous dyspnœa the respiration is frequent in excess; the respiration-sounds loud, exaggerated, somewhat harsh, are not seriously altered in quality.

931. The gastric branches of the vagus may likewise suffer, as indicated by uneasy sensations at the epigastrium and excessive or perverted appetite. It seems probable, too, that a saccharine state of the urine may follow:⁴ the dyspnœa then becomes, in part, of hæmic mechanism [1704].

932. This form of dyspnœa may temporarily occur in the course of organic diseases of the lungs.⁵

III.—NERVOUS APNŒA, OR DYNAMIC INFREQUENT BREATHING.

933. The singular infrequency of respiration in chorea may be used as an argument, tending, with others, to localize the perverted

¹ The amount of experimental labor of the most admirable kind bestowed on the physiology of the vagus from the day of Reid downwards, has been immense; yet the results are often so deplorably discordant, that the clinical student of the whole is often disposed to give up the matter as inherently beyond the power of elucidation. The discovery of the "inhibiting influence" of nerves, it is true, explains many seemingly contradictory results [1697].

² Gilchrist, Brit. and For. Med. Chir. Rev., vol. xxii. p. 500.

³ Experiments of Eckhard, Budge, Aubert, and Ischischwitz, quoted by Gilchrist, loc. cit.

⁴ Vide Sherman on "Neurosis of the Vagus," Med. Times, 1856.

⁵ Jones, U. C. H., Females, vol. xv. p. 271. Here the nervous dyspnœa was only of temporary duration in the course of phthisis.

dynamism of that disease in the emotional and respiratory-centre of the encephalon.¹

934. But there exist, besides, some cases, marked by infrequency and other peculiarities of the breathing-act, which seem clearly dependent on defective nervous stimulation—in a word, upon special anæsthesia of the vagus.² I refer to cases where the ordinary indications of hysteria are wanting; and in point of fact, as is familiarly known, hysterical breathing is unduly frequent, not perversely infrequent.

935. In this singular condition the respirations are rhythmically infrequent, numbering sometimes only six in the minute. The sounds are then exaggerated, but of good quality. The normal subjective sense of the necessity of breathing seems deficient; and, in some instances at least,³ voluntary effort at full inspiration scarcely produces the slightest ingress of tidal air. The state is a perfectly different one from the gradually rising and falling apnoea of fatty disease of the heart.

SECTION VI.—DISEASES OF THE PARENCHYMA.

I.—PRIMARY MORBID CHANGES.

936. A given portion of the lung may be brought within a smaller area than that it naturally occupies even in extreme expiration, by various causes depriving it, especially of its air, to a less degree of its blood: even the *persistent* air [122] may thus be removed. The implicated tissue is, in consequence, *condensed*.

937. Or, conversely, the proportion of air within the cells may be increased, and those cells distended; the involved tissue, taken as a mass, is consequently *rarefied*.

938. Again the quantity of air may remain stationary, or nearly so, while the proportion of tissue within a given area increases or diminishes; hence either *hypertrophy* or *atrophy* of parenchyma.

A.—CONDENSATION OF THE LUNG.

939. *Anatomical Characters*.—Simple condensation may affect an entire lung, one lobe, irregular ill-defined portions of a lobe, or sharply defined lobules, either separate from each other or in contiguous association.

940. Condensed parenchyma is tough, leathery, fleshy to the feel and look (hence Laennec's term, *carnification*); does not tear or break readily under pressure; sinks rapidly in water; varies in color, according to the quantity and condition of the blood in its vessels, from grayish to dull brown, violet, or purple; is non-crepi-

¹ Clin. Lectures, Lancet, January, 1849, p. 86.

² Valentin (Die Einflüsse der Vaguslähmung, &c., 1857) found that section of both vagi in the neck of a rabbit lessened the frequency of respiration by about seven-tenths.

³ M. Y., seen with Dr. Tapson.

tant; contains little or no fluid or froth; unless as a pure accident, encloses no exudation-matter; occupies less space than in the normal state, and is consequently depressed on the surface below surrounding parts; gives a plane smooth surface on section; and (unless under certain exceptional circumstances) may, with greater or less facility, be distended with air by insufflation from the communicating bronchi, when it becomes healthily colored and spongy.¹

941. Condensation of tissue is invariably the result of morbid influences beyond the part actually condensed, and is consequently an indirect, not a direct, evidence of disease. But if the condensation be maintained for any long period, the nutrition of the actual part itself undergoes impairment—atrophy ensues; the bronchial surfaces may also probably become coherent. To other morbid processes condensed tissue is little prone; the imperfect supply of blood tends to protect it from *sequential* inflammation, serous infiltration, and deposition of new products. But collapsed parts may be the seat of *antecedent* congestion and its results.

942. *Causes and Mechanism.*—Condensation of tissue may result from the following main causes: (a) *pressure* on the pleural surface of the lung; (b) *non-expansion* of cells; (c) *collapse* of cells.

943. (a) The typical conditions of diffuse condensation are best seen in lung pressed upon by fluid or by gas in the pleural sac. To a less degree the contracting action of exudation-matter, throwing the subjacent lung-substance into wrinkles more or less deep, condenses the intervening tissue. And if chance have deposited a ring of exudation round a portion of lung, the inclosed texture may be rendered completely airless.

944. (b) Non expansion of cells, originally described by Jörg, under the title of "*Atelectasis*" of the Lungs," is a congenital defect principally found in infants of low vital power, in whom the foetal heart-openings show little or no disposition to close, and respiration is from the first attended with difficulty. The condensation here affects the lobular form or arrangement, and especially occupies the anterior edges and posterior bases.

945. (c) In contradistinction to this congenital state stands acquired collapse, which may be limited to some portions of a lobule, or involve either separate lobules or irregular portions of lung.³

¹ To Bailly and Legendre (Archives Générales, 1844) we are indebted for the valuable idea of insufflating lung, as a test between solidity from collapse and from inflammation. It must not be forgotten, however, that the bulk of a hepatized spot may occasionally, unless the density be very marked, be slightly increased by insufflation; while on the other hand, in undoubted collapse, it is sometimes impossible to distend the part to its normal size.

² ἀτελής, "imperfect;" ἔκτασις, "expansion."

³ An elaborate attempt has been made by Fuchs (Die Bronchitis der Kinder, 1849) to show that the anatomical characters of congenital non-expansion and acquired collapse are variously different; but the alleged differences are too slight to require notice in a practical work.

946. Acquired collapse may, in almost all cases, be traced to influences directly obstructing the movement of air in the communicating tubes; the superficial area of the collapse being directly, and the amount of the collapse inversely, as the calibre of the obstructed portion of the air-passages. The diseases in which such collapse has actually been met with, may be grouped in the following manner:—

- | | | |
|-------|---|---|
| A ... | { | Chronic enlargement of the tonsils. |
| | { | Permanent narrowing of the glottis. |
| | { | Encroachment of tumors, &c., on the upper air-passages. |
| B ... | { | Spasmodic asthma. |
| C ... | { | Bronchitis. |
| | { | Whooping-cough. |
| D ... | { | Narrowing and obliteration of bronchi. |
| E ... | { | Pressure on a main or large-sized bronchus by tumor. |
| | { | Paralysis of the chest-wall. |
| F ... | { | Typhoid fever. |

947. The special mechanism in each of these classes requires to be briefly surveyed.

948. *Class A.*—The mechanism of collapse in these cases has already been explained [36, 54]. Here the collapse affects the inferior parts of the lungs, equally implicates both organs, involves a moderately extensive surface, and, as far as I know, never reaches any very marked amount.

949. *Class B.*—In spasmodic asthma, where the fact of collapse, coincident with the paroxysm, may be occasionally proved, especially at the bases, by changes of percussion-sound (loss of resonance and rise of pitch), the mechanism is fundamentally the same as in Class A, but the obstruction dynamic instead of statical. Spasm prevents the entry of air in inspiration to replace that lost in expiration. Where bronchitis coexists, the influence of glutinous secretion is, probably, felt as in the next class of cases.

950. *Class C.*—The experiments of Mendelssohn and Traube have shown, that artificial obstruction, produced by forcing foreign bodies as far as possible into the bronchial tubes of animals, produces collapse of the structure in direct connection with those tubes, and emphysematous distension of adjacent and distant parts. It seems fair to conclude, that in bronchitis viscid packets of secretion, which expectoration fails to dislodge, play an analogous part. But why, and how, does collapse ensue on such obstruction? The conjecture of Fuchs, that the air imprisoned beyond the obstruction is absorbed into the bloodvessels, is obviously unsatisfactory. Dr. Gairdner¹ with much greater plausibility, supposes that plugs of secretion falling back during inspiration on the next subdivision of the bronchial tube, occlude it in the manner of a ball-valve acting on the orifice of a syringe. The consequence must be, that at every expiration a portion of air is expelled, which is not restored in in-

¹ On Bronchitis, p. 32, 1850.

spiration, partly owing to the comparative weakness of the inspiratory force, and partly to the valvular action of the plug.

951. In hooping-cough collapse depends at once on the perverted state of respiration, which allows of almost complete emptying of the lungs of air, and consequent falling in of the chest-wall—on obstruction by accumulated secretion in the tubes—and lastly, on general debility.

952. In classes D and E, the mechanism of collapse is a combination of those already described.

953. *Class F.*—In “typhoid” fever considerable portions of lung are sometimes found in a state of carnification.¹ That general debility favors the occurrence of pulmonary collapse cannot be doubted; but whether unaided, it is capable of thus condensing the lung is certainly unestablished. And yet, I do not know on what other principle typhoid condensation, when pure, often confounded with hepatization, is to be explained—all evidence of bronchitic obstruction being deficient.

954. Such is an outline of the characters and conditions of *acquired* pulmonary condensation; in its practical aspect it is considered with the diseases of which it forms a more or less constant part (*vide* BRONCHITIS, HOOPING-COUGH, NARROWING OF THE BRONCHI, MEDIASTINAL TUMOR, CYANOSIS, AORTIC ANEURISM). The *congenital* form, atelectasis, requires a separate description.

ATELECTASIS OF THE LUNGS.

955. *Symptoms.*—The respiration and connected acts are feebly performed—the cry wants force, the mouth grasps the nipple imperfectly, and the act of sucking is difficult or impossible. Slight cough sometimes exists.

956. The tissues are ill nourished, and the temperature of the surface low (food, both calorific and plastic, is sparingly taken); the skin pallid with slight lividity; drowsiness with occasional convulsions, chiefly excited by abrupt movements, and attended with extreme dyspnoea, indicates suffering of the nervous centres.

957. Deficient or perverted chest-movements, the base sinking in with inspiration—some want of resonance under percussion, if the atelectasis be on a large scale—feeble fremitus with the cry—marked weakness of respiration, with occasionally a little dry rhonchus, constitute the physical signs.

958. Atelectasis generally destroys life (which may be said never to have been thoroughly developed) in a few days. Existence, however, may certainly be prolonged for some weeks; complete recovery with expansion of the lobules affected, is possible; but whether, and how long, the lobules remaining unexpanded, life may be prolonged, seems an unsettled point. I have seen an in-

¹ M. Louis found the large proportion of 19 in 46 fatal cases.

fant of nine months old, in whom, while physical signs and symptoms such as those above-mentioned clearly existed, the history left no doubt as to their congenital origin.

959. *Diagnosis*.—In the case referred to, the circumstances which led me to venture on the diagnosis of atelectasis, rather than of consolidation by chronic pneumonia or tubercle, were these: the absence of pyrexia, the coolness of the surface, the difficulty in taking the breast, the drowsiness of the infant, the slight dulness under percussion at the base (there was, however, some want of tone under the clavicle also), the absence of notable rhonchus, and of bronchial quality in the markedly weak breathing. But I saw the child once only, and know nothing of its subsequent career.

960. *Treatment*.—The immediate effect of non-expansion being failure of calorific power, and an imperfect state of hæmotosis, the indications of treatment are plain enough.

961. Warm clothing, and high temperature of the surrounding air, dry friction of the skin, the warm bath followed by inunction of oil over the entire surface, with the internal use of cod-liver oil, and in minute doses, of phosphate of iron, will probably best fulfil these indications. Paroxysms of dyspnœa may be relieved by chloric æther. This, at least, seems the fitting kind of management after the first few weeks of extra-uterine life have been struggled through; for the case of the actually new-born infant, I must refer the reader to works on "Obstetric Medicine."

B.—RAREFACTION OF THE LUNG, OR VESICULAR EMPHYSEMA.

962. The disease, termed vesicular emphysema by its original describer, Laennec, seems essentially characterized, anatomically, by enlarged capacity of the air-cells. But with this state of distension of the vesicles is associated obliteration, more or less extensive, or actual destruction of the capillary rete of their walls; and atrophy of the proper substance of those walls.

963. In emphysema of acute origin, distension of cells is the primary phenomenon; in the chronic disease, atrophous degeneration of the walls of the cells in all probability leads the way in a large proportion of cases [978].

964. Occasionally oil, as first pointed out by Mr. Rainey, is discoverable in the walls of the vesicles; but is not constant, and when present, its relationship, of cause or of effect, to the existing atrophy is uncertain.

965. Rarefaction, distension, and loss of elasticity are the most striking *physical* characters, practically considered, of emphysematous lungs; with these are linked the symptoms and the signs of the disease. General distension is shown by the downward encroachment of the organs: by their overlapping each other in front at, and above the level of the second costal cartilages; by their bearing

on the pleural surface more or less deep impressions of the ribs;¹ and by the encroachment of the left lung on the superficial cardiac region. Instead of the natural area of that region, we may have one the shape of a narrow isosceles triangle, the base measuring one-third of an inch, the two vertical equal sides about two inches.² Local distension, again, is exhibited in irregular lobulated elevations of the surface by so-called sub-pleural sacculi—sacculi formed by enormous distension of some air-cells and total destruction of others: they are in truth *air-cavities* beneath the pleura, or within the area of the lung.

966. *Seat.*—Emphysema affects one or both lungs, and the entire, or, as is much more common, a part only of each organ. The upper division of the right, the lower of the left, seems to suffer most frequently.³ The disease may be limited to some scattered vesicles, affect entire lobules or even lobes: in the latter case the interlobular cellular tissue disappears.⁴ The surface of the organ suffers most,⁵ the entire substance being rarely affected, though deep-seated islets of the disease are not uncommon. The anterior edges seem particularly prone to emphysema; the sub-pleural sacculi, however, are chiefly met with at the posterior bases and mediastinal surfaces.

967. *Alliances.*—The bronchi, commonly the seat of chronic inflammation, are sometimes dilated—but not with sufficient frequency to suggest a relationship of cause and effect. Pleuritic adhesions are scarcely more common, pulmonary tubercle less common,⁶ than in persons of the same age cut off by all varieties of disease indiscriminately. Not only, then, is emphysema not a cause of tuberculization, but the two diseases seem to a certain extent indisposed to alliance: they are not incompatible, it appears to me, on account of their being attended by antagonistic crases of the blood, as has been fancifully suggested by Rokitansky and others; but simply seldom associated, because they are essentially diseases of different periods of life. The two affections are, in truth, sometimes found in activity in the same individual—tubercle forming and softening, although the so-called venosity of the blood,⁷ or cyanæmia, is carried to the highest point. I believe, however, that as emphysema entails obliteration and destruction of minute vessels, it must within certain limits prevent the deposition of tubercle, as of any other morbid product: the rarity of pneumonia in highly emphysematous patients is indubitable. Local tuberculization may, on the other hand, lead to the distension of air-cells,

¹ Skinner, U. C. H., Males, vol. ix. p. 97.

² *Idem.*

³ Louis, Mém. de la Soc. Méd. d'Observation, t. i.

⁴ Lombard, de l'Emphyseme pulmonaire, p. 8.

⁵ Anatomists teach that the vesicles are normally larger (the extreme diameters being $\frac{1}{20}$ and $\frac{1}{70}$ of an inch) on the surface than in the interior, and largest at the thin edges of the lung.

⁶ Louis, loc. cit.

⁷ Just as in cases of genuine cyanosis, the lungs sometimes grow tuberculous.

in a manner to be by and by considered [974]. Interlobular emphysema, as also mediastinal and subcutaneous infiltration of air, are very rare sequences of the vesicular disease. A sub-pleural air-sacculus has been known to give way and produce pneumothorax.

968. Emphysema tends, in the course of years, to produce dilated hypertrophy of the right heart; and maintains more or less habitual venous congestion within the head—a congestion scarcely, however, demonstrably productive of either hemorrhage or softening. What part, if any, it may play in generating Bright's disease, seems to me as yet undetermined; and the alleged alliance of the two affections, through the fatty diathesis, is wholly problematical: the extremest degree of emphysema, aided even by dilatation, is not necessarily accompanied with even a trace of albumen in the urine.¹

969. Emphysema may, in its clinical aspects, be a primary or secondary affection—and, in the former case, be the result of a chronic or an acute process.

I.—PRIMARY CHRONIC EMPHYSEMA.

970. *Causes and Mechanism.*—Dr. Jackson, junr., of Boston, U. S., found, that of twenty-eight emphysematous persons, eighteen had either a father, or mother, or both, similarly affected; whereas, of fifty non-emphysematous people, three only sprang from emphysematous parents. Further, fourteen persons, emphysematous from early youth, came all of them of emphysematous stock; whereas, of fourteen, first affected at an advanced period of life, two only were of emphysematous parentage. These facts render it, to say the least, strongly probable that emphysema is much more thoroughly hereditary than phthisis.

971. Valleix thought emphysema congenital in some instances; but he appears to have scarcely been aware, with what great rapidity distension of the cells may be developed. A few hours of extra-uterine obstructed breathing seem capable of effecting their dilatation [1017.]

972. Laennec's chain of causation of emphysema, consists of the following links: chronic catarrh; plugging by secretion of minute bronchial ramifications; consequent difficulty in the movement of air through these: inspiration being a more powerful act than expiration, conveys air inwards beyond the obstruction, which the latter fails to reconvey outwards; air, thus accumulating in the cells, distends them, more especially as it is itself expanded by the high temperature of the lung around. The foundation of the disease is consequently bronchitis.

973. M. Louis denies this mechanism, because the symptoms of dilated vesicles are not always preceded by catarrh—because habitual dyspnoea does not undergo permanent increase after attacks

¹ Parsons, U. C. H., Males, vol. xi. p. 151.

of acute catarrh—and because emphysema exhibits its maximum at the anterior borders, while the clinical evidences of bronchitis are commonly most marked at the posterior bases. Laennec, too, gravely erred in supposing inspiration a more powerful act than expiration [133].

974. Dr. Williams maintains the catarrhal basis of Laennec, but supposes that, while the air-cells communicating with plugged bronchia escape distension, those adjoining, and possessed of free communication with the trachea, dilate in consequence of the extra work and pressure thrown upon them. This relationship and this localization are supported by the position occupied by emphysema secondary to adjoining tubercle, as originally insisted on by Carswell.

975. Dr. Gairdner, generalizing this latter view, looks on emphysema as “a secondary mechanical lesion, dependent on some condition of the respiratory apparatus leading to partially diminished bulk of the pulmonary tissue, and consequently disturbing the balance of air in inspiration.”¹

976. Guided by these and other considerations, we may, I think, adopt the following as the most reliable doctrine of the mechanism of emphysema.

977. The vesicular dilatation may be a primary or a secondary phenomenon—that is, it may occur independently of any acknowledged form of statical change within the chest, or it may supervene on some actual organic mischief.

978. The acute emphysema of infancy occasionally illustrates the former mechanism. I have seen well-marked emphysema, vesicular and interlobular, in an infant that survived birth by two hours only, where no form of bronchitis, pneumonia, or atelectasis existed. But almost immediately after birth extreme difficulty of breathing, probably of cerebral origin, had set in. And it would seem that any violent disturbance of the balance between the possible expansion of the thorax and the mass of air brought within the lungs may produce such dilatation. In the adult, the emphysematous distension and rupture that have followed parturition efforts, violent laughing,² concentrated rage,³ seem only thus explicable.

979. But in the great majority of cases, emphysema is the result of some antecedent mischief. In a lung affected with the disease we find, however, that the localization and the character of that mischief vary in the following ways:—

Emphysematous parts of lung	Diseased	} Statically	} Walls of vesicles degen- erated.	} Dynamically	} Elasticity } Impaired. Tonicity . }
Non - emphysematous parts of lung	Healthy.	} Collapse. Bronchitis.	} Extrinsic pressure of bronchi, &c.	} Obstructed	

¹ On Bronchitis, p. 62, 1850.

² Vide art. “Emphysema,” Cyclop. of Surgery.

³ *Idem.*

980. The dilatation may thus be the result of *primary* nutritive change in the actual walls of the enlarged vesicles, affecting both their statical and dynamic properties; or these cells, being in their own structure healthy, may dilate through the extra strain thrown on them through the inaction of neighboring portions of lung. Nature may be said to make an effort to supply by distension of the remaining vesicles, the loss of oxygenizing surface entailed by the obstruction of certain portions of texture. But the effort fails; because the distension interferes with the nutrition of the cell-walls, and entails *secondary* degenerative changes and atrophy.

981. But at what period of the respiration-act are the cells submitted to the necessary extra strain; is the dilatation effected in inspiration or in expiration? A strong objection to the exclusive inspiratory theory seems to me to lie in the fact that, as the tidal air does not reach the vesicles in inspiration [253], each inspiratory recoil of air, tending to escape in the previous expiration, must be feebly felt by those vesicles. Still, it is conceivable that in the long run, a slight excess of pressure may work out appreciable distension, more especially where the faculty of resisting centripetal pressure is impaired in the vesicles through textural and dynamic change. But, on the other hand, in all cases where dilatation is a *sudden* phenomenon, the effect of violent effort, with its attendant closure of the glottis, it is impossible to conceive the occurrence except as an attendant on expiration.¹ And in cases of *slow* evolution the act of cough must produce expiratory distension, and aid the inspiratory process.

982. *Symptoms.*—The essential symptom of chronic emphysema, *per se*, is dyspnoea. Often commencing in early youth, or even infancy, at first slight in amount, and only felt on some unusual exertion, such as running up stairs, it remains, when once developed, a permanent evil, though subject to great variations in intensity. The patient feels as if his chest were never thoroughly, at least naturally, emptied of its air: and is conscious of an annoying sense of inflation or distension. On the other hand, it is true, many persons laboring under emphysema will affirm that their dyspnoea is only occasional; that habitually their respiration is perfectly healthy. But I have never known an instance of this kind where the patient was not the victim of a delusion; the truth was that a moderate amount of dyspnoea had become to him second nature, a state of comfort and health, and excessive difficulty of breathing alone gave him annoyance. The dyspnoea undergoes increase, from time to time, through bronchial spasm, through abdominal flatulent distension of the stomach and bowels, a loaded state of the portal system, or through intercurrent bronchitis. The former two causes produce sudden paroxysmal attacks, requiring the patient to rush to the open window for air, or pass the night in the sitting posture

¹ Vide Jenner in Med.-Chir. Trans. vol. xl. 1857.

out of bed; the latter, less violent, are more protracted in their action. The amount of persistent dyspnoea is generally proportional to the duration of the disease. The paroxysm occasionally induces a fit of palpitation, but not of any severity, unless some cardiac disease coexist.

983. Cough ranks next in importance, as a general rule, among the symptoms. It may precede, commence with, or follow the first establishment of dyspnoea. But, unless excited by intercurrent and accidental bronchial irritation, it may be wholly wanting; in other words, pure emphysema does not necessarily excite reflex expulsive action. The habitual sputa, when expectoration occurs independently of superadded bronchitis, are frothy, liquid, mucopithelial, or watery, never sanguineous: some patients eject the pearly sputum of Laennec's dry catarrh [604].

984. It is matter of doubt whether distension of the air-cells alone, or that of the pleura when pouched superficially, may, independently of other intra-thoracic change, give rise to pain. My own observation leads me to disbelieve in the occurrence of acute suffering—but a sense of uneasy aching oppression may be felt, independently of the interference of bronchitis, behind the sternum.

985. The countenance of emphysematous patients is peculiar; of dusky color, and anxious melancholy expression, the face is full, out of proportion with the chest and body generally—a probable result of thickening of its cellular membrane and muscles, as suggested by Dr. Stokes—the former from repeated venous obstruction, the latter from respiratory effort. The nostrils are thick, and very often the lower lip full, and venously turgid; I have, however, not seen the latter state carried to extremes without heart-disease. The muscles of the neck enlarge, and its cellular tissue disappears. The patient's gait is stooping; Dr. Stokes has known the acromial, interscapular, and lower scapular regions, almost horizontal.

986. The strength ranges inversely as the dyspnoea; in aggravated cases, bodily exertion becomes an impossibility. The fat and flesh of the body generally and slowly waste,—each attack of bronchitis diminishing the weight *pro tempore*, or permanently. The specific gravity of the frame, as a whole, may fall in consequence of the air-distension of the chest,—so that its buoyancy in water, as shown by improved facility of swimming, increases—a fact that occasionally astonishes the patient himself not a little, as all the while he grows more and more short-winded.

987. Emphysema is non-pyrexial. The pulse is not accelerated, —far from this, it ranges below the average of health in a considerable number of cases, except when intercurrent bronchitis is present. The respiration also, with the same qualification, is less frequent than in health; in fact, the act is so labored and prolonged a one, that it cannot be often repeated in the minute. The pulse often strikes the observer by its weakness, as compared with the amount

of cardiac impulse. This want of accordance comes of the frequency with which the right heart undergoes enlargement—a consequence of the pulmonary disease—whereas the left does not thus suffer. I have noticed visibleness, with locomotion, of the radial pulse at one or other or both wrists, independently of aortic regurgitation, but never more than to a slight amount.

988. No conceivable amount of emphysema, even of both lungs, will necessarily entail the smallest amount of dropsy—even œdema of the ankles. If dropsy occur, there is something else, generally speaking, tricuspid regurgitation, to account for it.

989. The appetite is commonly below par, and the bowels constipated: the want of exercise, enforced by habitual dyspnoea, explains both conditions. Some patients at the time of spasmodic seizure suffer from diarrhoea.

990. The urine, habitually aqueous, may become excessively so, during, and for twelve hours after, paroxysms of dyspnoea. If the liver be congested, lithates may be discharged in excess; saccharine impregnation, as far as I know, does not occur.

991. The voice loses tone and strength; sustainment of a note, protracted or loud speaking, become intolerable efforts. These changes depend on the deficiency of tidal air simply; there are no alterations of register, pitch or quality of voice indicating organic changes in the larynx.

992. *Physical signs.*—Inspection discovers bulging of the infra-clavicular, mammary, and central sternal regions, or of the anterior surface, uniformly. General expansion of the chest occurs very rarely; M. Louis observed it only once in ninety-six cases; when it exists, it gives the thorax a globular form.

993. The state of the interspaces in the bulged portions of surface has been matter of dispute. Dr. Stokes has taught that in emphysema, “even after great dilatation of the chest has occurred, we see the intercostal spaces, so far from being obliterated, *deeply marked*,” and that the single malady in which this obliteration really occurs is pleurisy in its advanced stages. The conditions directly conducive to its production are *paralysis* of the intercostal muscles and centrifugal pressure, one being as essential as the other; this paralysis is presumed to be the result of inflammation extending to the muscular tissue. For the same reason the intercostal spaces will not be obliterated in cases of simple hydrothorax, nor in *all* instances of pleuritic effusion; because muscular inflammation and paralysis do not exist at all in the former, and are not *necessarily* present in the latter.

994. The question here started is strictly one of observation; and it, must be confessed that the experience of physicians generally does not accord with that of Dr. Stokes in respect of the bulging of emphysema. MM. Louis and Woillez are wholly opposed to Dr. Stokes on this point. Both maintain that the intercostal hollows are in this affection either effaced or manifestly less marked than

in the natural state; and even point out this implication of the muscular plane of these spaces as one of the distinctive marks of emphysematous prominence.

995. It seems, however, possible to reconcile these conflicting opinions. I believe, in point of fact, that in emphysema, the conditions in respect of bulging are of three distinct kinds. *First*, there may be no expansion at all, general or local; *secondly*, there may be bulging of the surface generally, with a natural state of the intercostal spaces; and, *thirdly*, there may be bulging with distinct obliteration of the intercostal hollows. The key to these apparent contradictions lies mainly in the anatomy of the disease—in its anatomical varieties, which have in this point of view escaped the consideration of the observers referred to. In the *first case*, I have found the disease, which, in respect of symptoms, may have been very intensely marked, of the *atrophous* kind, with but *slight* distension of the lung; here the physical cause of expansion was altogether wanting. The *second variety* of prominence I have never observed in the infra-clavicular region (when alteration of shape was limited to that region, one of the special seats of such change in emphysema), but have met with it elsewhere in certain cases of almost globular expansion of the thorax in emaciated emphysematous subjects. But in these instances—and doubtless they exist more frequently than they are discovered or suspected—the local prominence, when characterized in the manner now referred to, was in all probability, especially when occurring at the back, a natural conformation, and wholly *independent of the emphysema*. *Thirdly*, when bulging has existed in regions where observation proves it to appertain specially to emphysema, such as the infra-clavicular, I have found the intercostal spaces distinctly prominent, and the disease, if opportunity for *post-mortem* inquiry presented itself, either of the *hypertrophous* kind, or of the atrophous variety, with great distension of the lung and formation of sub-pleural air-sacculi,—a distension which may be looked on as simulative, physically, of local pneumothorax. A woman¹ came under observation with acute bronchitis, superadded to extensive emphysema, with great lividity of surface, and without valvular disease or notable cardiac dilatation; bulging of both bones and spaces existed in certain parts. Now, as the bronchitis disappeared under treatment, and consequently the general air-distension of the lung diminished, the interspaces became hollow.²

¹ Quinland, U. C. H., *Females*, vol. xiv. p. 41.

² The difference of opinion under consideration appears to be very readily explicable in the manner now proposed. What I have stated I believe to be in strict conformity with observation; whereas I am not aware that Dr. Stokes's theory, of inflammation of the intercostal muscles being a necessary condition of their eccentric displacement, rests upon any observed cases, submitted to close anatomical examination. It is not easy to understand, in his theory, why the intercostal muscles should resist eccentric pressure more powerfully than the ribs; and this, be it noted, equally in frames of every degree of muscular weakness or vigor. It

996. Inspiratory expansion-movement falls to a minimum, the lower part of the sternum and adjoining cartilages, in aggravated cases, even sinking inwards during inspiration,—nay, the base of the chest may then slightly retract circularly [54]. On the other hand, the elevation-motions are exaggerated,—the whole chest is raised, with the shoulders, as one piece.¹ The duration of the expiratory movement considerably exceeds that of the inspiratory; both acts are laborious,—the expiratory, because the elasticity of the lung is destroyed by the disease,—the inspiratory, because the previous expiration has failed to empty the lungs to the normal amount, and the chest is with difficulty further dilated. The faculty for prolongation of the expiratory act, is probably derived from irritative hypertrophy of the muscular coat of the bronchial tubes [595];—their expressing power is permanently taxed to the utmost. The respiratory action of the intercostal planes may be completely perverted,—bulging occurring in inspiration; the latero-inferior interspaces may bulge outwards beyond the level of the ribs in expiration.

997. The condition of vocal fremitus varies; it may fall below, equal or exceed the average of health.

998. The semi-circular measurement of one side, or of the whole chest, is increased; in right handed emphysematous persons, as first noticed by M. Woillez, the excess of width of the right over the left half of the chest inferiorly ranges lower than natural,—showing by inference the greater frequency of emphysema of the lower part of the left lung. The disease may, however, be highly marked without any such increase.

999. The percussion-sound is essentially of Type II. [197],—mass of tone increased, pitch lowered, quality exaggerated, pulmonary, or tympanitic. I have, in rare instances, met with parietal distension from emphysema sufficient to deaden the sound [200]. The excessive resonance extends beyond the middle line, if one lung only be affected. The natural tone at the sternal notch, where no lung exists in health, is exchanged for emphysematous resonance; this fact, which depends on the junction of the edges of the lungs taking place higher than natural, in consequence of their distension, is very easily ascertained, both in the living and dead.² Forced expiration has little or no effect in diminishing the amount, or contracting the area, of the morbid resonance.

1000. The respiration in emphysema belongs to one or other of

appears to me that there will always be more or less hollow in the intercostal spaces, as has been shown by M. Woillez, so long as the elasticity or concentric force of the lung is not destroyed; that as soon as this change has taken place, as, for example, from the progress of emphysema, pressure sets in and influences the position of the intercostal muscles at least as readily as that of the ribs.

¹ The strain on the extraordinary muscles of respiration is sometimes very great. I have known violent tic of the cleido-mastoids accompany the paroxysm of dyspnoea.

² Dickinson, U. C. H., Males, vol. xvi. p. 244.

two main types; it is either weak, or of raised pitch, and altered quality. When of weak type, the failure may amount to actual suppression in some points; while in others, exaggerated respiration of harsh quality exists. Of the occasional existence of such exaggeration in lung substance, on the confines of circumscribed emphysema, I have satisfied myself by a considerable number of observations; but, on the whole, it is rare. Respiration of raised pitch, loud, harsh, and uneven, exists, in many cases, immediately over emphysema carried anatomically to the very highest point; the quality is sharply sibilant, and in part it may be constituted by a sibilant rhonchus in the very finest tubes.

1001. The rhythm of the sounds is variously altered. Inspiration may be deferred [281]; and the two sounds both jerking and divided [280]. The inspiratory sound is comparatively short, the expiratory greatly prolonged: the ratio of the former to the latter sound may be changed from 3 : 1 to 1 : 4; in other words, the latter sound made *twelve* times longer in proportion to the former than in health. In such cases of enormous prolongation of expiration, this is rather a fine sibilant rhonchus than true respiratory sound. Rhonchi, bronchial, and dry or moist, are evidences of bronchitis, or of spasm of the tubes: very commonly, when an emphysematous patient seeks advice both bases are the seat of fine bubbling rhonchus. None of these rhonchal sounds owe their existence directly to emphysema: a peculiar dry crackling noise, by some termed a rhonchus, of doubtful mechanism, and rarely heard [341] forms, along with dry grazing friction-sound produced by prominent sub-pleural air-sacculi,¹ the sole direct rhonchoid sign of the disease.

1002. The vocal resonance varies. It may be normal, null or bronchophonic. When very feeble, this apparently depends on weakness of the laryngeal voice,—itself caused in turn by the imperfect supply of air and labored process of expiration.

1003. The heart's sounds are feebly transmitted through emphysematous texture [462].

1004. Signs of importance are derived from the heart. If one lung only be affected, the heart is pushed slightly to the opposite side; if both are implicated, downwards, and commonly to the right somewhat, inasmuch as the left lung is generally more affected than the right, at the base. The præcordial region, filled with distended lung, is bulged forwards, and sounds grave under percussion; no cardiac impulse may be felt within its area,—that impulse being transferred to the epigastrium. Enlargement of the right side of the heart, however, plays its part in thus altering the seat of impulse. The jugular veins may be swollen, though the heart is not obviously diseased; but I have never known them pulsatile, without coexistent affection of that organ. Emphy-

¹ Quinland, U. C. H., Females, vol. xiv. p. 40.

sema is sometimes, we have seen, accompanied with visible arterial pulse [987].

1005. *Diagnosis*.—The only affection with which emphysema can be physically confounded is pneumothorax. The distinction is not difficult. In emphysema the percussion is less truly tympanitic than in pneumothorax; the area of morbidly exaggerated resonance less extensive; the side is less dilated; there is more respiration (and, possibly, loud, sibilant, respiration, as we have seen), and such respiration as exists is superficial, instead of being deep-seated and distant, as in pneumothorax. Besides, pneumothorax affects only one side (double pneumothorax must be almost instantly fatal); whereas, if emphysema exist to such a degree as to simulate in regard of percussion-sound the presence of air in the pleura, both lungs prove to be very seriously affected. Lastly, the symptoms of pneumothorax come on suddenly, and are greatly more urgent than those of emphysema.

1006. *Prognosis*.—Emphysema may last a lifetime prolonged beyond the ordinary span; and never, as far as I know, kills *per se*. But, inasmuch as it gives extra severity to bronchitis, of which it may be looked on as a permanent predisposing cause, and likewise entails dilatation and hypertrophy of the right side, especially, of the heart, the position of an emphysematous patient must practically be considered seriously precarious.

1007. *Treatment*.—The anatomy of emphysema prepares us to fear that its radical cure is impossible; we have no means of causing reproduction of destroyed lung. Experience, unfortunately, goes further than this, and shows that *permanent* palliation even proves difficult of accomplishment; *temporary* relief is, on the contrary, most readily effected; the fair aim of art is, then, to ascertain how a state of brief ease may be indefinitely prolonged.

1008. The proofs, that great amelioration is actually produced by treatment, are furnished not only by favorable change in the symptoms and in the patient's feelings, but by alterations in the physical signs: the morbid resonance under percussion may be lessened, the quantum of respiration increased, and the distension of the lung reduced. The latter fact I have shown may be demonstrated by increase in the superficial extent of the chest-surface impaired in its resonance by the subjacent heart¹—in other words, by increase in the area of the heart's superficial dulness. But what organic change in the lung substance do these alterations in physical signs demonstrate? Not, assuredly, that atrophy is gone, but that *distension* is reduced. And the reduction of distension is effected by the removal of bronchitis and the relaxation of spasm.

1009. In nine cases out of ten, when a sufferer from emphysema applies for relief, sub-acute, or more rarely very acute, bronchitis is present. Local bleeding, blistering, and small doses of tartar

¹ Clin. Lect., Lancet, loc. cit., April, 1849.

emetic are the essential agents for its removal; but when emphysema exists to any amount, caution in the employment of depletory measures is essentially called for. The other remedies, spoken of under the head of bronchitis, are not to be forgotten, however, when the first vigor of the intercurrent disease is controlled.

1010. For the habitual chronic bronchitic state, I know of no combination superior to the æthereal tincture of lobelia inflata, with ipecacuanha, in ammoniacum mixture. Fits of dyspnoea are to be relieved by extract of cannabis indica in half-grain to grain doses, or by belladonna and stramonium, either in the form of pill or smoked in cigarettes. Stramonium alone may be used in an ordinary pipe, and may be more safely intrusted to patients than belladonna; it may be smoked until the head begins to ache slightly. Opium, however, must be had recourse to in very severe attacks, and may be given until sensible, but slight, narcotic effects are produced. The camphor cigarettes of M. Raspail occasionally afford much relief. Other remedies applicable in the paroxysm are enumerated under the head SPASMODIC ASTHMA.

1011. Arsenious acid, in some rare instances, seems to lessen the violence of the paroxysms, and render their recurrence less frequent. There can be no objection to its cautious trial in obstinate cases. But I should hesitate to employ the arsenical cigarettes of M. Trousseau¹—more especially as even the seeming evidence of their special utility is yet a desideratum.

1012. Transmission of the interrupted galvanic current from the nucha to the epigastrium will sometimes avert, frequently mitigate and postpone, the paroxysm of dyspnoea.² An emetic will do so also: especially when the attack is connected with a loaded state of stomach. Cajuput oil and other carminatives, with soda, put a term to that caused by flatulent distension. The statements made concerning chloroform in the treatment of simple spasmodic asthma [1698] hold true only to a certain extent of asthmatic seizures accompanying emphysema: that is, relief in the paroxysm is here easily obtainable; but, on the other hand, serious and permanent impression on the malady cannot be even hoped for.

I have known the frequency and intensity of seizures lessened by the continuous electric current.

1013. Strychnia has been recommended for the purpose of improving the tone of the non-striated fibre of the bronchial tubes. I have tried it in a small number of cases, both endermically and by the mouth, in sufficient doses to produce obvious effects on the voluntary muscles, without in the slightest degree modifying the symptoms of the emphysema.

1014. Regularity of habits, moderation in indulgence at table,

¹ Bibulous paper is saturated with a solution of two to four grammes of arseniate of soda in twenty grammes of distilled water; portions are dried, rolled into cigarettes, and then smoked.

² M. Henley, U. C. H., Males, vol. vi. p. 126, April, 1851.

and the avoidance of efforts of all kinds, and of forced breathing,¹ are essential to the well-being of emphysematous sufferers; and it is obviously, from their forced obedience in regard of these points, that their lives are often (a questionable boon, it may be, as they themselves often emphatically aver) prolonged beyond the average term of existence.

1015. Change of air proves singularly beneficial, or singularly detrimental, according to the nature of the change; but no amount of experience will enable the physician to predict positively what manner of air, soil, or geological formation will best suit any individual case.

In the Appendix will be found some observations on the use of the Compressed Air-Bath.

II.—ACUTE VESICULAR EMPHYSEMA.

1016. Pulmonary emphysema is unquestionably, in the main, a disease of the chronic class. M. Louis, registering the fact as singular, records a case where, at least symptomatically, it grew up in twenty-nine days.

1017. There is no doubt, however, of the actually acute development of emphysema under a variety of circumstances. I have seen it, accompanied with interlobular emphysema, highly developed in an infant born without dyspnoea, and dying two hours after with obstructed breathing [979]. The freedom of respiration at birth opposes the idea of the disease having, in this instance, been congenital.

1018. The lungs of persons, dying in the algide stage of cholera, occasionally present emphysema in addition to general pulmonary collapse—the former, in infinite probability, the result of the latter, and occurring within the true algide period.

1019. Of the less rapid, but still acute, development of emphysema in bronchitis, influenza, hooping-cough, and acute phthisis, enough is said with the descriptions of those diseases.

1020. In the very acute forms of the disease the anatomical changes do not appear to be carried beyond the stage of dilatation of the cells: how soon atrophy may set in is yet undetermined.

1021. May cells thus actually dilated be restored in course of time to their natural condition? I am led to surmise that such may be the fact, from the extreme rarity with which the origin of chronic emphysema can be satisfactorily traced to an acute pulmonary attack.

¹ Lehmann, regarding emphysema from the chemical point of view alone teaches that this class of sufferers are best to be relieved by "practising augmentation or expansion of the chest in respiration, or taking exercise suited to produce this result, while we should forbid the use of spirituous drinks and not prescribe tinctures, which might hinder the necessary excretion of carbonic acid." (*Physiol. Chemistry*, by Day, vol. iii. p. 383.) But does not the distinguished chemist here forget the dynamics of the disease, and ignore the results of cautious clinical experience?

III.—VESICULAR EMPHYSEMA SEQUENTIAL TO ORGANIC DISEASE.

1022. Emphysema, either affecting vesicles singly or in groups, or involving the entire of a lobule, tends to spring up, on the principle of obstruction already explained [980], in the neighborhood of portions of lung disabled by tubercle, and other forms of organic disease.

1023. Such development of emphysema modifies the pre-existing physical signs of tuberculization. The percussion-note falls in pitch, increases in mass of tone, and becomes more pulmonary in quality; but the respiration-sounds grow yet weaker than before, or lose in some measure their previous bronchial quality. These changes might easily induce the erroneous belief that retrogression of the tuberculizing process, even absorption of the deposit, was occurring.

1024. But, if the emphysema be carried to any amount, increased dyspnoea, lividity of the face, and coldness of the tips of the fingers, will disclose the true cause of the alteration in the physical signs.

1025. It seems impossible to avoid admitting that the secondary development of local emphysema, causing pressure on, obliteration and wasting of, the capillary rete, must act as a barrier to the further direct deposition of tubercle, within the actual area of patches of dilated vesicles. But this local interference with exudation from the bloodvessels, it need scarcely be added, does not even insure cessation of the tuberculizing process in other parts of the lungs, still less does it involve such diathetic change as shall entail the practical cure of phthisis. Even the spontaneous general development of emphysema, when observed in connection with disappearance of phthisical symptoms, is an effect, not the cause, of modified constitutional state.

IV.—INTERLOBULAR EMPHYSEMA.

1026. Accumulation of air in the cellular tissue between the lobules, and in the interspaces of the cells anatomically characterizes interlobular emphysema. Very seldom associated with the vesicular variety, interlobular emphysema is acutely produced by sudden rupture of air-cells, leads to infiltration of air into the mediastina, and lays the groundwork of one variety of external subcutaneous emphysema.

1027. Interlobular emphysema is commonly the result of violent efforts, which require the abrupt introduction of a large quantity of air into the lungs, and its forcible retention therein by closure of the glottis. The efforts in parturition, defecation, raising weights, coitus, violent coughing, paroxysms of rage, excessive laughter,¹ and hysterical convulsions, have all been occasionally followed by

¹ Case related to me by Mr. Graham, late Professor of Chemistry.

rupture of the air-cells, by interlobular, and occasionally by subcutaneous emphysema.

1028. Carried to extremes, interlobular emphysema may cause sudden death.¹ Martini enumerates forcible lung-insufflation among the modes of perpetrating infanticide. The experiments of Leroy d'Etiolles on animals show that death may thus be produced as suddenly as by dividing the medulla oblongata. Ollivier records the case of a man who suddenly fell dead, in a quarrel with a comrade, from the asphyxia entailed by extensive interlobular emphysema.

1029. When added to any amount to pre-existent vesicular emphysema, it must gravely increase dyspnoea: the occurrence is fortunately very rare.

1030. Are there any special signs of interlobular emphysema? I know of none. It is quite possible, as Laennec originally taught, that, if the surfaces of the interlobular spaces become prominent through distension, grazing, dry, friction-sound may be heard; but there will be nothing distinguishing the sound thus produced from that caused by the sub-pleural sacculi of advanced vesicular emphysema. The same observations apply to Laennec's "dry, crepitant rhonchus, with large bubbles."

C.—HYPERTROPHY OF THE LUNG.

1031. Hypertrophy of the lung, unless when accidentally ensuing upon emphysema, cannot be regarded in the light of a disease. It arises as the result of inaction of the fellow-organ, as when this has been compressed and rendered permanently useless by empyema. Or, if the influence at work play upon the entire pulmonary mass, both organs enlarge. The most striking illustration of this general increase of bulk occurs in the inhabitants of elevated regions; the lungs, and consequently the width [93] and height of the chest, enlarge so much, as to produce an unseemly disproportion to an eye, accustomed to the standard of flat portions of the earth, between the dimensions of the torso, and the length of the limbs, and total stature. M. d'Orbigny found the air-cells of the Inca race, largely dilated according to the European average, as well as the mass of the lungs huge [1300]²—the elevation of their habitations above the sea-level, varying from 2500 to 5000 mètres.

1032. The absolute bulk and weight of a hypertrophous lung are increased; the inter-vesicular substance may thicken considerably. The cells are large—sometimes morbidly dilated. A lung thus affected, either collapses slightly or not at all, and may actually protrude, when the chest is opened after death. Whether the pulmonary and bronchial arteries enlarge is unknown.

¹ Cyclopædia of Surgery, art. "Emphysema," p. 79.

² Vide Morel, *Traité des Dégénérescences*, p. 27. The causes of the enlargement referred to are clearly climatic; but there is unquestionably a difference in the bulk of lungs in different races, independent of extrinsic influences.

1033. The amount of breathing work performed by a highly hypertrophous lung greatly exceeds that done by a normally healthy organ—at least as far as physical signs may be accepted in evidence. It may be inferred from these, the effective oxygenizing surface actually undergoes increase.

1034. The side may become considerably dilated; if the hyper-nutrition be limited to one lung, this is easily ascertained [804]. The percussion-sound acquires the characters of Type II. [197], the vocal fremitus increases, the vocal resonance becomes strong, and the respiratory sounds exaggerated and harsh, with an undue amount of expiration. Emphysematous distension of the air-cells sometimes advances *pari passu* with hypertrophy.

D.—ATROPHY OF THE LUNG.

1035. The density of the lungs and the quantity of blood, they admit, diminish with age; their structure undergoes throughout a normal atrophy.

1036. Hourmann and Dechambre¹ describe three types of change in intimate structure. In the least advanced the air-cells are rounded and considerably enlarged: in the second stage, the cells elongated into ellipses, so as to look like chinks, are still further enlarged; while the lobules present the same elliptical outline: in the third, the air-cells, greatly enlarged, uneven in size and without distinct form, give the appearance of torn net-work to a dried section of the lung; the distinction into lobules is lost.

1037. The loss of vesicular walls and of inter-vesicular substance diminishes the positive bulk of the lung: the thorax contracts in consequence. The extent of aërating surface undergoes great reduction also; but as the excess of blood gradually lessens, no dyspnoea occurs. The chest-walls sink in; and in some highly marked cases serosity accumulates in the pleura to fill the space which would otherwise be left empty, through the inability of the chest to follow beyond a certain point the dwindling and receding lungs.

1038. Local atrophy forms an important secondary constituent of a variety of pulmonary diseases; and, according as diminution in the amount of circulating blood occurs or not, will obstructed breathing and subjective dyspnoea ensue, proportionally to the extract of wasted texture.

1039. Thus, atrophy forms an essential element of vesicular emphysema. Local wasting of the parenchyma follows its infiltration with induration-matter, tubercle, or carcinoma. Mediastinal growths or aneurism, interfering with the supply of blood by pressure on the bronchial or pulmonary arteries, impede nutrition locally. Pressure on a main bronchus, if long continued, first causes collapse of the lung, and subsequently atrophy from inaction.

¹ Arch. Gén. de Médecine, 1835.

Further, exudation-matter in the pleura sometimes tightly embraces a portion of lung, and causes its atrophy by obstruction of its vessels.

1040. Attention has recently been drawn by Dr. Buhl, of Munich, to a presumed form of acute atrophy of the lung occurring in typhoid (Peyerian) fever, and essentially characterized by destruction of the air-cells, coupled with collapse of tissue and dilatation of the minuter bronchi.¹ The process described seems to be one of low pneumonia, with tendency to local gangrene.

II.—CONGESTION OF THE LUNG.

1041. Congestion of the lung is of mechanical, passive or active mechanism.

A.—MECHANICAL CONGESTION.

1042. The lungs may be mechanically congested as a result of (a) undue attraction to, or of (b) undue propulsion of blood towards, their vessels—or through the influence of (c) some physical obstruction to the onward passage of their blood to, and through, the left heart.

1043. (a) The phenomena of effort illustrate the first mechanism. A full inspiration draws blood copiously to the pulmonary capillaries; the glottis is closed, and the blood partially fixed in its position. Hence the eccentric pressure on the capillaries undergoes a remarkable increase, which occasionally finds relief in extravasation. If hæmoptysis ensue, the blood is vividly arterial in tint.

1044. Again when the body has been exposed to intense cold, threatening congelation, the pulmonary capillaries, contracted by the frigid air inspired, circulate less than the normal quantity of blood. If, under these circumstances, the frame be suddenly placed in a heated atmosphere, the capillaries swell, and blood is mechanically attracted in relatively enormous quantity, whence stagnation and asphyxia follow.²

1045. (b) It has been habitually held, that increased weight of the atmosphere must drive the blood from the surface, and determine internal congestions, especially of the lungs and brain. The employment of the Compressed Air-Bath seems to have demonstrated that such apprehension is illusory. The equilibrium of pressure in all directions prevents the anticipated result. And even conceding that extra propulsion towards the lungs occurs, the effects of this must be rendered comparatively light through the slackening influence of the bath on the circulation, the pulse being often reduced by twelve or fifteen beats in the minute.³

¹ Ranking's Retrospect, vol. xxvi.

² Larry, while following Napoleon in his Russian Campaign, had frequent occasion to observe fatal turgescence of the pulmonary and cerebral capillaries, when soldiers, benumbed with cold, approached too near the bivouac fires.

³ Bertin, du Bain d'Air Comprimé, p. 32.

1046. (c) The conditions of the left side of the heart, which obstruct the exit of blood from the lungs are, essentially, disease, obstructive or regurgitant, of the mitral orifice—and in a less degree, flabby dilatation of the left ventricle. The former state produces the congestive effect through physical impediment; the latter through dynamic incapacity. The results of the congestion, low pneumonic exudation, cedema, pulmonary apoplexy, and hemorrhage, rank among the important clinical conditions of those cardiac diseases.

1047. In the classes (a) and (b) the congestion anatomically resembles the active variety; in class (c) more nearly approaches the passive.

1048. *Treatment.*—Congestion of this kind is most effectually relieved by cupping, dry-cupping, counter-irritation diuretics, and purgatives.

B.—PASSIVE CONGESTION.

1049. In all diseases of adynamic and exhausting character, there is a tendency, more or less marked, to accumulation of blood in the most dependent parts of the lungs,—commonly, of course, the posterior bases. This congestive state, purely a result of failing vital power, has frequently been described as a form of pneumonia, under the title of *hypostatic*. As a general rule, the distinction from actual inflammation may be effected through the following characters. Congested tissue is externally less deeply livid,—internally shows blood-staining, partially removable by washing,—it collapses more,—crepitates more,—furnishes more markedly frothy, and less markedly red, liquid on section, is of lighter specific gravity, and firmer in consistence than inflamed substance. Besides, congestion commonly implicates, and to an equal degree, the posterior aspect of both bases,—inflammation one base only, or, if both, these to very different amounts.

1050. In exceptional instances, especially where the blood is hypinotic, congested tissue may break as readily under pressure as if it were inflamed; and, sometimes from the mode of decumbency before death, sometimes from inexplicable causes, either lung may be much more involved than its fellow. The presence of exudation-cells and blastema in any quantity will dispose unmistakably in favor of inflammation; but I believe cell-growth on a limited scale to be perfectly compatible with mere passive congestion,—exosmosis of liquor sanguinis, through hydrostatic pressure, supplies the blastema.

1051. *Symptoms.*—Passive congestion gives rise to but one local symptom, dyspnoea. And even this is, both subjectively and objectively, greatly less in amount than might be expected from the mass of substance cut off in many cases from oxygenizing action. Where it occurs, there is failure of nervous impressionability—a state of general hyperæsthesia—either from the nature of

the primary disease, as in adynamic fevers, or from the near approach of death,—an anticipation of the slackened breathing of the death-struggle. There is neither local pain, cough, nor expectoration.

1052. *Physical signs*.—The percussion-sound of Type I., raised in pitch and toneless [195]; the respiration coarse, faintly or markedly bronchial, accompanied with little rhonchus, finely bubbling or crackling in character, or with none; the vocal vibration and resonance commonly range above par.

1053. *Treatment*.—Where the tendency to such congestion exhibits itself, occasional change of posture from the back to the sides, or even to the prone position, is one of the most important remedies. The general management should be tonic and stimulant.

C.—ACTIVE CONGESTION.

1054. Active congestion may affect both lungs more or less extensively, one lung, or a portion (generally the middle height, or the apex) of either organ. Its precise anatomical characters are with difficulty established; seeing that it does not destroy life *per se*, but only through its issues or terminations, the characters of these are mixed up with its own. Awaiting more minute information, we may for the present set down arterial injection of bright vermilion tint, excess of blood of that tint, abundant aëration, dryness of feel, with very slight, if any, perceptible increase of specific gravity, as its essential constituents.

1055. Active congestion may occur as a primary state; or ensue upon various organic affections of the lung, especially tuberculization, chronic or acute,—occurring in typical perfection in the latter case; or result, in rare instances, from over excited action of an enlarged right ventricle.

1056. Active congestion may disappear without going further,—as it not unfrequently does in measles; it may constitute the first stage of pneumonia; or it may find vent in hemorrhage by capillary molecular perforations, or by rupture of a vessel of some size,—this, however, with infinite rarity, unless tubercle, cancer, or other grave organic disease pre-exist in the lung. This form of congestion never, within my knowledge, leads to true pulmonary apoplexy.

1057. *Symptoms*.—Active congestion produces dyspnoea with suffocative and uneasy feelings within the chest, without actual pain; the uneasiness may be limited to the spot, where the physical signs localize the congestive process. The patient lies with the head high. The respiration is variably accelerated; troublesome, even urgent, cough, with frothy, somewhat viscid, muco-epithelial expectoration, occasionally containing blood-disks, perceptible under the microscope, but insufficient to tinge the fluid to the naked eye, commonly ensues.

1058. The respiration-sound loses in strength, rises in pitch, and becomes rough in quality—but all this to a very slight amount. I have no evidence that the percussion-note is affected. A dryish, rather fine, but distinctly bubbling rhonchus may sometimes be heard in secondary active congestion; but I am uncertain as to the existence of any rhonchal sound in the primary disease.

1059. Much general excitement and distress occur in well-marked cases; the pulse is relatively less accelerated than the breathing.

1060. Abrupt in its onset, congestion is commonly rapid in its course.

1061. *Diagnosis.*—The paucity and indeterminate character of the physical signs makes it difficult sometimes to distinguish congestive dyspnoea from certain other kinds of distressed breathing, where the physical signs are likewise negative in the main. From nervous dyspnoea [927] and hæmic asthma [1704] it can only be separated with surety through the certain absence of the special attributes of each of these varieties.

1062. *Treatment.*—In cases where the circumstances of the attack and its own intensity render it probable, that a given active congestion preludes pneumonia, blood-letting, either general or local, and antimonials should be employed. The rarity with which the disease is caught in this state probably explains the well recognized difficulty of preventing pneumonia from reaching the exudation-stage.

1063. In cases of limited congestion, cupping to a small extent, dry-cupping and counter-irritation are the fitting measures.

III.—ACUTE PNEUMONIA.

1064. *Anatomical characters.*—Acute inflammation of the pulmonary tissue, or pneumonia, is habitually divided into three anatomical stages—those of engorgement, of red hepatization, and of gray, or yellow hepatization.

1065. In the stage of engorgement, the external surface of the affected parts is of livid or violet color, or mottled with both tints and with dull red; the weight of the organ is increased,¹ its elasticity diminished; it retains marks of pressure like an œdematous lung; and crepitates imperfectly. On section reddish spumous serosity escapes in greater or less quantity; the spongy character of lung is still to be recognized: the consistence is diminished. The permeability to air is lessened, not destroyed; the tissue floats in water, even after forcible pressure with the fingers.

1066. In the second stage the section of the inflamed part presents a rude resemblance to the liver, hence the name of red hepa-

¹ The weight assigned to healthy lungs in books on anatomy is decidedly above the reality, in consequence of the measurements being habitually made from organs more or less congested in *articulo mortis*. Lungs really normal in all respects weigh from ten to twelve ounces. Tuck (U. C. H., Females, vol. ix. p. 67), *ætatis* 52, the right lung weighed only nine ounces.

tization. The outer surface is commonly redder, less livid, than previously; the specific gravity and absolute weight are more or less increased, the tissue rapidly sinking in water; all natural elasticity is gone; the texture quasi-solid. On section the surface proves generally of red tone, not uniformly red, but mottled, or as it were, veined; a variegated character increased by the different hues of the bronchi, vessels, black pulmonary matter and interlobular septa. Fluid escapes on pressure, but in less quantity than before; it is thicker, more bloody, and more or less completely airless. The surface looks either smooth, planiform, or beset with a multitude of red, granular-looking eminences, particularly obvious if the texture be torn: in the latter case the air-vesicles especially, in the former both vesicles and inter-vesicular spaces, are loaded with exudation. The absolute volume of the organ increases; hence it encroaches on the mediastinum, enlarges its side of the thorax, and takes the impress of the ribs. Its weight may increase to six or eight times, its specific gravity to near double, the natural amount.

1067. In new-born infants the granular aspect is quite wanting, even when the tissue is torn; in advanced age granulation on a large scale, with empty spaces interspersed through the lung, occasionally presents itself. The minuteness of the vesicles at birth, on the one hand, and the frequency of pulmonary atrophy or emphysema in aged persons on the other, explain the condition peculiar to each period of life.

1068. There is a variety of this stage in which the inflamed tissue of vinous red, or livid tint, heavy, impermeable, containing very little fluid and no air, with a uniform smooth, non granular section, proves really firm and resistant. This state indicates the existence, prior to inflammation, of pressure-condensation or collapse, and its occurrence is rare, for reasons made clear in the description of those states [941]. It has often been spoken of as carnification, a term which, in this sense, it is safer to avoid, as it has been also applied to the state of simple condensation without inflammation.

1069. The inflamed lung is sometimes peculiarly soft, almost pulpy, breaking down under the slightest pressure, and gorged with thickish claret-colored, non-aërated blood; on this state the term splenization has been bestowed. Its peculiarities seem to depend on the constitution of the blood; it is most common either in persons cut off acutely by adynamic affections in which that fluid is hypnotic (such as continued fever), or in those worn down by previous old-standing disease.

1070. In the third stage, that of yellow hepatization, several of the properties of the second remain substantially unaltered. The organ is still, in its affected parts, dense, heavy, enlarged, impermeable; the specific gravity greatly increased, the friability of texture even greater than before. But the color, on section, has undergone a more or less complete change. The general tint has grown yellowish or yellowish-gray—sometimes granite-like from

spotty intermixture of the black matter of the lung. The granular character may be still, though faintly, retained.

1071. Dr. Stokes contends that a stage of pneumonia prior to that of engorgement exists, distinguished by dryness and bright vermilion color, and constituted by intense arterial injection. Skoda denies this, and with Rokitsansky looks on this coloration as the product of anæmia.

My opinion coincides with that held by Dr. Stokes. The vivid arterial tint in question is seen to perfection in rapidly fatal cases of acute miliary tuberculization, in persons presenting none of the acknowledged characters of anæmia, but many of those of pneumonic irritation. Besides, it may exist in one lung and be absent in the other.¹ Its characters are essentially those of acute active congestion [1054]. And further, in cases of intense general anæmia, the lungs look pale and bloodless—locally, congested, and hemorrhagic, spots standing out in strong relief on a colorless ground.²

1072. Abscesses, varying in dimensions from that of a nut to that of the clenched hand, one or more in number, sometimes form in a part affected with gray hepatization. Commonly seated near the pleura, they may perforate this membrane and produce pneumothorax—an event, however, of extreme rarity. The cavity of such abscesses is irregular, traversed by bronchi, vessels and fragments of tissue; the walls are formed of pulmonary substance, either bare, or lined with a pyogenic membrane, which sometimes forms with great rapidity.³ Minute sloughs may form secondarily on the walls. The pyogenic membrane may eventually become pseudo-mucous, and the cavity fall into a quiescent state symptomatically; or actual cicatrization may occur.

Amid the contents of pulmonary abscess, essentially composed either of laudable or sanious pus, fragments of parenchyma are occasionally discernible.

Abscess is more common towards the apex of the lung than elsewhere; advanced age seems favorable to its occurrence.

1072*. The interlobular and interlobar cellular tissue may inflame and suppurate;⁴ or, as shown by Dr. Stokes,⁵ the pleura may be dissected from the lung by suppuration. These exceptional states appear to have no connection with parenchymatous pneumonia.

1073. *Microscopical characters.*—In the first stage the congestion of the capillary system of the lung is accompanied with commencing stagnation, but unattended with escape of blood-elements, or sepa-

¹ Knowles, U. C. H., Males, vol. x. p. 175.

² Monk, U. C. H., Males, vol. xii. p. 85, death from pure anæmia without leucœmia.

³ A case recorded by Grisolle shows that seven days will certainly suffice for the purpose.

⁴ Carswell's Drawings, U. C. Museum, No. 57, C. b. 573.

⁵ Dublin Journal, 1833.

ration of these from each other. The tissue, we have seen, is drier than natural.

1074. The capillaries of the pulmonary artery are those essentially affected; that those of the bronchial arteries are likewise involved seems infinitely probable, though as yet undemonstrated; but I cannot believe, in spite of the advocacy of Dr. Morehead,¹ that the bronchial capillaries are those mainly concerned in parenchymatous inflammation. He argues that inflammation, being a perverted nutrition-process, must take place in the bronchial arteries, because they nourish the lung. That they are the sole nutrient vessels is more than unlikely [1211]: but, conceding this, it must be remembered tuberculization is, yet more decidedly than inflammation, a perverted nutrition-process. Now, Schröder and Guillot have shown, by fine injections, that the pulmonary artery undergoes obliteration, while the bronchial arteries remain perfectly pervious during the tuberculizing process.

1075. In the state of engorgement, the capillaries become still further loaded, and encroach on the cavity of the cells; exosmosis of water, stained with hæmatin, and to a slight extent escape of blood-disks and liquor sanguinis ensue. Granular epithelium and free granules, even a few exudation-corpuscles, may be seen.

1076. In the stage of red hepatization, the serum, red disks, and plasma escape copiously into the vesicles, infiltrate their walls, and accumulate in their interspaces. Formative processes become active; exudation-cells and compound granular corpuscles (fat) distend the vesicles; free fat granules, protein granules, and fibrillated amorphous or flaky protein particles are seen. Such epithelium as can be traced is highly fatty. The coloring matter of the blood infiltrates the cell-walls; but, as originally shown by Gluge,² the pulmonary fibres may be brought into view by washing. The fibrinous casts of the vesicles and ultimate tubes, described by Remak, are rarely to be seen.

1077. Even in the stage of gray hepatization, actual destruction, macerative or other, of the lung-fibres does not occur. Gluge² affirms that gray hepatization is "constantly a genuine suppuration" of the lung. This is very certainly incorrect; true pus-cells abound doubtless in some cases, are rare in others, and in yet others cannot be found, exudation-cells being alone visible. The naked eye appearances of suppuration are consequently sometimes simulated by liquefied exudation-matter.³ The quantity of granular fat and oil-drops still further increases.

¹ Disease in India, vol. ii. p. 311. A work of genuine clinical worth.

² Anat. Mikros. Untersuchungen, Heft. i. p. 60. Minden, 1838.

³ This passage, from the edition of 1854, appears to have escaped the attention of Dr. Da Costa, who, in an interesting essay on the Minute Anatomy of Pneumonia (Amer. Journ. Med. Sciences, Oct. 1855), looks upon the announcement by himself of the frequent absence of pus-cells as a novelty. I have known and taught the fact in my lectures since 1847.

1078. The material of so-called abscesses is sometimes merely liquefied exudation-matter.

1079. *Chemical characters.*—M. Guillot ascertained some years since, that whereas the natural proportion of fat to parenchyma averages about 10 per cent., it may rise to 50 per cent. in pneumonia. Doubtless, from the impermeability of the lung, products which should be oxidized in the act of respiration fail to undergo that change and form new combinations. The quantity of fat will increase directly as the amount and duration of obstruction to breathing. The increase of fat with the progress of the disease may be seen microscopically. There can be little question, too, that when actual suppuration occurs in the stage of gray hepatization, the quantity of fat will attain its maximum.¹

1080. Sugar, also, would probably be found, if hepatized tissue were examined immediately after death.

1081. The peculiar acid (pneumic) of the lung-substance, described by Verdeil, appears to undergo increase in pneumonia. In a single hepatized lung of a male there was a very considerably greater quantity of the acid, than in both lungs of a perfectly healthy guillotined woman.²

1082. *Physical Signs.*—The physical signs of acute pneumonia vary with the amount of consolidation, and the nature of the material poured into the cells—hence with the various stages of the disease.

1083. I.—Are there any special signs of the *stage of arterial injection*? It would be difficult to prove the affirmative positively: but previously to the occurrence of crepitant rhonchus, it is certain the following conditions may sometimes be detected. The breathing-sounds reach the ear weaker, harsher, and rougher, and of higher pitch than natural from the affected part, provided this be near the surface³ (*vide* ACTIVE CONGESTION [1058]). If the affected structure be deep-seated, on the contrary, exaggerated respiration, from the intervening healthy tissue, is heard: the percussion-sound is unchanged. I have now seen a fair number of cases in which such exaggerated respiration, coupled with febrile excitement, and slight pain in the side, were the earliest indications of a central pneumonia, eventually travelling to the surface.

M. Grisolle states that he has, in a large proportion of cases, found weak respiration, in the neighborhood of already hepatized lung, the precursor of signs of consolidation: this statement I can confirm; in some such instances no crepitation can be caught from day to day, while the spread of the disease is indicated by percussion-dulness and bronchial breathing.

1084. It would appear, then, a disturbed state of respiration, not

¹ In some species of pus, fat constitutes as much as 29 of 114 parts, representing the solid ingredients in 1000 parts.

² Robin et Verdeil, *Chimie Anatomique*, t. ii. p. 460.

³ Styles, U. C. H., *Males*, vol. x. p. 304.

always of the same type, and hence liable to misinterpretation, is the only condition referable to this stage.

1085. II.—In the *engorgement-stage*, the movements of expansion and of elevation are, if pleuritic pain be present, somewhat restrained. The vocal fremitus maintains its natural standard.

1086. The percussion-sound acquires to a slight extent the characters of Type I. [195]—the amount of tone diminishing,¹ its pitch rising. Any serious change in these respects indicates a great amount of engorgement—or that an intermingling of actual exudation has occurred.

1087. The respiration-sound loses strength, and may be even locally suppressed, or masked by rhonchus, in the affected parts and their confines, exaggerated in those at some distance from them and in the opposite lung; the vocal resonance is somewhat intensified, and slightly sniffling in quality.

1088. In a considerable majority of cases, watched from the outset, crepitant rhonchus [318] is more or less extensively heard during this stage; but, in hospital practice especially, the period of its existence has often passed when the patient is first seen. There are instances, too, in which, though the pneumonia be developed under observation, no crepitation occurs: here intraparenchymatous exudation seems to be thrown out so rapidly, as to arrest all breathing action in the actually inflamed part, *ab initio*. And in a word, the diagnosis of pneumonia must often (on a rough estimate probably once in every four or five cases) be made without the help of true crepitant rhonchus.

1089. III.—In the *state of red hepatization* the form of the chest may undergo slight change, independently of the presence of pleuritic effusion. In a small minority of cases I have found positive, though slight, increase of width by measurement at the base of the affected side. M. Grisolle reports two cases showing that the infra-clavicular regions may bulge under the pressure of pneumonic enlargement. Besides, the evidence of slight encroachment of the inflamed organ on the mediastinum may very frequently be obtained by percussion at mid-sternum; the attendant dulness may reach a quarter of an inch beyond the middle line. The heart, too, may undergo slight lateral displacement.² General expansion of the side is never the resultant of pneumonia alone.

1090. The expansile movement of the chest, and even the ab-

¹ Skoda appears to maintain that in this stage the percussion-sound remains unaltered (Markham's Translation, p. 269), on the ground that no possible amount of congestion of the bloodvessels can change it. But, conceding this latter point (which the illustration of the normal lung-resonance in mitral disease fails in my mind to prove, as slight deficiency of tone posteriorly is often, according to my experience, observable in that cardiac affection), it must be remembered that escape of serosity into the parenchyma takes place during the congestive stage of pneumonia.

² If such displacement be to any amount, say as much as an inch and a half, the presence of fluid may be looked on as certain.

dominal movement, are lessened in amount on the affected, somewhat augmented on the sound side—and this in simple pneumonia with extensive consolidation, quite independently of the influence of severe pain. But the movement of elevation is not by any means so much obstructed, according to my observation, as that of expansion; a circumstance which will perhaps account for the contradictory opinions held concerning thoracic motion in the disease. In certain cases of pneumonia with a slight amount of plastic exudation on the pleural surfaces, friction-phenomena are not to be discovered. To what can this be attributed, but to the diminished expansion of the lung, and deficient mobility of the thoracic walls? while, on the other hand, it would be preposterous to explain the diminished motion by the interference of the painless pleuritic exudation supposed.¹ The respiratory play is impaired, not only by want of expansile, but of contractile power on the part of the lung: I have known the latter even more deficient than the former: the elasticity of the texture is wholly destroyed.

1091. As a rule the vocal vibration is increased in intensity; sometimes simply maintained at the normal average;² while in cases of exceedingly extensive, and, as it were, massive hepatization, it may actually fall below the natural standard. Fortunately this is rare [76, 77]. A vibratile tremor is sometimes conveyed to the surface through the lung from the heart—sometimes generated by the pulsation of its own vessels.

1092. The percussion-sound is always of abnormal type; and its principal peculiarities may be stated as follows:—(a) Types I. and III. [194], those of *dulness* or of *hardness*, are the usual conditions. The quality is always modified, the pitch raised, the resistance increased. (b) Absolute dulness on firm percussion very rarely exists; and the note may be “clearer” over highly consolidated tissue than over healthy lung [137]. (c) The morbid quality is either wooden, tubular, amphoric, or, infinitely rare instances, genuinely tympanitic [214]. (d) The former three varieties of morbid quality may be rendered more intense by proximity of hollow organs, the stomach or distended colon, to the hepatized part, or by inclusion of large bronchial tubes within its area (as originally suggested by Dr. Hudson); but they may exist in perfection at the right base posteriorly,³ as well as at the left, and also in the axillary regions. (e) While the hepatized base gives tubercular resonance, that of the non-pneumonic apex may be of exaggerated quality (Type II.).

¹ Even where the consolidation of the bases is extreme, and the amount of pleural lymph very small, there may on the other hand be well-marked friction-sound. Skinner, U. C. H., Males, vol. ix. p. 98: here the lungs, though emphysematous, weighed 37½ oz. and 42½ oz.

² When pneumonia supervenes on extensive emphysema, this will be the case; the vocal resonance may be less marked over the pneumonic than the simply emphysematous parts, and yet the fremitus be well maintained over the former—on the right side. Skinner, U. C. H., Males, vol. ix. p. 95.

³ Lewis, U. C. H., Females, vol. ix. p. 320.

(*f*) While the hepatized base gives dull resonance of Type I., the non-pneumonic apex may somewhat lose its normal pulmonary tone—but this never becomes tubular, as it does when fluid has accumulated inferiorly. (*g*) The amount of tone and of abnormal quality in the same spot varies, or rather may vary, within brief periods; the change may be referable to the states of bronchial accumulation, or to varying flatulence in the abdomen—or prove inexplicable. (*h*) The superficial area of the hepatized tissue is sometimes sharply, sometimes feebly, defined by the percussion-signs. In this aspect the sense of resistance is a safer guide than the tone; for unquestionably conduction exercises a disturbing influence in a sideward direction as well as in a direct, or vertical, line [221].

1093. The surface over the solidified tissue furnishes blowing respiration of the diffused or tubular varieties, sniffling, metallic, abrupt and divided in rhythm [280]; the denser the hepatization, the more metallic the quality. In distant parts the respiration is exaggerated. No crepitant rhonchus forms in the actually hepatized part, but, generated on its confines may be heard therein only, or (likewise conducted through the dense tissue) may be accidentally caught through the loud inspiration-sound.

1094. Bronchophony, sniffling, metallic and intense, sometimes quasi-ægophonic, ranks as the special form of vocal resonance. But the most perfect pectoriloquous whispering bronchophony may occur,¹ or the first resonance may be followed by a separate whispered echo.² Bronchial cough and unnatural intensity of transmission of the heart's sounds, complete the list of discoverable signs.

1095. Of all the signs, the intensified vocal fremitus, the abnormal percussion-note, and the metallic tubular breathing, are the most important.

1096. Sonorous rhonchus, erroneously referred by Laennec to compression of the bronchi by the indurated pulmonary tissue, is an accidental, and, in the adult, rare effect of coexisting bronchitis.

1097. In certain rare cases of pure red hepatization, the physical signs, with the exception of dulness under percussion, are wholly wanting; the vocal fremitus is deficient; there is neither vocal resonance nor respiration heard on the affected side. These peculiar conditions seem probably to depend on such extensive closure of bronchial tubes, as to prevent the possibility of reinforcement of respiration or of vocal sound within them, while the side is motionless, and the powers of conduction of the lung (which, we know, vary widely according to the precise acoustic conditions of the hepatized substance [425, *d*]) are annulled. Pressure on a main bronchus by an enlarged gland or tumor, if of sufficient size to

¹ McLane, U. C. H., Males, vol. xii. p. 181.

² Wright, U. C. H., Females, vol. xv. p. 14.

obstruct the tube completely, will produce this effect on the signs ; but such pressure is not a necessary condition.

1098. A more singular state of things still may exist. Tubular respiration may be intermittent—sometimes existing, sometimes no respiration being audible. I have traced this in one instance to pressure on the main bronchus of the affected side—obviously acting at various moments with different amounts of force.¹

1099. IV.—In the *stage of gray hepatization*, interstitial suppuration, or liquefied exudation-matter, the signs are essentially the same as in the previous stage. If suppurating or liquefied spots freely communicate with bronchial tubes, loose liquid rhonchus, more or less thin and high-pitched, according to the more or less completely purulent quality of the fluid in the lung, will be produced. But such communication is, of course, a matter of accident ; and, admitting the occurrence both of communication and rhonchus, I know of no character by which such rhonchus can be positively distinguished from bubbling rhonchi arising in tubes surrounded by the consolidated tissue.

1100. There may, too, as in the previous stage, and through the same causes, be complete absence of all auscultatory signs. I saw a remarkable case of this kind in 1847, with Dr. Storrar : there were neither respiration-sounds nor rhonchi audible in front of the chest, directly over lung thoroughly infiltrated with yellow semi-liquid exudation ; dulness the most absolute was the only physical sign in the spot.

1101. *Signs of resolution.*—The resolution of pneumonia may occur, in some very rare instances, before red hepatization has been effected ; but in the vast majority of instances, the disease has advanced to the hepatized stage before resolution commences. The signs of this favorable event are, first, a change in the quality of the tubular breathing ; it falls in pitch, becomes less sharp and metallic, more open—in a word, of diffused blowing type, a change serving as a transition to a harsh and weak respiration. The bronchophony rapidly loses its peculiar sniffing quality, but holds on to a slight amount for some time ; while either redux crepitant or fine bubbling rhonchus, becomes, and remains, audible for a variable period. The percussion-sound gradually grows pulmonary, and, as a rule, in cases of favorable course, more rapidly recovers its natural character than after the absorption of pleuritic effusion. I have known the tone scarcely different from that of health in a spot where, three days before, there had been very marked dulness : but such rapid resolution is, unfortunately, very rare ; and there are instances, conversely, in which wooden quality and much resistance hold on for a considerable time.

1102. It has been made a matter of much dispute, whether retraction of the chest-walls may occur in the advanced periods of

¹ Beckett, U. C. H., Males, vol. v. pp. 231, 274.

pneumonia, where no suspicion can exist of the presence of pleuritic effusion. Dr. Stokes teaches the affirmative. Contraction may be observed, he states, in cases where the lung has been long indurated and still continues impervious, and may even coexist with gradual and ultimately perfect resolution. In all cases where he has observed this contraction, the primary disease has been of the *typhoid* type; in one instance of the kind, the contraction seemed to affect the whole side more than is general in pleurisy; in other cases it was very similar to that of empyema. M. Woillez maintains, on the contrary, that where contraction occurs in pneumonia, there has always been some effusion into the pleura, and that the process of contraction is identical with that in simple pleurisy. M. Grisolle adopts the same views respecting this question as M. Woillez. In nine cases of *simple* pneumonia, antero-posterior and circular admeasurement failed to detect any diminution of size during the progress of convalescence.

Some years since I observed a case of extensive pneumonia of the left side, in which indisputable depression of the *latero-anterior* part of the chest gradually took place during the progress of recovery. As far as physical and symptomatic evidence can decide the point, there was certainly neither pleural exudation nor liquid effusion in this instance; hence, although, as in Dr. Stokes's cases, there was no *post-mortem* examination to decide the question, I cannot help feeling persuaded that simple pneumonia may entail the alteration of shape which I thus believe I have actually witnessed. Perhaps, all things considered, the most efficient agent in producing depression of the chest after pleurisy, is the contraction of the plastic matter exuded on the pleural surfaces. Why should not the same contraction, occurring as a law of its existence, of exudation poured into the substance of the lung, cause similar alteration in the form of the thorax? I say similar, not the same in amount, because, in the case of pleurisy, there is another well known cause of depression (diminution of bulk by fluid pressure), which does not exist in the instance of pneumonia. It appears curious that M. Grisolle (who professes to have seen the size of the lung, enlarged by interstitial exudation solely, gradually return to its natural state) should maintain depression of the surface to be impossible. What is to prevent the tendency to diminution of bulk from gradually bringing the lung to a less volume than in health; and this once effected, will not depression of the parietes inevitably follow?

1103. The rhonchus crepitans redux, like the true crepitant, suggests the idea of crepitation; but the crepiti constituting it are moister and commonly more suggestive of "bubbling;" they convey the impression of larger size, are more slowly evolved, rarely, if ever, occurring in abrupt puffs; are comparatively few in number; are more or less dissimilar to each other; somewhat irregular in occurrence; and frequently audible in expiration as well as in inspiration, though more specially appertaining to the latter.

1104. Such are the ordinary characters of the rhonchus coexisting with the resolution of pneumonia. But in a certain number of cases its properties are much more similar to those of true crepitation: it possesses the same dryness, the same minuteness (I have never, however, observed *redux* crepitation of greater delicacy than the primary, as M. Grisolle appears to have done), and coexists with inspiration only. The observation of these facts, and of the vague manner in which the phrase "*redux* crepitation" is applied to the rhonchi existing in lungs undergoing the resolution of pneumonia, coupled with examinations made for the express elucidation of the point, has long led me to the conclusion that under that phrase are confounded two very different phenomena. These phenomena are a fine bubbling rhonchus, and a true returning primary crepitation. The former is by far the more common, has all the characters of a humid rhonchus, and is, I can scarcely entertain a doubt, produced in the minute bronchial tubes; the latter, which affects the characters of primary crepitation, is probably generated in the same seat and manner as this.¹

1105. The immediate cause of the fine bubbling rhonchus attending resolution is probably the passage of air through fluid contained in the minute bronchi: and this fluid may either be the result of capillary bronchitis, or be merely on its passage from the previously engorged and now œdematous lung. This latter opinion seems calculated to throw some light upon the cause of a circumstance with which auscultators are well acquainted: namely, that the rhonchus of resolution of pneumonia sometimes lasts but a few hours, and at other times persists for weeks.

1106. *Signs of abscess.*—When, instead of the infiltrating form of liquid exudation or suppuration, abscess occurs, the physical signs are of course peculiar. The student should remember that in diagnosing pulmonary abscess, the first point, if possible, to be ascertained is, whether the signs of pneumonia have existed in the organ which is suspected to be the seat of purulent collection. Admitting this to be settled in the affirmative, the special signs of abscess will vary according as the pus has been more or less completely evacuated, or is still retained.

1107. First, in the case of a *pulmonary abscess of which the contents are more or less completely evacuated*, the diagnosis is grounded

¹ It will be observed that the rarity of true *redux* crepitation is in accordance with the theory which localizes the primary rhonchus in the parenchymatous exudation [323]: it is in truth unlikely that the physical condition of the interstitial plastic exudation should often be similar at the two opposite periods of the malady; and hence improbable that a given phenomenon, depending for its existence on that condition, should frequently occur with identical characters at both those periods. But the thing may, *à priori*, be conceived a possible occurrence; and so we find by observation, that the effect which would follow, did it occur—that is, the reappearance of the true primary rhonchus—is occasionally met with. On the other hand, were the primary rhonchus produced by bubbling in the interior of the vesicles, there is no obvious reason why the return of true primary crepitation should not be an invariable sequence of resolution.

generally on the fact of the signs of excavation supervening upon those of pneumonia. The percussion-sound is either dull with marked parietal resistance, or of tubular, amphoric, or cracked-metal quality; the respiration is cavernous, or tubular, accompanied with large-sized, thin, metallic, echoing rhonchus. The vocal resonance may be bronchophonic, pectoriloquous, or null.

1108. Secondly, in the case of *an abscess with its contents retained*, in consequence of want of ready bronchial communication, the signs are, of necessity, extremely obscure. There are none, indeed, of a really distinctive kind. The resistance is marked, the percussion-sound may be toneless or tubular, the respiration tubular, and the vocal resonance strongly bronchophonic. But all this might have existed before the formation of abscess.

1109. Sphacelus of the lung—one of the very rarest terminations of acute pneumonia¹—would be signified by the signs of a cavity; the expectoration growing, at the same time, profuse, and of peculiar fetor.

1110. An œdematous state of the parenchyma may remain long after the resolution of pneumonia.

1111. *Symptoms.* (A) *Prodromata.*—A certain proportion of adults, varying between a sixth and a third of the whole number attacked, suffer from prodromata in the shape of general febrile disturbance, of from one to four days' duration, after the action of the cause, and before any local symptom of the disease makes its appearance. In the majority of cases the invasion is sudden.

1112. (B) *Invasion.*—The invasion of the disease is marked by rigors, followed by pain in the side, short cough, oppressed breathing, and sometimes cephalalgia and vomiting. Rigors, oftentimes severe, are very rarely deficient: in a large proportion of cases they form the phenomenon of invasion: with greater frequency, indeed, than in any affections, except ague, and perhaps puerperal fever. The respiration is often accelerated greatly out of proportion with the pulse, at the very outset,—before any local symptom or sign points to pneumonia.

1113. (C) *Actual disease.*—1. *Local.*—Among the symptoms of the actual disease stands *pain in the side* (29 only of 301 patients escaped it; and in 161 of 182 it appeared within the first twelve hours; Grisolle). This pain, generally seated below the nipple on the affected side, and rarely corresponding precisely in seat with the pneumonia, depending commonly on coexisting pleuritic irritation, in infinitely rare cases springs apparently from the lung substance itself; in the latter case always slight; in the former

¹ The rarity with which gangrene of the lung originates in acute sthenic inflammation is now generally recognized. Of 305 cases of pneumonia analyzed by M. Grisolle, not one terminated by gangrene; and of 70 cases in various journals perused by him, 5 only could be considered positive instances of this mode of termination of the acute disease.

variable in amount and increased by cough and parietal pressure, and sufficiently difficult of explanation [789].

1114. *Increased frequency of breathing*, to a variable amount, is a constant symptom; occurs within the first few hours; and raises the number of respirations to from 24 up to 80 per minute,—from 30 to 50 being the more usual extremes. The amount of subjective distress varies inexplicably: not uncommonly 30 to 40 respirations per minute may exist without the patient being conscious of particular dyspnoea,—whereas, if they reach 70 to 80, speech is obstructed, and suffocation may appear imminent: but, on the other hand, a man breathing 60 to 70 times in the minute,¹ may be wholly unconscious of dyspnoea. The frequency of breathing does not depend on any particular seat of pneumonia, nor even, singularly enough, on its extent,—at least, necessarily. I have known double pneumonia attended with a less number of respirations than inflammation of a limited portion of one lung.

1115. Now the heart's contractions do not increase in frequency in the same proportion as the respiration,—hence the ratio of the two becomes more or less perverted. Thus, for 100 pulsations per minute there may be 60 respirations (I have seen this)—numbers giving a ratio of 1.7 : 1, instead of 4.5 : 1, that of health. The same perversion exists in those exceptional cases of pneumonia in which the pulse maintains a low frequency throughout; nay it here seems to attain its maximum possible limit, as I have actually known the pulse beat 56, while the respiration oscillated between 60 and 70.² In certain cases of asthenic pneumonia, the ratio may fall quite within the limits of health, as 132 : 32, or 4.1 : 1.³

1116. The significance of the perverted pulse-respiration ratio is great; I have found it in several instances, *prove the first sign of sthenic pneumonia, appearing before crepitation or rusty expectoration*; as *per contra*, a return to, or towards, the healthy standard, *may announce resolution some days earlier than the rhonchus crepitans redud.*⁴

1117. *Cough*, in the great majority of cases, occurs within the first twelve hours,—moderate in amount, rarely paroxysmal, more severe in double than single pneumonia, and diminishing, occasionally even ceasing, towards the close in fatal cases. It is accompanied in the majority of instances with *expectoration* of very striking characters,—sanguinolent, or rusty in tint, viscid, semi-transparent, adhering to the vessel, but slightly aerated, passing through various shades of orange, apricot color, faintly greenish, and lastly becoming white—then opaque and of bronchitic qualities. In some cases the sputa are diffluent, watery, and of dull brown, or even

¹ Styles, U. C. H., Males, vol. x. p. 306.

² Sheers, U. C. H., Males, vol. xv. p. 85.

² *Idem.*

⁴ Craddock, U. C. H., Males, Clin. Lect., loc. cit. p. 144. I have observed the same perversion, antecedent by twelve hours to any physical sign, in a case of pyo-hæmic pneumonia following the excision of axillary cancer.

faintly blackish, hue,—resembling liquorice juice, or prune juice,—conditions of evil augury. The red tint of the sputa in the mass of patients comes on during the first forty-eight hours, and after the fourth day its appearance becomes very unusual; once developed, it may last from one to fourteen days. In some rare instances, the sputa continue white throughout; and yet rarer ones, especially where the pneumonia is central, or of the upper or still more rarely of the lower lobe,¹ there is no expectoration. If the expectoration in pneumonia be actually more or less profusely bloody—if there be hæmoptysis, in short—the pneumonia is, according to my experience, tuberculous.

1118. Microscopically the rusty sputum consists of muco-epithelium, blood-disks, exudation-cells, amorphous patches of exudation-matter, oil-globules and granular fat sometimes in large quantity. Moulded exudation-casts of the ultimate bronchial tubes, and even of the air-vesicles, studded more or less abundantly with exudation-cells, are sometimes to be seen: but the opinion of Remak as to their significance and constancy seems unfounded. True pus-cells are very rare in the sputa at any period, and never appear in the rusty sputum, as far as I know. Accidental ingredients, such as biliphæin, are met with in certain diathetic varieties of the disease. Sugar exists in sufficient quantity, sometimes, at the height of the inflammation to be discoverable by Trommer's test: the interference with oxidizing processes in the hepatized tissue accounts both for the oil and sugar in the sputa.²

1119. The *expired air* is sensibly colder than natural, especially when the respiration is very frequent; and the quantity of *carbonic acid* expired, as originally shown in the last century by Nysten, falls sensibly below the average [510].

1120. 2. *General*.—The pyrexia of pneumonia is habitually well marked. The *pulse* may reach 140 to 160 beats per minute,—and in the mass of serious and fatal cases, is of much greater frequency than in those of recovery, generally attaining its maximum frequency by the third or fourth day. I have, however, known pneumonia run its course, both in old persons and in young adults, with a pulse never exceeding 60; but in these individuals the healthy standard has, on recovery, proved even still lower. Unless when very frequent, the pulse is habitually full and resisting: when feeble and small, this sometimes depends on embarrassed circulation, produced by *distension of the right cavities of the heart* with blood. Fulness of the jugular vein occasionally appears under such circumstances,—possibly, sometimes, from actual pressure on the vena cava by the hepatized lung: jugular pulsation is a possible

¹ McLane, U. C. H., Males, vol. xii. p. 180.

² The freer the use of amylaceous food, the easier is the detection of sugar in the excreta of pneumonia, as of all other diseases in which sugar persistently or temporarily impregnates the liquid secretions.

occurrence, and pulsation even of the dorsal veins of the hand has, in rare instances, been seen.

1121. The *blood*, buffed and cupped, is hyperinotic in the highest degree,—the fibrine ranging from 6 to 13 per 1000. There is a peculiar tendency to the formation of solid resistant coagula in the right heart, and in the pulmonary arteries, an obvious source of embarrassed circulation and occasionally actually causing sudden death; but I must express my dissent from the opinion of M. Bouillaud, that their formation is an invariable attendant on hepaticization. These coagula rapidly soften centrally; they sometimes contain genuine pus cells.

1122. The serum occasionally exhibits a milky aspect, from excess of fat.

1123. The temperature of the *skin* rises; its feel often grows, as specially insisted on by Dr. Addison, pungently, acridly, burningly hot—not more so in the vicinity of the inflamed part than over the rest of the chest. Sweating, sometimes copious, may occur towards the decline of the disease; and sudamina may form in abundance. I have known the temperature under the tongue reach 106° Fah.

1124. The *digestive organs* sympathize. The *tongue* varies in appearance, but does not exhibit the characters attaching to adynamia in sthenic cases: *thirst*, scarcely in the ratio of the fever; *anorexia*; occasionally vomiting; tendency to constipation, or sometimes, especially in fatal cases and towards their close, diarrhoea, more or less profuse; mark the implication of the alimentary canal. *Jaundice* occasionally occurs, on the whole more frequently when the right lung is affected than the left, but with little more frequency when the disease is seated in the lower rather than the upper lobe of that lung. Writers who insist that intercurrent jaundice is limited solely, or almost solely, to pneumonia of the right base, at once ignore the evidence of facts, and strive to support what appears to me a false theory (that of irritation by continuity or contiguity of texture) of the mechanism of pneumonic icterus. They forget, too, that hepatitis itself even is not an active cause of jaundice. The truth seems to be that, when much obstruction occurs in the right cavities of the heart, the clogged state of the vena cava falls back upon the radicles of the hepatic vein; these in their swollen state press upon the minute bile-ducts, and cause stagnation of their contained bile, which is then absorbed into the circulation. I have seen two cases, post-mortem, fully sustaining this view.

1125. The characters of the urine, of ready clinical discovery, may be set down as follows, from the analysis of a considerable number of cases. The specific gravity ranges between 1012 and 1030, the maximum being observed at the height of the disease, the minimum at the outset and at the period of convalescence. Crystals of uric acid occasionally, urates in abundance, coincide

with deep color, strong urinous odor, and high specific gravity. Muco-epithelium occurs indifferently at all periods. Convalescence is sometimes coeval with a copious appearance of crystalline triple phosphate, or of oxalate of lime, with or without the former salt: where both are at first associated, the phosphate may disappear in a day or two, the oxalate remaining.¹ Albumen may be absent from first to last, appear temporarily, or exist in the urine of every twenty-four hours from first observation to convalescence²—always in very small quantity. My observations prove that no connection exists between the appearance of albumen and convalescence.

The organic constituents generally range high, the inorganic salts fall below the average. Redtenbacher ascertained that, in particular, the chloride of sodium gradually diminished until hepatization was established, when no traces of it could be found—the salt reappearing with resolution of the disease.³ Dr. L. Beale, further, finding an excess of the chloride in the sputa, refers the latter fact to a determination of the salt to the inflamed lung, depending on the activity of morbid cell-development occurring within it.⁴ It is, however, to be remembered that deficiency of chloride of sodium in the urine is by no means peculiar to pneumonia—occurring (though to a less serious degree) in pleurisy, capillary bronchitis, and acute tubercularization of the lung. The nature of the food consumed at the time of examination must not be forgotten. And it is yet open to question, whether pneumonia be always attended with diminished proportion of the chloride. In a recent instance of acute rheumatism,⁵ the chloride appeared in full quantity, during the course of an intercurrent attack of pneumonia.⁶

1126. Among *cerebral symptoms*, the only one of frequent occurrence is cephalalgia; it comes on from the first, as an attendant on the febrile state. Delirium, coma, and convulsions are rare; complete insomnia is seldom observed. The *organs of sense* are not specially affected; epistaxis, however, is sometimes met with.

1127. *Prostration of strength*, as a rule, occurs from the first, and is so positive and so marked, that the fact may be made available in diagnosis; the exceptions are very rare. The *face*, more or less anxious in its expression, is of heightened color generally, or particularly about the malar bones—the tint being actually red or tending to lividity—or pale, sallow, yellowish, earthy-looking.⁷

¹ P. Kennedy, U. C. H., Males, vol. viii. p. 79, May, 1849.

² A. Bishop, U. C. H., Males, vol. ii. p. 194, July, 1847.

³ Zeitschrift der Gesellschaft der Aerzte zu Wien, 1850.

⁴ Med. Chir. Trans., vol. xxxv. p. 325, 1852.

⁵ Tennant, U. C. H., Males, vol. xvii. p. 1.

⁶ But the influence of rheumatic pyrexia, *per se*, is yet undetermined. It may be that, like the paroxysm of ague and of hectic, it tends to increase the quantity of chloride. Vide S. Ringer in Med. Chir. Trans., vol. xlii.

⁷ Dr. Beale suggests that this sallow tint may be due to deficiency of chloride of sodium in the blood. Loc. cit., p. 369.

When one malar surface only is red, this has been affirmed to depend rather on the decumbency of the patient, than on the influence of the lung affected: there is, however, nothing unreasonable in the supposition that the innervation of the sympathetic in the face may be modified through excitement of that nerve in the inflamed lung. The state of the pupil deserves investigation. The *decumbency* is most commonly dorsal, with inclination to one or the other side. Andral affirms that not one out of fifteen patients lies on the affected side.

1128. *Emaciation* rarely reaches the amount noticed in other acute diseases of equal or nearly equal danger: whether the non-destruction of fat, consequent on defective respiration, explains this, is a matter for inquiry.

1129. *Terminations*.—The anatomical terminations of acute pneumonia are—by resolution, diffuse suppuration, abscess, gangrene, and chronic induration; the clinical terminations, by recovery, death, and lapse into the chronic state.

1130. *Resolution*, of which the signs have already been systematically set down, occurs at very various periods, and with different combinations of those signs. Thus, of 103 convalescents, observed by M. Grisolle, and discharged from hospital between the twentieth and fifty-fifth days of the disease, 37 had no morbid signs, 36 weak respiration, 14 slightly blowing respiration, 11 redux crepitant or “subcrepitant” rhonchus, and 5 deficient expansion with bronchitic rhonchi.

It is most important to observe that the physical signs of resolution, when the entire lung has been affected throughout by idiopathic inflammation, make their appearance first at the apex. If they pursue the contrary course, travelling from below upwards, the existence of tubercle superiorly is to be strongly apprehended.

1131. Absolute fall in the frequency of the pulse and respiration, affecting, however, the latter in excess, whereby the pulse-respiration ratio returns somewhat nearer the natural standard—diminished heat of skin—with occasionally more or less marked changes in the urine as already described, are among the most striking general symptoms attending resolution.

What support does the dubious doctrine of crises and critical days receive from the phenomena of pneumonia? Copious perspiration, cutaneous eruptions, hemorrhages from the nose and kidneys, fetid dejections, and deposits of urates, have been set down as critical occurrences. In respect of critical days, M. Andral refers to 112 cases, of which, it is affirmed, one-half terminated on the seventh, fourteenth, or twenty-first days. In 34 cases, collected by M. Grisolle, where resolution occurred between the fourth and twelfth days, the fifth and ninth days are, on the other hand, the only ones exhibiting undue shares (9 and 11) of recoveries; the seventh day contributing only 3, or not quite 9 per 100 of the whole number.¹

¹ The whole subject of crises and critical days requires re-examination. Traube, who in his recent work (*Ueber Krisen und kritische Tage*—or B. and F. M. C. Rev.,

1132. The symptoms of *diffuse suppuration* are vague and unsatisfactory. Shivering may be completely absent, and dark fluid liquorice-juice expectoration, to which some writers attach much significance, may exist in the stage of red hepatization. The general symptoms become more severe, and of adynamic character—dry tongue, sordes on the teeth, pinched features, anxious expression, clammy skin, failure of strength of pulse, wandering delirium, or somnolence, and semi-coma occur. But all this *may* happen in cases where no suppuration has taken place; and, as already admitted, there is no positively distinctive physical sign. Hence it follows, that the difficulty of proving the fact of recovery after diffuse suppuration, is extreme; in truth, there is no conclusive evidence of recovery having occurred in such cases.

1133. There are no positive symptomatic evidences of the formation of *abscess*. The contents may be fetid, from a sloughing condition of the walls. Such a case is readily to be confounded with primary gangrene of the lung. Abscesses may terminate favorably by passing into the state of quiescent cavity: and it is alleged (although they early—sometimes in a week—become lined with pyogenic, and, eventually, pseudo-mucous membrane) by perfect cicatrization.

The symptoms and signs of *gangrene* of the lung will be separately considered presently, as likewise the subject of *chronic pneumonia*.

1134. Dating *convalescence* from the fall of temperature of the skin, and restoration of the pulse-respiration ratio more or less closely to that of health, the process is generally rapid: the recovery of strength, and such amount of flesh as has been lost, quickly follows. The ex-patient is for a time easily put out of breath, and often suffers from pain in the side, sometimes for many weeks. Percussion-dulness and various forms of morbid respiration gradually, but slowly, wear off. The signs of pulmonary œdema sometimes supervene.

1135. M. Macario records two cases of pneumonia, in which, during the period of convalescence, formication and muscular weakness, commencing in the palms of the hands and soles of the feet, were followed by motor paralysis, perfect in the lower, imperfect in the upper limbs. The intellect was unaffected, and no excitement of the spinal cord observed. Of the real nature of the affection nothing is known: one case ended in recovery, the other in death, without *post-mortem* examination.¹ But it appears exces-

1853) refuses to admit crises of *disease*, but acknowledges in a novel sense that of the *fever* accompanying them, appears to have struck out an important path of inquiry. This writer settles the question that has puzzled alike schoolmen and clinical observers from time immemorial, as to the relationship between the disappearance of fever and the occurrence of critical discharge by cutting the Gordian knot, and affirming that sometimes the crisis is the effect, sometimes the cause, of the apyrexia.

¹ Bulletin Gén. de Thérapeutique, 1850.

sively probable the symptoms may have depended on venous obstruction in the brain, produced by coagulation. I have seen the same phenomena precisely in anæmic women. Besides, in the convalescence from pneumonia, firm anasarca of a lower extremity occasionally occurs, evidently depending on local venous obstruction, caused by coagulation of the blood—and sometimes with, more commonly without, imperfect evidences of phlebitis.

1136. The frequency of *relapse* has been estimated by M. Briquet at about one-fifth, by M. Grisolle at about one-twenty-eighth of the cases. The experience of this country supports the observation of M. Grisolle as to the rarity of true relapse, announced by fresh rigors, rusty expectoration, and crepitation.

1137. *Mortality*.—The mortality caused by pneumonia in Great Britain is very serious. Taking the estimates of two years and a half [816], as furnishing a fair average, we may rate the annual mortality in England and Wales at about 18,908—an amount actually giving this inflammation the third place among fatal diseases. Further, out of 1,000,000 living population, 1201 annually fall victims to pneumonia. In this country, as elsewhere, however, the annual mortality from pneumonia is subject to serious and inexplicable fluctuations.¹

1138. Pneumonia destroys life, in London, much more extensively in the cold than the temperate months. It may be calculated from the invaluable returns supplied in the Registrar General's Twelfth Report, that in the metropolis the deaths in the quarter ending June, averaged 774; in that ending September, 477; in that ending December, 1185; in that ending March, 1250; for the five years 1845 to 1849. The deaths average 2435 for the six coldest, 1251 for the six warmest months.

1139. In fatal cases, death rarely occurs before the sixth, or after the twentieth, day. In the great majority of cases, the patient perishes from gradual asphyxia; in rare instances from sudden obstruction of breathing through œdema of the glottis. The rapidity of the fatal issue is by no means always proportionate to the amount of pulmonary tissue implicated.

1140. *Prognosis*.—The major influence regulating the prognosis of pneumonia in individual cases is *age*. In new-born infants, and after the age of seventy, the disease is almost always fatal: between the ages of six and twelve, death is the rare exception; between the sixteenth and twentieth years, scarcely one in fourteen of those attacked perishes; while in each succeeding decade up to the seventieth year, the deaths range between one-fifth and one-seventh of those seized. As to *sex*, the disease, though destroying males more extensively than females, is, relatively to the numbers attacked, more fatal to females: the first of these propositions is based on the Registrar General's Second Report, which gives 1339 male

¹ Vide an interesting paper on this subject by Ziemssen, Ed. Med. Journ., 1858.

deaths, 1064 female deaths, to 1,000,000 of each sex living; the second on the results carefully obtained in France by MM. Briquet, Grisolle, and others. *Season*, if we are to trust M. Grisolle's experience, has but slight influence on the fate of those actually seized; of 100 pneumonic patients, very nearly the same number will perish in summer and in winter: this result is rather startling, when compared with that we have just obtained, showing the influence of season in increasing the absolute mortality of pneumonia [1138]; but the two are by no means irreconcilable. *Habitual drunkenness* and *weakness of constitution*, are of unfavorable augury. *Traumatic pneumonia* is, *per se*, the least dangerous. Inflammation of *both lungs** is more serious, as matter of experience, than of one,—as also of a large mass, than a small portion, of one lung. The *side affected* in single pneumonia does not appear to exercise any positive influence: but inflammation commencing with the *upper*, appears on the whole, though the evidence is somewhat contradictory, to be more dangerous than that first implicating the *lower*, lobe. Above all, the so-called *epidemic constitution* is of signal importance in estimating the prognosis: at one period recovery is the rule, at another almost the exception.

1141. According to Remak, the earlier the expectoration of fibrinous casts commences, and the more abundant and continuous it is, so much the more certain and speedy will be the cure. In fifty cases observed by him in Schönlein's wards, there were not more than four or five, in which even a partial diminution of the symptoms occurred previously to the appearance of the casts, while in the great majority an amendment was first observed after their occurrence.¹ But, as already signified [1118], these observations seem to require corroboration.

1142. Although marked acceleration of breathing is an unfavorable sign, it is not, even to the highest degree, of fatal augury: recovery may take place where the respiration has reached 80 per minute. I have, on the other hand, observed cases where an unfortunate issue coincided with a slack rate of breathing throughout.

1143. Diffluent prune-juice sputa are of evil, but not necessarily fatal, significance.

1144. Cases in which the local and general symptoms improve, despite an extension of the inflammation, as proved by physical signs, do not terminate out of proportion unfavorably.

1145. *Sequelæ*.—Pneumonia is very rarely immediately followed by tuberculization of the lung: so rarely that intense predisposition to tubercle must be admitted, when such a consequence occurs. If lungs, already tuberculized, become acutely inflamed, convalescence from the pneumonia often takes place as rapidly, as if the lungs had previously been sound: and no increase in activity of the tuberculous disease necessarily follows. This fortunate course

¹ Diagnostische und pathogenetische Untersuchungen (Berlin, 1845); or B. and For. Med. Rev., April, 1847.

is, however, only observed, at least only habitually observed, where a small extent of lung has been inflamed: if the pneumonia be extensive, rapid breaking-up of tuberculized parts may follow. The anasarca just referred to [1135], sometimes comes on with extraordinary rapidity and great suffering: two hours in one case sufficed to enlarge a limb enormously.

1146. *Diagnosis*.—The diagnosis of acute pneumonia as a rule is simple. The combination of crepitant rhonchus, dull or tubular percussion-sound, tubular breathing, rusty expectoration, burning heat of skin, and perverted pulse-respiration ratio, is peculiar to itself. No one of these conditions can, however, be held to be pathognomonic of the disease; the greater the number of them associated in any instance, the more certain the diagnosis. Thus, though sputa having all the characters described [1117] are almost peculiar to pneumonia, the naked-eye appearances, more especially, cannot be held to be formally distinctive: for in some cases of mechanical congestion of the lungs, especially from mitral disease, the expectoration may be somewhat viscid, faintly aerated, and semi-transparent, and the blood-tint rusty. Again, analogous perversion of the pulse-respiration ratio may exist in hysteria.

1147. The distinctive marks of capillary bronchitis [578], of fluid in the pleura [809], and of acute phthisis [1598], are elsewhere given.

1148. When pneumonia sets in with adynamic symptoms, it may be impossible to distinguish the case from "typhoid" (Peyerian) fever, with superadded pneumonia, until the period for the appearance of the specific eruption, having passed with or without result, decides the point.

1149. *Edema* of the lungs is, except in very rare instances [324], distinguished by the comparatively large size and bubbling character of its rhonchus, by the absence of tubular breathing, by the deficiency of febrile action, heated skin, and perverted ratio of the pulse and respiration, and by the circumstances under which the disease originates.

1150. Attention to the character of the different *pseudo-rhonchi* (pleural, mediastinal, and parenchymatous), as elsewhere described, will prevent their being mistaken for true crepitant rhonchus.

1151. *Treatment*.—Pneumonia is an inflammation; hence anti-phlogistic remedies, and among these blood-letting, must hold the first rank among means calculated to bring it to a favorable issue. Such is one *à priori* view of the proper management of the disease. But if we hesitate to adopt this view, unless sustained by experience, a difficulty the most disheartening meets us at the threshold of the necessary inquiry. We find some men ascribing results the most favorable to venesection pushed to startling extremes, and others tracing an equal or yet greater success to a system of absolute non-abstraction of blood. Lamentable indeed is the spectacle of hostile opinion and vacillating practice afforded by the history of the treat-

ment of pneumonia from the days of Hippocrates to our own. Yet from the experience collected within that lengthened period, inferences may be gathered by the unprejudiced inquirer guiding to a tolerably sure verdict concerning this still vexed question.

1152. In the first place, moderate venesection has been numerically¹ proved by MM. Louis and Grisolle to diminish the mortality and lessen the mean duration of the disease, and also curtail the duration of its prominent symptoms, both subjective and objective, the pain in the side, the febrile action, the peculiar expectoration, and the physical signs. Whether venesection possess the power of actually arresting the disease at the very outset, and preventing the occurrence of hepatization, must be held to be yet scientifically undetermined. If, on the one hand, in the immense majority of cases, it be vain to push bleeding to extremes in the hope of producing any such effect, clinical observation has more than once led me to at least strongly surmise that active congestion may be prevented from reaching the exudation stage by a well-timed abstraction of blood [1062].

1153. In acute sthenic pneumonia there are few barriers to venesection. Advanced age cannot be set down as an *absolute* preventive; for Morgagni bled nonagenarians with success. But, in the mass, aged persons bear bleeding badly, and recover in notably smaller proportion if bled than if not bled. It does not appear that either pregnancy or menstruation, provided the indications be otherwise positive, stands in the way of the use of the lancet. I have occasionally bled women laboring under pulmonary inflammation during the flow of the catamenia without arresting the discharge: and if such stoppage should occur, cupping over the sacrum, or leeching the perineum, will prevent any ill consequences.

1154. During certain epidemic, bleeding is very badly borne; and persons of a constitution either originally feeble, or shattered by excess, social anxiety, physical privation, or chronic disease, should, of course, be cautiously deprived of any of their, already spanæmic or hypinotic, blood. If the disease be of asthenic type, or even if a tendency to adynamia be distinct from the first, blood-letting proves gravely injurious.

1155. Where legitimate, the earlier the bleeding the better. Louis shows that pneumonic patients bled within the first four days recover, *cæteris paribus*, four or five days sooner than those bled at a more advanced period; and Dr. Jackson, the enlightened practitioner of Boston, has proved that by bleeding on the first day the mean duration, in a mass of cases at the Massachusetts Hospital,

¹ The mass of numerical returns bearing on the main question is large; but unfortunately it is worthless. Obviously, when we find some therapeutists returning their deaths as 1 in 90, or as 0 in 30, while, on the other hand, certain observers plead guilty to a mortality of 33 and even 45 per 100, the conclusion is unavoidable that either different diseases are referred to, or that errors in diagnosis, unintentional or wilful, have been extensively committed.

was lowered from 14.60 to 11 days.¹ No *period* of the disease is too late for blood-letting, provided the indication be thoroughly and strongly established on general principles. Even the *stage* of suppuration is by some held not to be a contra-indication, in itself alone, to the use of the lancet; but, although the name of M. Andral appears among those of the supporters of this doctrine, I have the strongest doubts of its correctness. M. Grisolle refers to four patients, bled to ten or twelve ounces, and in whom *post-mortem* examination, the sole positive test, proved the existence of the purulent stage. In all four cases, the fatal issue was obviously hastened, in one almost immediately caused, by the loss of blood.²

1156. No fixed rule can be laid down for the quantity of blood to be drawn; the mean amount of four pounds five ounces taken from his patients by M. Bouillaud, has been most satisfactorily proved by M. Grisolle to have produced no more favorable immediate results (and of the ultimate effects what may not be feared?) than the abstraction of a mean quantity of two pounds seven ounces from the mass of patients treated by himself and others.³ For my own part, I strongly question the utility of even such amount of depletion as this. Certainly no cases have of late years presented themselves to me, in London practice, where it seemed necessary or advisable to draw blood oftener than twice; eight or ten ounces sufficing in the first instance, and some six or eight in the second. Further, in cases of moderate severity, even in the male adult, abstraction of eight to ten ounces from a vein, as the total quantity, effects all the good to be obtained by general bleeding. But I desire it to be understood that I only make this affirmation in regard to the sphere of practice with which I am familiar—that of the metropolis. Slow convalescence is not the worst evil in cases where blood has been too lavishly sacrificed, especially by repeated venesections. A form of spanæmia is sometimes induced which it may take months, nay, years, to remove.

¹ Putnam's *Louis on Blood-letting*. Boston, U. S., 1836.

² Sometimes, as we have seen [1077], a lung apparently in a state of suppuration is in reality infiltrated with softened fibrinous exudation—exudation cells alone, and no pus-cells, being found with the microscope. This anatomical fact, not generally known, may have some important bearing on the question of bleeding after the stage of red hepatization has passed. But who shall distinguish, during life, the case of softened exudation from that of suppuration?

³ Even in our own country, it was at one time thought by many that bleeding could scarcely be pushed far enough: men were systematically bled to convulsions. It was held theoretically sound to take away blood, the presumed source of the existing evil, to the uttermost point; but it was forgotten, or it was not known, that the increased impetus of the circulation during hemorrhagic reaction might make up for the diminished quantity propelled. In those days, too, provided *theory* were satisfied, *facts* were held as matters of no importance. "Dr. Gregory, of Edinburgh," reports Dr. Watson, "used to bleed to the verge of convulsion. His colleague, Dr. Rutherford, seldom went beyond three bleedings, and generally accomplished his object by two. *His* patients recovered quickly; *Dr. Gregory's* very slowly." Yet Dr. Gregory continued to cling to his practice, for he had the theory of the hour on his side.

Leeching, or rather cupping, over the affected part, should always be employed in addition to general bleeding; in very mild cases it will suffice alone; local abstraction of blood assuages pain much more directly and quickly than venesection. Four to six ounces may, with propriety, be taken by cupping in a case of medium intensity, in addition to the quantity drawn from a vein; all local pain sometimes instantly disappears after the operation.

1156*. That bleeding in inflammation generally is infinitely less in vogue than formerly, is a fact known to all. Why has the practice fallen into disrepute? Is it because, as some affirm, the qualities and type of diseases have changed, and asthenia become that dominant element? Obviously not so: for Broussais to his latest breath, and Bouillaud and his adherents, and some exceptional practitioners in our own metropolis, at the present hour, maintain, on the ground of existing qualities and type, that inflammation demands the lancet as pressingly as at any historic period of Medicine. Is it because pathology has improved? Not a whit more; they, who well-nigh drain their patient's veins, know the current pathology quite as familiarly, and as confidently refer to that pathology in their support, as they who dread even the application of a leech. No! we are simply in a period of reaction from the excesses of the Sangrado school. We have learned from our predecessors the evils of *over-bleeding*—and seem, in my opinion, very much disposed at the present day to learn from ourselves the evils of *under-bleeding*.

1157. Tartarized antimony stands next in importance to venesection in the treatment of pneumonia—were I, indeed, henceforth, in the management of this disease, forced to surrender either, on the one hand, venesection, or, on the other, cupping and tartarized antimony, I should not hesitate to relinquish the former. In what manner this important agent produces its beneficial effects on the lung, is matter of the loosest speculation;—that it does produce such effects, is the really important point, and one of which proofs, obtained by scientific observation, abound. There is not any available evidence to show positively whether the effects of antimony on pneumonia are more marked when the mineral is, as is technically said, *tolerated* perfectly or imperfectly, or when it is not *tolerated* at all. The question could obviously only be decided by numerical comparison; and the number of cases in which complete tolerance is observed (that is, total absence of effects on the stomach and bowels) is relatively very small. Improvement often takes place within eight or ten hours after the medicine has been commenced with, and without any notable effect on the alimentary canal being noticed; whereas recovery also ensues when it acts freely both as an emetic and purgative. Hence it is more as a result of prejudice (for what but prejudices are even plausible *à priori* theories?) than of logical deduction from experience, that, in imitation of Rasori and Laennec, I prescribe antimony in such

manner and combinations as are most likely to prevent its disturbing the stomach. The salt should at first be given in doses of half a grain, combined with dilute hydrocyanic acid, paregoric, and tincture of orange-peel, every hour for the first three or four hours—and the dose then increased, at intervals of two hours, to one grain; in the course of twelve hours the quantity may be raised to two grains—its repetition made less frequent, say every fourth hour.

1158. The constitutional effect of mercury is by some held to be peculiarly efficacious in the stage of red hepatization. It is even maintained that when that stage has been reached, calomel is a more valuable medicine than antimony. No scientific demonstration of this view exists. If it were correct, the value of antimony in hospital practice, at least, would be singularly small; for the great majority of persons admitted into hospitals, have some amount of hepatization, when first seen. Mercurials appear to me to be desirable in those cases of pneumonia only, where, from some cause or other, antimony is inadmissible.

1159. Attended as it is, with the maximum amount of hyperinosis observed in any affection, pneumonia seems *à priori*, likely to be controlled by free and rapid administration of alkalies. Half a century ago, Mascagni treated the disease, during a severe epidemic, on this plan, with remarkable success; his follower, Farnese, gave the bicarbonate of potass in quantities varying from a drachm to an ounce daily.

1160. Should adynamia appear early, or should the patient's constitution be notably feeble [1154], antiphlogistic remedies are wholly inapplicable. Carbonate of ammonia, with bark and wine, then become the staple agents of treatment. The ammonia may be associated with bicarbonate of potass.¹

1160*. The announced success of the treatment by copious libations of brandy appears simply to furnish a fresh illustration (as conversely Bouillaud's alleged triumphs by his *saignées coup sur coup*, in genuine "typhoid," Peyerian, fever) of the wondrous power of the *vis medicatrix Naturæ*.

1161. Blisters are not advisable in the earliest periods of pneumonia: it would appear that they have no effect in shortening the mean duration of the disease, and they certainly increase fever and general irritation at the outset of the attack. At its more advanced periods, when fever has been materially controlled, they, on the other hand, relieve pain and dyspnoea, and seem to promote absorption of the infiltrated exudation. They may with advantage be repeated—care being taken not to apply them too close to the affected part. Cold applications to the surface are strongly recommended by some.

1162. The ordinary *juvantia* of the antiphlogistic regimen must,

¹ Furby, U. C. H., Males, *æt.* vol. xi. p. 268.

of course, be carefully put in requisition; the bowels, if necessary, should be opened by medicine; but profuse purgation, is, to say the least, absolutely useless.

1163. Complete demonstration of the utility of treatment in pneumonia is found in the fact, that the mortality of the disease steadily increases with each succeeding day it has been allowed to run its course uncontrolled. The statistics of M. Grisolle, referring to the treatment by moderate bleeding and tartar emetic, show, that while the mortality among those seen and treated within the two first days, is only one-thirteenth, it rises among those whose treatment does not commence till the eighth day, from one-third to one-half of the whole number. Here, then, is a condition of success or the reverse, which should never be lost sight of in estimating the value of any given mode of treatment. There are certain other circumstances, beyond the control of the physician, which exercise a most indubitable influence on the issue. Among these, the pre-existence of organic disease, and the state of health generally of the individual, hold an important place. But of all collateral conditions, age is the most important: while at the two extremes of life, in the new-born infant and the octogenarian, pneumonia is, as we have seen, almost inevitably fatal; the mortality between the ages of six and twelve scarcely exceeds two and a half per cent. And if it be true, that between the ages of fifteen and thirty, the deaths equal about six per cent. of those attacked—suddenly rise to about fourteen per cent. in persons aged between thirty and forty—and thenceforth steadily increase with each succeeding decade, it becomes manifest, that, when we plume ourselves on the special excellence of a favorite system of medication, we should take count of the ages of our patients. There are periods of life at which it is next to impossible to save—there are periods of life at which it is not easy, with common prudence, to lose—a sufferer from idiopathic and *sthenic* pneumonia.

1164. And hence it is, that, in spite of its apparent gravity, pneumonia is a disease which may, and actually has been, therapeutically played with—and this with seeming impunity to the sufferers. Thus Skoda, drawing not a drop of blood, employing solely extractum graminis, or a few grains of nitre, and in some instances, corrosive sublimate, lost three only of forty-five patients; but the mean age of the series was only twenty-five and three-quarters years.¹

1165. The value of the treatment of pneumonia by chloroform-inhalation, as practised by Wucherer, Baumgärtner, Helbing, Schmidt, and Varrentrapp, must be as yet considered *sub judice*. Varrentrapp, one of its most earnest advocates, admits his want of perfect faith, for cases of severity were managed on other plans. Had severe cases been included, his mortality would have averaged

¹ Balfour's Report, Br. and For. Med. Rev., p. 591, Oct. 1846.

about 11.5 per cent. in a mass of patients aged thirty,¹ whose treatment commenced on the fifth day.

I have in a very few instances tried this inhalation as a subsidiary measure, but not with the flattering results described by its originators. Still, relief of cough and of dyspnoea do very certainly temporarily ensue. Caution is requisite: Varrentrapp lost a patient clearly through the effects of the chloroform.

The number of inhalations averaged seventy-four in ten and a half days; the inhalation was not pushed to stupefaction—the vapor of a drachm only on cotton being allowed to enter the lungs for ten or fifteen minutes; it was repeated every two, three, or four hours.

1166. Should swelling of a limb with venous coagulation [1135] have occurred, careful bandaging, saline douches, dry friction, and shampooing are the means by which, with the aid of time, the annoyance may be got rid of.

VARIETIES OF ACUTE PNEUMONIA.

1167. The varieties of pneumonia may be arranged in the following manner:—

Varieties depending on—

- | | | | | | | | |
|---|---|--|---|---|--------|---|---|
| (a.) Topographical seat . . . | } | Single or double. | | | | | |
| (b.) Textural seat | | Upper, lower, central, marginal, hypostatic. | | | | | |
| (c.) Amount of subjective symptoms | } | Lobar, lobular, interlobular. | | | | | |
| | | Obvious, latent, terminal. | | | | | |
| (d.) Secondary or intercurrent origin | } | In new-born infants. | } | In | Acute. | } | Hardening of the cellular tissue, diphtheritic disease. |
| | | | | | | | |
| | | In adults | } | Pulmonary tuberculization and cancer, diseases of the heart, cancer of abdominal viscera, diseases of the liver, scurvy, purpura, Bright's disease, &c. | | | |
| | | | | | | | |

1168. (a) The *topographical seat* of pneumonia, though mainly interesting anatomically, is not devoid of clinical import, as a guide to the observer in quest of the physical signs of the disease. Of one thousand four hundred and thirty cases, seven hundred and forty-two were of the right lung, four hundred and twenty-six of the left, and two hundred and sixty-two of both organs. With respect to the cases of double pneumonia, which hold a rather high numerical rank (they furnish 18.3 per 100 of the whole series), it

¹ The age of three patients not treated with chloroform, but included here, is not given. Vide "Medical Times," Oct. 1851.

is to be observed that the great majority of them were not so from the outset; in other words, that the implication of the second lung was secondary in point of time. This, indeed, is a matter of no mean importance; for the existence of the phenomenon at one only, or at both sides of the chest, will aid materially (where its intrinsic characters are ill-defined) in distinguishing the true crepitant rhonchus of pneumonia from the fine bubbling of capillary bronchitis. And even with the qualification now mentioned, alone, the frequency of double pneumonia is probably considerably exaggerated in the estimate just given: fine bubbling has often been mistaken for true crepitation, and a double capillary bronchitis put down as a double pneumonia; it is traditionally well known in Paris that even Laennec committed this error. The age of patients, too, must be borne in mind: in the adult, the proportion of double pneumonias does not probably much exceed one in twelve;¹ it has even been estimated so low as one in seventeen. On the other hand (though from the long-standing confusion between hepatization and collapse, the precise ratio cannot now be furnished) it is certain the double disease is more common in early infancy and childhood.

1169. In two hundred and sixty-four cases, the upper lobe was affected one hundred and one, the lower one hundred and thirty-three, the middle part thirty times (Grisolle). Pneumonia commencing about the middle of the lung is rarely primary: it is commonly either a sequence of endopericarditis or of blood origin—a fact of obvious practical signification. The anterior *margin* of one or both lungs is sometimes separately inflamed: I believe that the frequency of this peculiar seat has been exaggerated from confounding mediastinal pseudo-crepitation with true pneumonic rhonchus.

1170. Under the term *hypostatic* pneumonia, asthenic inflammation occurring in the aged and adynamic, has been included, as well as passive congestion of the lungs [1049]. Clinically it is impossible to draw the line between the two states: fortunately the treatment for both is precisely the same, stimulant and calorific.

1171. (*b*) *Textural seat*.—The pneumonia of infancy and early childhood, instead of spreading through a lobe of the lung, limits itself (pretty frequently) to scattered groups of lobules, the intervening tissue remaining sound: such pneumonia is called *lobular*.² So, too, pneumonia preceding the formation of secondary abscesses or collections of exudation-matter in the lungs, sequential to

¹ During one scholar year, when I was attending at the Hôtel-Dieu, 48 cases of pneumonia occurred in the wards of M. Chomel: 33 of these were of the right lung; 11 of the left; 4 were double.

² Infantile pneumonia, supposed to be the commonest of conditions, until the simple test of Bailly and Legendre demonstrated its rarity [940], bids fair now, through exaggeration in the opposite direction, to be expunged from nosological lists. Fuchs, for instance, denies that true pneumonic consolidation is to be seen in children under five years of age.

phlebitis and pyohæmia, commonly assumes this form, no matter what be the age of the individual.

1172. True lobular pneumonia is distinguished in the dead subject from collapse by the physical characters elsewhere [940] enumerated.

1173. The *physical signs* of lobular pneumonia are obscure. Inspection, application of the hand, and mensuration give merely negative results. Percussion, too, does not disclose such an amount of dulness as can be clinically trusted to; which is no more than might be anticipated, when we consider that the nodules of consolidated lung are separated by tissue perfectly permeable. In many cases originally, to all appearances, at least, lobular, I have found the percussion-sound duller than natural, it is true: but when this was the case, and the opportunity of examining the parts occurred, I invariably discovered such extension of the inflammation between the nodules as to reduce the organ, physically speaking, almost to the state of ordinary consolidation. The respiration is exaggerated in some points; harsh, bronchial, or even slightly blowing (never tubular, so long as the pneumonia is simply lobular), in the spots probably corresponding to the consolidated nodules. Occasionally a few cracklings of an imperfect crepitant rhonchus may be heard; but it is difficult to distinguish these from the humid rhonchus of fine bronchitis—a disease almost constantly associated in children with inflammation of the parenchyma.

1174. The signs of *diffuse* pneumonia in the infant scarcely differ from those noticed in the adult. Crepitation, metallic tubular breathing, and dulness under percussion are the essential signs: the child's cry resounds with sniffing and bronchophonic character. The crepitation is of larger size than in the adult.

1175. The *interlobular cellular tissue* may be the seat of acute suppurative inflammation,¹ pus occupying the situation that is filled by air in interlobular emphysema. Or this tissue may be infiltrated with fibrinous exudation, which solidifies into induration-matter, and causes considerable contraction of the lung, and sinking in of the side—an exudation, however, more probably produced by a low congestive than a true inflammatory process (*vide* CIRRHOSIS OF THE LUNG).

1176. (c) *Amount of subjective symptoms*.—Instead of running the ordinary course with marked subjective symptoms, pneumonia may be completely *latent*. The perverted ratio of the pulse and respiration, and the physical signs, are then the sole guides to the detection of the disease. Pneumonia occurs in this form solely under circumstances of general physical debility; it is either *senile* or connected with *adynamic* diseases, of which it is an intercurrent phenomenon.

¹ Carswell's framed drawings, U. C. Museum, No. 57, C. b. 573.

1177. Physically, latent pneumonia is characterized by the rapidity with which it runs into solidification, and with which it involves a great extent of substance.

1178. In managing this form of the inflammation, the main attention must be given to the state of the system generally. Venesection I cannot believe to be ever requisite; and abstraction of blood, even locally by cupping, should be very cautiously ventured on. Still, if the respiration be much accelerated, and consolidation very rapidly extending, a few ounces of blood may be taken by cupping. Dry-cupping is always a measure of utility, and unattended with danger. The early application of blisters is by some observers strongly recommended in this variety of the disease: I have not happened to observe results justifying their confidence.

1179. (*d*) *Secondary or intercurrent origin*.—It is impossible to exaggerate the importance of pneumonia, when occurring as a *secondary* or *intercurrent* disease: in truth, the majority of cases of fatal pneumonia belong to this class. It is intercurrent pneumonia that commonly kills new-born infants, affected with hardening of the cellular tissue and diphtheritic disease. From childhood to puberty, croup, cancrum oris, measles, whooping-cough, variola, frequently prove fatal through inflammation of the lungs. Again, we meet it complicating the diseases of the adult,—and, if not at this period so frequently fatal, not the less important for the practitioner to watch. Thus it appears in continued fever, phlebitis,¹ glanders, puerperal fever, inflammation of the bowels, and of the brain or membranes, and in acute rheumatism; among chronic diseases, in pulmonary tubercle, Bright's disease, chronic affections of the liver, not so commonly as might be expected in organic diseases of the heart, and in cancerous affections, not only of the thoracic, but of distant organs.

1180. In treating intercurrent pneumonia, we must remember that the inflammatory character of the local malady is modified more or less seriously by the general state of the system. It is exceedingly probable, indeed, that various differences exist in the intimate constitution of many of the intercurrent pneumonias,—though at present no absolute proof of the fact can be given. Hence, if antiphlogistic management be proper, as it positively may be in these cases, the state of the system at large should always be allowed full control. This is more especially true in the instance of diathetic diseases, such as rheumatism: it may be that colchicum is a more important remedy than antimony for rheumatic pneumonia. In pneumonia complicating purpura, the treatment, except in regard of blistering and dry-cupping, is wholly that of the blood-disease present.

¹ Hill, U. C. H., Males, vol. x. p. 278.

IV.—CHRONIC PNEUMONIA.

1181. Chronic pneumonia is rare as a sequence of the acute disease; it is rare as a primary disease; it is common as a local attendant on the progress of tubercle, cancer, and other adventitious products in the lung.

1182. *Anatomical characters.*—(a) A lung chronically inflamed is heavy, its tissue of high specific gravity, solid to the feel, tough, resistant, torn with difficulty, more or less dry, or at most giving out a little frothy pale buff fluid on pressure, non-granular on section, or even when torn, and variable in color, dull brown, grayish, dirty-whitish. These varieties of tint depend on the relative amounts of permeable bloodvessel, black pigment, induration-matter, and slantingly divided bronchial tube on the surface examined. The natural characters of pulmonary texture are untraceable.

1183. The solidified exudation essentially lies within the air-cells, and sometimes blocks up the ultimate bronchial tubes. But in a minor degree the inter-cell spaces may be infiltrated; just as conversely, in cirrhosis of the lung, the air-cells may suffer on a very limited scale.

1184. There is no tendency to a softening process. Circumscribed gangrene, as originally shown by Carswell, occurs in very rare instances, involving a small extent of substance.

1185. (b) There is, however, another form of disease in which the affected tissue is clogged with induration-matter, less tough in character, friable and short, and disposed to break up into a kind of granular detritus. This condition forms, clinically as well as anatomically, a middle term between pure chronic inflammatory induration, and tuberculous infiltration. Whether it possesses these characters *ab origine*, and so constitutes a special form, or is merely a degenerate condition of that already described, I am uncertain. As fat may be found in quantity in the induration-matter, the latter view is probably the correct one.

1186. When acute pneumonia lapses into the chronic disease, the strength and flesh, instead of returning with more or less rapidity, continue to fail; there is habitual, though moderate, dyspnoea; sensations of discomfort and oppression within the chest are almost constantly present; cough, with insignificant catarrhal expectoration, and in the vast majority of cases not attended with any (never, so far as I have seen, productive of notable) hæmoptysis, exists. Thirst and anorexia, with irregular fever, which gradually grows constant, and has its evening-exacerbation, rarely followed, however, by any notable night-perspiration, betoken serious constitutional suffering; while in addition to all this, the loss of flesh may, for a time, almost equal that occurring in the same period in phthisis.

1187. *Physical signs* mark the changes in the lung. The thoracic surface is more or less extensively depressed, according to the area

implicated; the chest movements are impaired, especially the costal ones; the antero-posterior diameter, and the superficial width of the side diminish. The percussion-sound acquires the characters of Type I. (dulness), or Type III. (hardness) [194], sometimes becoming wooden or tubular, with marked parietal resistance. The respiration weak, uneven in quantity, harsh, bronchial, or diffused blowing in the affected parts, is occasionally exaggerated beyond these. The vocal resonance varies; it may be bronchophonic or null: the vocal fremitus is intensified.

Chronic pneumonia has no rhonchus of its own; but there may be fine bubbling from bronchitis or oedema. In all probability under favorable circumstances, interstitial creaking-sound may be produced by forced inspiration in lung-substance in this condition.

1188. M. Grisolles refers to a case observed by M. Requin, which shows that the auscultatory signs in chronic consolidation may be of a different kind—in fact, all of them negative; total absence of all healthy or morbid respiration-sounds, of rhonchus, and vocal resonance, the percussion-sound at the time being completely dull. In the case referred to, the affection was mistaken for simple pleuritic effusion; but the patient dying *in a state of marasmus* two or three months after the outset of the affection, the sole morbid condition discovered in the chest was very firm induration, neither granular nor tuberculous, of the lower lobe of the right lung. Unfortunately we are not informed of the state of vocal fremitus. What the physical conditions were, capable of thus annulling the effects of conduction, unison-resonance, and echo [433], remains matter of pure conjecture; it is a parallel state of things to that sometimes observed in acute solidification.

1189. *Diagnosis*.—In cases where the affection principally implicates the upper lobe, and where obstruction of air-cells has been extensive, while the contraction of the exudation-matter thrown out into the substance of the lung has been active, flattening of the infra-clavicular region will take place. Under these circumstances, especially if, as often is the fact, among the general symptoms appear emaciation, and slow fever, the distinction of the case from tuberculous consolidation becomes extremely difficult—impossible, indeed, unless by the aid of repeated examinations at certain intervals of time. The comparatively stationary condition of the part in simple consolidation, taken in conjunction with the progress of the general symptoms, if it do not perfectly explain the nature of the case, will, at least, point to the necessity of a cautious diagnosis. Fortunately difficulties of the class now especially referred to are of rare occurrence.

1190. *Treatment*.—The treatment of chronic pneumonia is not essentially different from that of the early stages of tuberculization. If the diagnosis were positively established, the occasional application of a few leeches, or the abstraction of three or four ounces of

blood by cupping, might be more freely ventured upon, in the absence of all acute symptoms, than in phthisis.

The external application of strong ioduretted solutions, the internal use of cod-liver oil, and bitter tonics, combined with alkalies, are medicinally the agents most to be trusted to.

V.—ŒDEMA OF THE LUNG.

1191. *Anatomical characters.*—Œdema of the lung is anatomically characterized by infiltration of its texture with a colorless (or in rare instances slightly sanguineous) watery fluid, more or less completely airless; the organ is inelastic, pits under pressure and scarcely crepitates. The texture is unchanged, however; fragments, firm and resistant, sometimes sink instantly in water, after trifling, or without any, pressure—sometimes float after firm pressure.¹

1192. A slight amount of pulmonary œdema is pretty frequently found, no matter what may have been the cause of death: clinically this is insignificant.

1193. *Mechanism.*—When of clinical importance, pulmonary œdema is in the immense majority of cases a secondary state, either of passive or mechanical origin. Passive when it forms a part of general dropsy, depending on morbid states of the blood, as in Bright's disease, purpura or scorbutus, or occurs in the course of acute general diseases, such as typhus or typhoid (Peyerian) fevers—passive, too, when it follows as a sequence of congestive conditions of the lung, as after the acute periods of bronchitis and pneumonia, or in the course of chronic bronchitis. On the other hand it depends on mechanical influence, when traceable to obstructive disease of the orifices or the left side of the heart, or on disease of, or extraneous pressure on, the pulmonary veins.

1194. Hypertrophy of the right ventricle and pulmonary artery are conceivable causes of a sort of active œdema of the lung; but I have not met clinically with œdema of the species.

1195. Section of the par vagum induces, among other effects on the lungs, sero-sanguineous infiltration of their texture; but of the influence of morbid states, dynamic or statical, of the nerve in producing such œdema, nothing is known but by conjecture. The effect in vivisections is probably of passive or paralytic mechanism. Laennec taught that pulmonary œdema may occur as a primary and idiopathic condition, and that the suffocative orthopnoea, which sometimes cuts off children after measles, arises from such œdema.

1196. In cases of general dropsy the external anasarca, as is well known, seems to be rapidly translated in some cases to internal cavities, especially the peritoneum, more rarely the pleura. I have

¹ Hill, U. C. H., Males, vol. x. p. 286.

once or twice known the transference take place essentially to the parenchyma of the lung.

1197. Considering the numerous ways in which pulmonary œdema is speculatively producible, it is of rare occurrence.

1198. *Site*.—Œdema, under whatever conditions generated, is usually either diffused through the lungs, or limited to those parts where the laws of gravitation would naturally direct the fluid. But serosity may accumulate especially at the apices. In a case of emphysema,¹ carried to so high a point that the anterior edges of the lungs overlapped superiorly, and almost completely covered the heart inferiorly, and in which there were dilated bronchi, bronchial abscesses, and some spots of pulmonary apoplexy, the apices, bearing the marks of the ribs upon them, were loaded with black-colored fluid, airless and of watery consistence. There was no disease of the mitral orifice or of the right side of the heart: nor was there any obvious obstruction of the pulmonary veins.

1199. *Symptoms*.—Disturbance of respiration from a slight to an intense degree, slight cough, watery, or sometimes rather tenacious, expectoration, sensation of weight and heaviness within the chest, constitute the symptoms—a combination anything but distinctive. Nor are the physical signs conclusive. Inspection discloses nothing sufficiently marked to be trusted to; the vocal fremitus may be slightly intensified; the percussion-sound is duller than natural; the parietal resistance increased; the vocal resonance varies in character; the respiration is weak, and harsh, or even blowing, and mingled with fine bubbling rhonchus, or in rare cases with a rhonchus not distinguishable from true crepitation [324]: the fine bubbling rhonchus, when very liquid and well marked, is the most distinctive sign.

1200. *Diagnosis*.—In congestion of the lung, if rhonchus exist, it is drier than in œdema, the expectoration more viscid, and there are no dropsical symptoms. Hydrothorax is unattended with rhonchus, and the dulness, caused by the pleural fluid, changes its seat with the posture of the patient. Pleural pseudo-rhonchus [355], unless care be taken, may be confounded with the bubbling rhonchus of œdema. The rhonchus of capillary bronchitis is rather to be distinguished, it must be confessed, by coexistent evidence of bronchial inflammation, than by its own characters.

1201. Œdema, occurring after pneumonia, furnishes an indication for the use of gentle tonics. If it form a part of general dropsy, it is mainly to be relieved by means calculated to lessen the latter; still dry-cupping and a succession of flying blisters to the chest, sometimes exercise a distinctly beneficial local effect.

¹ Skinner, U. C. H., Males, vol. ix. p. 97; the right lung weighed 42½ oz., the left, 37½ oz.: also Hill, U. C. H., Males, vol. x. p. 286; pneumonia sequential to plebitis and glands.

VI.—GANGRENE OF THE LUNG.

1202. *Anatomical characters.*—Laennec described two forms of gangrene of the lung, the diffused and the circumscribed: the tissue may besides sphaclate in patches or in nodules, embracing a greater or less number of lobules. Of sixty-eight cases, sixty-two are represented to have been of the circumscribed, six of the diffused form.¹

1203. In the *diffused form* there is no evidence of limitation, either by exudation-matter or otherwise, of the gangrenous process. In the *circumscribed form*, the sphaclated parts are surrounded by tissue infiltrated by exudation-matter of low plastic type. In both forms excavation occurs: in both, though more readily in the former, perforation of the pleura, of the œsophagus, and even of the diaphragm may ensue; fatal pneumo-hydrothorax may thus be caused. Or, both pleural layers, having been previously agglutinated, may be perforated, and the gangrenous ichor conveyed beneath the skin, subcutaneous emphysema following,—a series of events, be it understood, of singular rarity. Hemorrhage, either into the bronchi or pleura, profuse enough to cause instant death, has sometimes occurred from perforation of a vessel; but this is rare, inasmuch as both arteries and veins are commonly plugged with coagula, not only in, but on the confines of, the mortified tissue. The bronchi are cut abruptly across by the sloughing process. An observation by Schroeder van der Kolk,² in which he found the pulmonary lymphatics and the bronchial glands more or less gorged with gangrenous fluid, requires confirmation: though there can be little doubt of its correctness, both from the character of the observer, and the fact that purulent matter distinctly makes its way from abscesses in the lung to the lymphatic vessels.

1204. Pulmonary gangrene is so commonly fatal, and fatal in so short a period, that opportunities rarely occur of tracing the changes undergone by the excavations it effects. There is evidence, however, to show that a cavity of the sort may eventually become lined with a vascularized pyogenic, or pseudo-mucous, membrane, secreting a fluid wholly free from gangrenous odor. In a case that has been under my observation for a considerable period, and which I believe to be of this kind, the sputa temporarily acquire a putrid smell from time to time,—but whether from mere alteration in quality of the secretion, or from patchy sphaclation of the surface of the excavation, I am unable to say.

1205. A tendency to cicatrize is in very rare instances exhibited by these cavities; but of actually complete closure I have met with no recorded example. A case described by Dr. Gerhard shows that nine years after the formation of gangrenous excavation, closure may not be effected.

¹ Dict. de Médecine, t. xxii.

² Obs. Anat. Path., t. i.

1206. Cruveilhier describes an odorless variety of gangrene; the texture falls into shreds; no smell is observed either during life or after death.

1207. The diffused circumscribed forms are generally limited to a single spot; *nodular* sphacelus, like pyohæmic abscesses, frequently affects many together. The periphery of the lungs seems especially to suffer from the latter, the postero-inferior and central parts from the former. The right lung is more commonly affected with diffused gangrene; both organs are implicated, when the disease is nodular.

1208. Pulmonary gangrene is either solitary, or associated with similar change in various parts. The former is more common in the adult; the latter in infancy. In certain hæmic diseases, too, several parts of tissues suffers coetaneously or consecutively.

1209. The conditions, under which gangrene of the lung occurs, may be thrown into tabular form, as follows:—

Gangrene of Lung produced by—

I.	}	Pulmonary dis-	{	eases	Pneumonia, acute and chronic; tuberculization; cancer; hemorrhage; hydatids.
II.		Other thoracic		{	diseases
III.	}	Hæmic diseases	{		Morbid viruses
IV.				Perverted innervation of the lungs	
V.	Epilepsy; insanity; organic cerebral disease.				
Traumatic.					

A few words of comment on each of these varieties seem called for.

1210. (I.) The rarity with which acute pneumonia eventuates in gangrene, has already been insisted upon [1109]; where such termination does occur, it may be immediately determined by excessive violence of the inflammation, or by obstruction, from extrinsic pressure, of nutrient vessels; under either circumstances a depraved state of the blood is, with general adynamia, probably necessary as a prior condition. In the case of chronic pneumonia also [1184], some such favoring condition of the blood is probably necessary. In rare instances the vascular obstruction caused by the progress of tuberculization and of cancer, by copious infiltration of blood, and the pressure of a hydatid sac, have all been productive of local gangrene. In all such cases, the nutritive processes are probably impeded by pressure on local nerves.¹

¹ Nervous activity is so important an element in nutrition, that, as we know some surgeons have imagined adventitious growths might be controlled by section of the nerves supplying the locality in which they vegetate.

1211. But by the obstruction of what vessels is the failure of nutrition brought about? Carswell held, by that of the pulmonary artery. Of the obstruction of the contiguous branches of that vessel, which he has figured, and which I have also seen on an extensive scale, there can be no doubt. But two objections may be urged. First, there is no certainty that such coagula were not sequential, instead of being antecedent, to the gangrene. Secondly, physiologists assign the nutritive quality especially to the bronchial arteries; while the blood of the pulmonary artery can only nourish, it is held, after oxygenation in the capillaries and within a limited area: now the state of the bronchial arteries in gangrene has never, that I know of, been examined.

1212. (II.) May obstruction of minute branches of the pulmonary artery, from circulation of the products of endocarditis of the right heart, cause patches of gangrene in the lung? All I know on the matter is this: In a child, cut off by endopericarditis affecting both sides of the heart, and combined with central pneumonia of the left lung, there were three or four pea-like spots in the inflamed tissue distinctly gangrenous; the condition generally of the child was not favorable to gangrene; and it seemed possible that plastic products or minute fibrinous concretions from the endocardium might have plugged the capillary vessels. Such facts, if not otherwise explicable, would tend to prove that the nutrition of the lung is really in part effected by the pulmonary artery; they would also corroborate Dr. J. Taylor's views on the mechanical production of pneumonia by endocarditic secretions. On the other hand, the nutritive importance of the bronchial arteries would flow from the occurrence of pulmonary gangrene (as originally observed, I believe, by Dr. Macdonnell of Dublin) from pressure of a tumor, or aneurismal sac on those vessels.

1213. (III.) Carswell figures gangrene of the lung, associated with that of the lip, ensuing on the bite of an insect. In children gangrene of the lung has particularly been noticed after measles, scarlatina, and variola, commonly associated with cancrum oris; so, too, in the course of "typhoid" fever, purpura, and scurvy; in rare cases of glanders; in the purulent, and in the gangrenous¹ diathesis, the lung sphacelates in a certain proportion of cases. Poisoning of the blood by inhalation of the gases evolved in animal putrefaction, seems to cause pulmonary gangrene in some persons. The slow deterioration of the vital fluid, worked out by habits of debauchery and by privation, lays the groundwork of gangrene in many instances, if, indeed, it does not unassisted directly produce it.² In all cases of this class there is a tendency to passive congestions and hemorrhagic effusion.

¹ A diathesis which, though not generally recognized, is just as real as the purulent, and for which the name gangræmia might be adopted.

² In Magnus Huss's work on Chronic Alcoholism, however, I do not find gangrene of the lung set down among the effects of slow alcoholic poisoning.

1214. (IV.) The occurrence of gangrene of the lung has been noticed by many persons as a dependence on cerebral disease. Of the tolerably frequent concurrence of the two states, there can be no doubt: and the former seems fairly explicable by deficient or perverted nervous influence, just as the local gangrene, which sometimes occurs in a hemiplegic side.¹

1215. (V.) In those rare instances where the lung has mortified after external injury to the chest, some favoring condition of the blood in all probability pre-existed.

1216. *Influence of age.*—Sphacelation of the lung occurs at all periods of life; the subjoined table, constructed from his own observations by M. Ernest Boudet,² furnishes by far the most trustworthy information on this point, as well as upon the frequency of the disease, and, indeed, of spontaneous gangrene in general.

AGE.	Numbers of post-mortem examinations.	Cases of gangrene of the lung.	Ratio of cases of gangrene to post-mortems.	Cases of various spontaneous gangrene.	Total cases of gangrene.	Ratio of cases of gangrene to post-mortems.
Children	135	5	1 : 27	9	14	1 : 9
Adults	156	2	1 : 78	4	6	1 : 27
Aged persons	220	2	1 : 110	7	9	1 : 24
	511	9		20	29	

1217. *Symptoms.*—The symptoms in the *diffused* form are great general prostration, oppressed breathing, profuse expectoration, frothy and purulent-looking, of gangrenous odor, with a small, feeble, and very frequent pulse, and all the general appearances of intense adynamia. The power to expectorate is soon lost, and death occurs directly from suffocation.

1218. The course of *circumscribed* gangrene is somewhat different. At first the evidences of affection of the lung are commonly extremely obscure; the signs of pulmonary congestion exist, coupled with an amount of prostration quite out of proportion with the extent of local disease. The expectoration muco-purulent, rarely bloody in adults, frequently so in infants and children (if they expectorate at all), acquires, the moment perforative communication is established between the bronchial tubes and the gangrenous tissue, properties more or less strongly characteristic of the disease. It is of dirty-greenish, yellowish-brown, or ash-gray color; very liquid; and exhales an odor distinctly gangrenous, or resembling that of wet mortar, or *sui generis* but painfully fetid. In the adult the breath commonly possesses the same fetor, but this may not be constant; the expired air may be completely free for some

¹ Clin. Lect., "Lancet," loc. cit. p. 281. 1849.

² Archives de Méd., Sept. 1843.

minutes at a time from disagreeable smell; when suddenly, without cough or any other apparent cause, it becomes intolerably fetid.¹ Possibly temporary plugging of the bronchi communicating with the mortified tissue may account for the absence of odor. In children, fetor of the breath is less common than in adults,—occurring in scarcely a third of those affected.

1219. *Physical signs.*—The physical signs are those of consolidation followed by the evidences of breaking up of tissue and eventually of excavation. There is no special character in the signs of any one of these conditions indicating the nature of the disorganizing process. The signs of pneumonia may precede, and those of bronchitis accompany, the evidences of giving way of tissue.

1220. *Terminations.*—The terminations of circumscribed gangrene are by death or recovery. Death may occur rapidly by collapse, or sometimes by hæmoptysis or hæmothorax. Or the fatal event may take place slowly: abundant purulent fetid expectoration, hectic fever, night-sweats, emaciation, wear out the patient; and, after protracted suffering of weeks, or even months, death ensues. In cases of recovery (unfortunately a small minority), the discharge loses its fetor, diminishes in quantity, and becomes simply mucous; the hectic fever ceases, the appetite returns, and a complete rally is gradually accomplished. The physical signs of local consolidation, deficient breathing-action, and sometimes of excavation, remain.

1221. *Diagnosis.*—The diagnosis of gangrene of the lung turns upon the peculiar fetor of the breath and expectoration, coupled with the physical signs of softening and excavation of the pulmonary substance, ensuing upon those of subacute adynamic pneumonia, or upon those of congestion of the lung arising in the course of the various morbid states already enumerated. But there are sources of fallacy of two kinds: (*a*) there may be the extremest fetor and profuse greenish sero-purulent expectoration, and yet no true gangrenous cavity formed; and (*b*) there may be a gangrenous cavity without the characteristic conditions of the breath and sputa.

1222. (*a*) In the first class of cases appear examples of acute added to chronic bronchitis, where the breath and sputa acquire an intensely fetid odor, not distinguishable from that of gangrene, without any evidence of excavation—where recovery takes place, the fetor being merely temporary, and where the most plausible explanation of the facts is, that sloughing of the mucous membrane has occurred within the tubes on a minute or even microscopical scale. I have no proof of this view, however, to offer in the form of *post-mortem* examination; and, as already admitted, the fetor might depend on putrescence of the bronchial secretion itself

¹ Hayes, U. C. H., Males, vol. vi. p. 92.

[599]. Again, the breath and sputa sometimes acquire gangrenous odor, in cases of broncho-pleural fistula with empyema, where changes in the pleural sac are the real causes of the fetor. I have even known the expectoration acquire that odor, in cases of non-communicating empyema, apparently from chemico-vital changes in the pleural cavity—a fact assimilable to that, familiar to surgeons, of the stercoraceous odor sometimes acquired by the contents of abdominal abscess without intestinal communication. In both cases transudation of fetid gas, through softened and rarefied tissue of low vital resistance, probably occurs.

1223. But that a combination of circumstances much more puzzling may occur is shown by the following case:—A man, affected with pleuro-pneumonia of the right inferior lobe, recovers slowly from this; but during the progress of convalescence, has hæmoptysis followed by copious frothy expectoration, of fetor so intense as to affect the atmosphere of a large part of the ward. At the same time the entire class of hollow signs, which, as already described [782], sometimes arise during the convalescent period of pleurisy, set in. Were these conditions to be looked on as the result of gangrenous excavation in lung-substance, impaired in nutrition by the past pleuro-pneumonia; or as the effects of fetid bronchitis accidentally coexisting with the special physical state that gives rise to cavernous signs, no cavity actually existing? The issue of the case argued in the latter direction, as the man left the hospital in fair general health, and free from all physical signs, except those commonly denoting hard consolidation.¹

1224. Further, even the positive signs of cavity in the lung *plus* the fetor, do not prove that the excavation is of essentially and primarily gangrenous nature. It may be tuberculous or it may be purulent. I have now seen some half-dozen cases of consumption, in which the special fetor occurred incidentally in connection with tuberculous cavities already formed. In one of these instances (Consumption Hospital, Chelsea), the expectoration of a fetid pea-like mass, distinctly possessing microscopically, and even to the naked eye, the characters of pulmonary tissue, put a term to the gangrenous discharge—a fact which I hold to be proof positive that a minute sphaclated spot may impress the characteristic fetor upon the expectoration and breath, quite as effectually as gangrene of extensive area. A tuberculous cavity, thus locally gangrenous, is very difficult to distinguish from true gangrene of the lung, if the patient be seen for the first time when that change has occurred, and if the history of the case be imperfect. The seat of the cavity at the apex, and the existing signs of induration at the other upper lobe, once guided me successfully to the diagnosis in a case of this kind; but I am far from thinking the observer would always be justified in an absolute affirmation on such data. A fetid abscess

¹ Hellen, U. C. H., Males, vols. xv., xvi.

is generally distinguishable from true gangrene, not by the amount of fetor, which may be just as great from local sloughing of the walls of the abscess, but by the fact that the signs of excavation precede the occurrence of fetor in the case of abscess, follow it in that of true gangrene.¹

1225. (b) The second variety of case, where real gangrene occurs without perceptible fetor, is rare, especially in the adult. In children a guide to the diagnosis of an excavation thus formed, is sometimes found in hæmoptysis; for, singularly enough, while tubercle scarcely ever causes hæmoptysis in childhood, gangrene is at that period of life frequently attended with the symptom.

1226. *Intermitting gangrene.*—Gangrene of the lung-substance, or of induration-matter infiltrating it, may run a chronic intermitting course. At least, I have seen a case in which fetid gangrenous expectoration continued with intermissions for months, without much attendant constitutional suffering, but with gradual development of the signs of excavation in a spot where, I was assured, the existence of a gangrenous cavity had been affirmed by a practised observer some time before, but of which no positive evidence remained, when I first became acquainted with the patient. Had accumulation of induration-matter taken place here, and subsequently slowly sloughed away?

1227. The condition referred to a moment since as connected with endocarditis [1212] may be considered an example of nodular gangrene; I have also seen it in one case of so-called secondary abscesses; only a certain number of the nodules, and only the central part of these, were actually sloughy.

1228. *Prognosis.*—The prognosis of gangrene of the lung cannot be held to be absolutely fatal. Recovery has been calculated to occur in one-twelfth of cases: this, however, I regard as altogether too high an estimate of the favorable chances, unless it be understood to include the most trivial cases, as, for instance, partial sloughing of the walls of a cavity. It must be remembered that the characteristic fetor may be impressed on the sputa, either independently of demonstrable loss of substance, or by the merest fragment of mortified tissue.

1229. *Treatment.*—In the treatment of gangrene of the lung, the chief reliance has hitherto been placed, in the acute state, in stimulants and tonics. The sesqui-carbonate of ammonia, opium, and camphor, in various combinations with bark or quinine, given in full and repeated doses, are held to afford the patient the best chances

¹ In a case which fell recently under my observation (Dr. Hayes, U. C. H., Males, vol. vi. p. 92; 1851), there was occasionally such abundant discharges of almost pure pus, alternating with the more characteristic diffluent gangrenous expectoration, that, had not fetor preceded by some days the signs of softening and excavation, I should have been disposed to regard the case as one of fetid abscesses successively bursting, and not of gangrene: unfortunately permission to examine the body could not be obtained.

of recovery. The effect on the powers of the system generally, often produced by the first few doses, is really extraordinary.

1230. The remarkable effects of chlorate of potass in gangrene of the mouth entitle this salt to a trial where the lungs suffer; the effects of yeast, in frequently repeated doses of an ounce, also deserve investigation. I should be disposed to confide more in either of these agents than in ammonia, the permanently beneficial effects of which I have never, I confess, seen demonstrated. Skoda strongly recommends the following plan of treatment: The essence of turpentine is poured upon boiling water, and the patient directed to inhale the vapor for fifteen minutes every two hours—sulphate of quinine is at the same time administered. Two cases of recovery are given; but the narratives do not carry conviction with them.¹ To my mind the recovery seems to have been so easily accomplished that the cases must have been of the kind a moment since [1223] referred to.

1231. The only local measures advisable, under ordinary circumstances, are dry-cupping and counter-irritation by blistering or otherwise; and these only when the disease appears, in the main at least, of local origin. If, however, the evidences of acute secondary pneumonia, produced by the irritative action of the sloughed lung, are conclusive, and the system generally has rallied, a few ounces of blood might be cautiously abstracted by leeches or cupping from the affected side: the positive indication for this practice will, however, very rarely arise, and has never done so within my own experience.

1232. In cases lapsing into the chronic state, the mineral acids and quinine become the main remedies; of the former, the nitromuriatic is probably the best.

1233. Fetor should be corrected by chlorinated mouth-washes, or by fluids containing creasote in suspension, or by Condry's solution of the permanganate of potash. The chloride of zinc may be used for this purpose in a state of extreme dilution; three grains to eight ounces of water. Inhalation of tar vapor, of creasote, of chlorine, should be had recourse to, not only as corrective of fetor, but as tending, in all probability, by their direct chemical action on the sphacelated tissue, to control septic changes within the lung, and so lessen the local irritation and constitutional depression.

1234. The diet should be nutritious and digestible: strong beef-tea, thickened with isinglass or prepared gelatine, finely-pounded meat, eggs beaten up with small quantities of brandy, milk, &c., should be given as frequently as the digestive powers of the patient appear to permit. Good porter in moderation is an advisable beverage. If the adynamia be marked, wine or brandy must be freely administered.

¹ Wiener Zeitschrift, 1853.

VII.—INFILTRATION WITH INDURATION-MATTER, OR CIRRHOSIS OF THE LUNG.

1235. Cirrhosis of the lung, although observed by Laennec,¹ attracted but little notice until the publication of Dr. Corrigan's inquiries.

1236. *Anatomical characters.*—Infiltration of the cellular tissue between the lobes and lobules, and of the intercellular spaces, with a solid material, sometimes obscurely fibro-plastic, more commonly possessing the qualities of induration-matter,² constitutes the essential anatomical character of the disease. The infiltrating process at first extrinsic to, merely compressing and so obliterating the cells, eventually extends to the actual texture of these.

1237. Limited in area, or affecting an entire lung, more commonly the right than the left, I know of no case where cirrhosis extensively implicated both organs. When the infiltration is on a large scale, the absolute bulk of the lung falls while the weight rises, each in the inverse ratio of the other.³

1238. Section of the affected part displays a whitish, uniform, glistening surface (almost fibro-cartilaginous in aspect), comprising both the interlobular spaces and the lobules, all vestige of pulmonary tissue having, in fully evolved cases, disappeared, both to the naked eye and microscope, under the encroachments of the induration-matter. Even the outline of the lobules baffles detection. On the divided surface appear the orifices of much dilated and thickened bronchial tubes, and of bloodvessels likewise enlarged and over-nourished. The form of the bronchial dilatations (an unfailling attendant on the disease in its advanced periods) is the nodulated [702].

1239. Irregular puckerings, from the interstitial contraction of the induration-matter, seam the surface of the lung more or less deeply.

1240. A thick stratum of induration-matter sometimes lies between the costal and pulmonary pleuræ. Vessels of new formation abound within it.

1241. The bronchial glands may be considerably enlarged and infiltrated with the same material.⁴

1242. The opposite lung, disposed to active congestion, grows hypertrophous.⁵

1243. Cirrhosis of the lung is only known in its chronic and advanced conditions, very much like the analogous state in the liver. The reality of a true inflammation process is equally con-

¹ Forbes's Transl., Amer. edit., p. 123.

² Vide "Products, Adventitious," Cycl. of Anat. and Physiol., p. 138.

³ Osmond, U. C. H., Males, vol. iv. p. 341. Here the cirrhused lung (somewhat tuberculized also), greatly reduced in size, weighed 55½ oz.

⁴ Clin. Lect., case of Sharman, "Med. Times and Gaz.," Feb. 1856.

⁵ In Sharman (the right lung being the diseased one) the anterior border of the left organ reached, on opening the chest, an inch and a quarter beyond the right edge of the sternum.

testable in the pulmonary and hepatic disease; the clinical history of such cases points to atonic, not active, congestion. No evidence has been given that interstitial suppuration in the lung [1175] has any connection with cirrhosis. There is, in my mind, a much broader distinction between true chronic pneumonia and cirrhosis, than the fact that in the former case exudation takes place within, in the latter without, the cells.

1244. The elasticity and contractile force of the bronchial tubes being destroyed, while the unyielding induration-matter lies around, it is easy to understand why those tubes should gradually dilate, especially in the retracted and almost fixed condition of the chest-wall.

1245. Cirrhosis and tuberculization are not absolutely, but, very surely, to a moderate amount, antagonistic.

1246. *Symptoms.*—Obstinate cough; copious expectoration, purulent, ash-green, running into one mass, or thin, diffluent, frothy, and of extreme fetor, free from blood; uneasiness, rather than pain, in the chest, not necessarily on the affected side, that on which the patient generally lies; no subjective, and but little objective dyspnoea: constitute the usual local symptoms.

1247. The sleep may continue good for years, the nutritive functions maintain fair vigor, and no œdema make its appearance. Hence, as night perspirations are very unusual, and the pyrexia, if any, moderate, a tolerable amount of strength and of flesh may long be retained. Diarrhœa (not dependent on ulceration) may become a grave symptom.

1248. Hæmoptysis has occasionally been observed; satisfactory proof of the absence of tubercle, though in some such cases wanting, has been furnished in rare instances. Whence comes the blood? From the evidence of one case (the patient still lives, so that certainty is wanting), I think probably from the sound one: to this organ at least bubbling rhonchus was confined during an attack of hæmoptysis.

1249. *Physical signs.*—The eye, tape, and callipers all testify to the retraction of the affected side, and to lessened respiration-play. Infra-clavicular and supra-spinous depression exist; the infero-lateral spaces may be very deep.

1250. The vocal fremitus, increased over the front of the lung, may be even less at the posterior base on the right side (this being the diseased one), than on the left, if there be much induration-matter between the pleural surfaces [77].

1251. The percussion is of the high-pitched tubular type [208], with firm wood-like resistance under the finger, both in front and posteriorly. At the top of the sternum this percussion-resonance reaches half way between the corresponding edge of the bone and the middle line.

1252. The respiration is high pitched, bronchial, or hollow, rarely metallic—dry, or attended with moist rhonchus of various sizes, thin

and ringing, or the reverse. The vocal resonance may be either diffused bronchophonic, or pectoriloquous, of both loud and whispered forms.

1253. The contraction of the lung, which seems in this disease to act even more in a sideward and in an antero-posterior, than in a vertical, direction, tends specially to produce displacement of the heart—best seen if the right lung be affected, when both eye and hand may fail to detect any impulse to the left of the sternum.¹ No cardiac murmur is necessarily produced by the malposition [778].

1854. Lasting, as this affection may, for years without materially lowering nutrition, it still paves the way for death by intercurrent events—more especially by obstinate diarrhoea, or by pneumonia, or bronchitis of the sound and hypertrophous lung.

1255. *Diagnosis.*—Cirrhosis of the lung, belonging, as it does, to the group of chronic pulmonary diseases which diminish the bulk and respiratory play of the affected side, and tend to draw contiguous organs towards that side, can be confounded only with other members of the same group. These are—chronic pleurisy with retraction, simple general collapse of the lung, cancerous infiltration, tuberculization, and chronic pneumonia.

1256. (a) *Chronic pleurisy with retraction* alters after a different fashion the shape of the side—twists the ribs downwards and inwards; draws the shoulder down, curves the spine, and tilts the inferior angle of the scapula outwards: none of these displacements are produced by cirrhosis alone. Physical signs of the hollow class, by percussion and auscultation, are more extensively distributed in this disease than in chronic pleurisy; the bronchial symptoms and the general suffering are of graver character; and the heart occasionally more displaced than is usual in the chest perverted in shape by the pleural affection.

1256*. (b) *Simple collapse* would cause toneless, dull, not wooden or tubular, resonance under percussion; with weak respiration, neither bronchial nor of hollow type. Besides, general collapse is only practically known as a result of pressure by tumor or aneurism (of which the signs would exist) on a main bronchus.

1257. (c) In *cancerous infiltration*, and in cirrhosis of the lung, there are these points in common: one lung only suffers, the right being that usually implicated; the retracted ribs are notably changed in axis; the patient habitually lies on the diseased side; there is cough, expectoration, and failure of general nutrition, with hypertrophy of the sound lung. But in cancer there are commonly inward pressure-signs [491] from coexisting mediastinal growth; the aspect is more, and may be cancerously, cachectic; there are greatly more lividity of face, subjective and objective dyspnoea;

¹ Clin. Lect., case of Sharman, U. C. H., "Med. Times." In this case, while the heart's displacement was so great, the vertical height of the right cirrhosed lung equalled 7 inches, of the left $9\frac{1}{2}$ inches; but the latter was hypertrophous.

frequently severe thoracic pain; hæmoptysis or sputa infiltrated with blood, so as to resemble red or black currant jelly; there may be tumors in other sites; the heart is not so much displaced;¹ the morbid percussion-note in cancer extends across the middle line, through the influence of associated tumor; the disease is more active, of briefer duration generally, and the whole aspect of the patient betokens graver constitutional mischief.

1258. (*d*) *Tubercle*, unassisted, never reduces the girth of the side to the degree attained in cirrhosis; tubercle, though proceeding at unequal rates in the two lungs, affects both—cirrhosis destroys one lung, and leaves the other free to grow in bulk and substance; in cirrhosis there are neither night-sweats, ulcerated bowels, chronic laryngitis, nor epiglottitis, and hæmoptysis is very rare. Unless under the tractive influence of an enormous excavation (which will then, of course, have its special signs), I have never known the heart carried to the right as much as it may be in cirrhosis.

1259. (*e*) The distinction during life of this state of the lung from simple *chronic pneumonia* is always difficult, sometimes impossible. In cirrhosis of the organ, retraction of the side is, however, greatly more marked than in parenchymatous chronic inflammation; and if there be a considerable amount of flattening, we may be certain that it is not caused by the latter disease alone. The tubular percussion-sound, stronger respiration, signs of dilated bronchi, and traction of the heart towards the affected lung (only distinguishable, however, on the right side), met with in cirrhosis, are not observed in the simple inflammation.

1260. *Prognosis*.—Though cirrhosis be ultimately incurable, it seems, as already mentioned [1254], to destroy life less by itself, than through its sequences. With care and appropriate treatment, existence may, I believe, be prolonged for a very considerable time, after serious symptoms have set in; but my number of cases is insufficient to justify a very positive opinion.

1261. *Treatment*.—Whether the free inunction of iodine locally would promote the absorption of the induration-matter, remains to be determined. A trial of natural ioduretted waters, especially those of Kreuznach and of Woodhall, might also legitimately be made.

1262. But essentially the treatment should be, as that of bronchial dilatation, a combination of the means fitted for chronic bronchitis and for phthisis.

VIII.—PULMONARY HEMORRHAGE.

1263. Under this head may be included all cases of extravasation

¹ It has occurred to me that the tendency of cancer is rather to draw upwards, of cirrhosis to draw sideways (Clin. Lect. on Jennings; Cancer of Lung, U. C. H., Females, vol. xv. p. 65): the former consequently plays more on the liver, the latter on the heart.

of blood, either from the mucous membrane, or other actual tissue of the bronchial tubes; or from the proper structure of the lung itself. Pulmonary hemorrhage is, accordingly, either bronchial or parenchymatous.

A.—BRONCHIAL HEMORRHAGE.

1264. It is generally stated in systematic works, that bronchial hemorrhage is extremely frequent; but, if the term be understood strictly in the sense above given it, I cannot help believing that it is of great rarity. Setting aside those instances—mere curiosities from their singularity—in which ulcers in the bronchial tubes, or plastic bronchitis, furnish the blood of hæmoptysis, I have never yet seen a case where blood, discharged in any quantity during life, either seemed from the nature of the case clinically, or was proved, on inspection of the bronchial tubes, to have come from their substance by molecular ruptures—the exhalation of the older writers. True, there is no *à priori* reason why blood should not ooze from the bronchial mucous membrane, as we know it does, as I have actually sometimes seen it do, from the mucous membrane of the lips or mouth: but, on the one hand, the evidences of the occurrence are wanting; and on the other, it is found in the great majority of cases (there are some in which it is impossible to form an opinion on the point), that, when blood in any quantity has made its way into the bronchial tubes, the pulmonary tissue itself is the source of supply.¹ In cases of diseased heart attended with hæmoptysis during life, there may always, as far as I have examined, be found more or less marked evidence that the parenchyma of the lung, and not the mucous membrane, has given way molecularly: the evidence I refer to, is the presence of dark blood points here and there in the pulmonary tissue—a sort of embryo pulmonary apoplexy. While, on the other hand, I have often found the finer tubes, as far as they can be followed with a scissors, free from undue vascularity or marks of interstitial saturation with blood after hæmoptysis—a fact the more remarkable, because the larger trunks are occasionally, in such cases, very evidently imbibed with that fluid.

Ecchymoses and petechiæ of the bronchial walls occur in scurvy and purpura.

1265. When blood is furnished by the bronchial tubes, hæmoptysis is its symptom, and thin bubbling abundant liquid rhonchus in the bronchi its physical sign. It does not appear to stagnate sufficiently within the tubes, when of this origin, to alter the percussion-sound.

¹ I exclude cases where, in the violent efforts of bronchitic cough, streaks of blood, or disks only microscopically visible, appear in the sputa. It is vain to argue in one direction or the other as to the source of these.

B.—PARENCHYMATOUS HEMORRHAGE.

1266. Hemorrhage springing from the actual parenchyma occurs with or without recognized anatomical characters.

1267. In the first class of cases, we meet with the nodular and the uncircumscribed pulmonary apoplexy of Laennec, petechial, and, lastly, interlobular hemorrhage—an example of which hitherto undescribed form I once observed in a new-born infant. No one of these anatomical states is necessarily productive of, or connected with, hæmoptysis.¹

1268. On the other hand, there is no established morbid anatomy of the most frequent variety of hæmoptysis, that depending on the process of tuberculization. Molecular ruptures of the capillary vessels of the parenchyma are doubtless the cause of the discharge of blood in tuberculous disease, except in those very rare cases where a vessel of some size is perforated; but absolute demonstration of the fact is still a desideratum.

1269. (*a*) *Nodular apoplexy*.—In this, the circumscribed variety, the blood contained in the air-cells forms sharply-defined, rounded nodules, from half an inch to four inches in diameter, excessively firm to the feel, and raising the pleural surface, if situated close to this. On section these nodules are of very dark red venous hue; slightly, or not at all, granular—in truth, homogeneous-looking, except that in rare instances clotted blood in small quantity may be found in the centre—in these latter cases only is blood expressible in any quantity. They are commonly seated rather in the lower and posterior parts of the organ than elsewhere; vary in number from one or two to some twelve or fifteen, five or six being about the average, and in the great majority of cases affect both lungs, though in different degrees. Each accumulation is bounded by tissue, either quite natural or slightly darkened by blood, apparently imbibed from the periphery of the nodule.

1270. The nature of the changes set up in the extravasated blood has been pretty fully ascertained; the time required for their accomplishment seems, as in the case of other interstitial hemorrhages, to vary widely. The outline of the nodule grows less sharply defined; the tint lightens by passing into brownish, and eventually yellowish red; the lung-structure reappears as absorption advances; the bloodvessels and bronchi, at first impermeable, allow water and air to pass. The seat of old hemorrhage remains permanently, though but slightly, tough. In very rare instances, a firm buff-colored hæmatoma marks the locality of past extravasation.

In yet rarer instances suppuration or gangrene occurs. It is

¹ It has been shown, indeed, by Dr. Watson, that nodular apoplexy may sometimes be an *effect* of certain conditions, producing discharge of blood through the mouth, instead of being the cause of the latter. In a man dying from hemorrhage from the lingual artery, several apoplectic nodules were found, evidently formed of blood, which had trickled downwards from the mouth through the windpipe, and accumulated in the air-cells.

said the effused blood sometimes becomes surrounded with a cyst; and also that pseudo-fibro-cellular formation may arise within it. I have never seen either condition.

1271. As to the vessels furnishing the blood:—clots have been found both in the pulmonary artery and veins: it is probable the necessary molecular ruptures occur in the intervening capillaries. Whether the bronchial arteries ever thus give way remains undetermined.

1272. The adjoining texture is sometimes inflamed—the inflammation being coetaneous, or consecutive—neither preparatory nor even precursory.

1273. (b) *Uncircumscribed apoplexy*.—In the diffuse variety the pulmonary texture is torn: blood infiltrates the intervesicular tissue; the pleura may undergo rupture, and instantaneous death from the combined loss of blood and mechanical obstruction to breathing ensue. Encephaloid cancer sometimes furnishes the blood in this variety. Whatever be its immediate cause, the variety itself, as far as I have seen, is decidedly rare.

1274. (c) *Interlobular hemorrhage*.—An infant, born to all appearance healthy, breathed well for two hours, without exhibiting discoloration of the skin, or other morbid appearance. Sudden dyspnoea then came on; the accoucheur, being still in the house ran up-stairs; on his arrival the infant was dead. On *post-mortem* examination I found the lungs gorged with blood, except at the anterior border; between the lobes and lobules lay dark clotted blood in considerable quantity. There was much vesicular emphysema with subpleural air-sacculi, and air appeared in some points between the lobules.

1275. (d) *Petechial hemorrhage* occurs in the lung-substance in purpura, scurvy and hemorrhagic exanthemata.

1276. *Antecedent conditions*.—Pulmonary apoplexy, in the nodular form, is almost invariably an effect of disease of the heart, especially of the mitral orifice: for my own part I have scarcely ever seen it, except in cases of mitral disease. Still dilated hypertrophy of the left heart may produce it. In a case of this kind the mitral orifice, almost circular in shape and gaping, readily admitted the points of the thumb and four fingers of a medium-sized hand: the valve and cords were texturally sound. I supposed the valve might not have been large enough to close the dilated orifice; but found that on tying the aorta, and projecting a column of water into the ventricle, through the opening made by cutting away the apex of the heart, none of the water made its way into the auricle. Hence there had been no mitral regurgitation, yet there was slight pulmonary apoplexy.¹

1277. Nodular apoplexy sometimes occurs, we are assured, from a "diseased state of the pulmonary vessels and parenchyma," independently of heart disease. Of diffuse hemorrhage few examples

¹ Fosbury, U. C. H., Males, vol. x. p. 133.

have fallen under my notice: cancerous disease of the lung, or injury to the chest, were the immediate causes.

1278. Emphysema of the lung, as its anatomy would prepare us to expect, antagonizes pulmonary hemorrhage of all kinds. Nodular apoplexy seems incompatible with active tuberculization.

1279. *Symptoms.*—The symptoms of pulmonary apoplexy are exceedingly difficult to specify, because they are mixed up with those of pre-existing disease in the heart, and of disturbance, secondary to this, in the lungs. Dyspnœa, tightness, and dull pain in the chest, all exist independently of such apoplexy in mitral disease; they, however, increase in severity when blood escapes into the lung-substance, as does likewise any cough previously present. The only symptom really important is hæmoptysis, in the forms of tinged mucus, striæ of blood, pure blood, rarely florid, rather darkish, of bistre tint, or even sooty-looking. The quantity of blood is habitually small; and I have never once, out of a very considerable number of cases, known anything like profuse hemorrhage attendant on nodular pulmonary apoplexy. I should not venture yet to say that there is any special appearance in the blood positively distinctive of its apoplectic origin; still my memory does not supply me with a single instance of bistre or sooty-coloured blood coming from the lungs, except in cases of the sort. Where such sanguineous expectoration has ceased before death, the nodules have exhibited signs of absorption. It is to be remarked that red disks may often be found in the sputa of persons with mitral disease, where there is no blood visible to the naked eye; and, conversely, numerous nodules may be found after death, though not the slightest hæmoptysis had existed during life.

1280. *Physical signs.*—The physical signs of nodular hemorrhage are, also, very obscure. The effusion of blood must, to say the least, be rarely sufficiently great to act as an impediment to chest-motion; such effect has certainly never fallen under my notice.

1281. If the nodules be few and small, percussion and auscultation give no positive information. But under the converse circumstances, I have known the vocal vibration somewhat intensified over the nodular masses, and the percussion raised in pitch and rendered very notably dull. Over the accumulated blood the respiration is weak; beyond it, harsh, bronchial, or diffused blowing; the state of vocal resonance varies. If there be hæmoptysis, thin, liquid rhonchi will be present. Even within the apparent area of the apoplectic nodules, fine bubbling, almost crepitant rhonchus, may sometimes be caught on full inspiration; but it would be impossible to prove that the rhonchus ever really originates within the nodules.

Instead of undergoing gradual absorption, pulmonary apoplexy may act as a source of irritation; the signs of local pneumonia, abscess, and, in rare cases, even of gangrene, may then be successively noted.

1282. *Treatment.*—In regard of treatment, assuming that there

are no signs of copious discharge of blood, I am disposed to insist most strongly on the value of extensive and repeated dry-cupping of the chest. I have repeatedly known hæmoptysis stopped almost at once by this measure, in cases of mitral disease, when the general aspect of the patient forbade the abstraction of blood. A small quantity of blood may be locally removed with propriety, where there is no prominent asthenia; or, if the hæmoptysis and attendant dyspnoea be very urgent, venesection to the amount of some six or eight ounces, is permissible, and sometimes gives extraordinary relief.

Counter-irritation, by blistering or otherwise, and free purgation, are the next most important remedies. The treatment must always be controlled by the state of the heart and of the secondary disorders dependent on that organ. Unless the hæmoptysis be considerable, it is not advisable to employ the ordinary astringents, or other more powerful remedies to be by and by enumerated. Digitalis will prove useful or detrimental according to the condition of the heart's substance and orifices.

IX.—HÆMOPTYSIS.

1283. Under the title of hæmoptysis, or expectoration of blood, may be included all instances of discharge of that fluid (either in minute or in large quantity) from, or through, any part of the air-passages below the epiglottis.

1284. *Conditions of origin.*—Hæmoptysis sometimes arises during the ascent of lofty mountains; its occurrence is then commonly referred to diminished pressure of the atmosphere. It may follow wounds of the lung and injuries of various kinds to the chest; and it may take place *vicariously*, as a periodical discharge in females, instead of the catamenia. Hysterical women, too, occasionally expectorate blood, in whose chest no positive evidence of disease can be discovered.

1285. Except under these circumstances, whatever be its immediate and direct mechanism, hæmoptysis is a sign of disease of the air-passages, lungs and appendages, or of the heart or great vessels.¹ It may be that in certain instances of scurvy, purpura, malignant typhus, and the hemorrhagic exanthemata, slight escape of blood through the bronchial tubes occurs; but I know, that even in the worst cases of the kind, hæmoptysis may be totally absent.²

1286. The diseases, which act as more or less frequent causes of hæmoptysis, trifling or grave, are, in the—

¹ Carcinomatous disease of the œsophagus may lead to spitting of blood; I have not actually observed this, except where the air-passages were perforated, but conceivably it might occur independently of this condition.

² C. Lennell, U. C. H., Females, vol. ii. p. 217. Hemorrhagic variola and scarlatina combined; hemorrhages from various textures, sloughing of the tonsils, breaking up and crenate form of blood-disks, cuticle separating under pressure before death, &c. Here there was no particle of hæmoptysis.

<i>Larynx</i>	Ulceration, phthisical, cancerous, syphilitic;
<i>Trachea</i>	Ulceration;
<i>Bronchi</i>	Bronchitis, simple and plastic; ulceration; cancer;
<i>Bronchial glands</i>	Tubercle, cancer;
<i>Lung</i>	Congestion, active, passive, and mechanical; pneumonia, acute and chronic; abscess; gangrene; cirrhosis; tubercle; cancer; hydatids;
<i>Pulmonary arteries</i>	Atheroma of; ¹
<i>Air-passages generally</i>	Perforative disease from without, cancerous or other;
<i>Mediastinum</i>	Tumor; abscess;
<i>Heart</i>	Mitral disease; hypertrophy of the right ventricle; dilatation with feebleness of the left ventricle;
<i>Great vessels</i>	Aneurism of aorta; aneurism of pulmonary artery; coarctation of arch of aorta. ²

1287. But, although it be impossible to ignore in pathology the power of all these affections to produce hæmoptysis, in actual clinical practice the symptom is so frequently connected with tubercularization of the lung, that it comes to be one of the most significant symptoms of phthisis. The laws of tuberculous hæmoptysis will hereafter be considered. In the present place I shall simply place before the reader an analysis of the clinical evidence I have been able to collect, practically illustrating the closeness of connection between hæmoptysis and pulmonary tubercle in the adult.

1288. "The *quantity* of blood voided, is the first point for consideration. It is commonly said that the expectoration of streaked or tinged sputa is utterly insignificant, because such are seen in *bronchitis*; but no attempt has ever been made to decide numerically to what extent this is true. I find that in twenty-five cases (observed at Brompton, and at University College Hospital) of chronic bronchitis with or without marked emphysema (*but always without serious disease of the heart*), the absence of such expectoration was noted in nineteen cases, its presence in six. Now in *all* these six cases of streaked expectoration, there was more or less ground for suspicion that tubercles were to a slight amount present,—in two of them this was proved to be the fact by *post-mortem* examination. While, then, as I have found, bloody expectoration occurs in 71.79 per cent. of tubercularized persons in the first stage, it occurred in 24 per cent. of bronchitic people, free from serious cardiac disease; but in all of the latter there was either suspicion or certainty of the existence of tubercle to a *slight* amount; pathologically, these people were *latently* tuberculous persons, with super-added bronchitis; but practically, they could only be regarded as bronchitic. The mean duration of the disease in the phthisical cases was 26.55 months, in the bronchitic 49.50; hence the significance (*quoad* tubercle) of hæmoptysis is greater even than the

¹ On the infinite rarity of this mechanism, it is unnecessary to insist; I know of but one well-defined example, that recorded by Prof. Schneevoght (Med. Times, 1855). Repeated grave hæmoptysis had frequently occurred, the patient perishing from cerebral hemorrhage.

² Case of Gunnee, Clin. Lect., "Med. Times," 1858.

relative percentages above given would signify. Streaked or tinged sputa are rarely or never the 'first symptom' of phthisis; should they appear in this guise, then they would probably be dependent on some other cause. The question of hæmoptysis in plastic bronchitis has already been referred to [637].

1289. "*Primary cancer of the lung and mediastina*, as I have elsewhere shown, from the analysis of a small number of recorded cases, is very frequently attended with sanguineous expectoration or pure hæmoptysis.¹ In regard to this symptom, the two diseases may be thus compared: the percentage of hæmoptysis of *all amounts* in cases of cancer is 72, in phthisis 80.92; while hæmoptysis *above one ounce* occurs in cancer and phthisis in the ratio of about 70 to 40. Hence 100 cases of cancer of the lung will be attended nearly as often with hæmoptysis of all amounts, and greatly more often with hæmoptysis above an ounce in amount at a time, than 100 cases of phthisis. But, on the other hand, tuberculous is so vastly more frequent than cancerous disease of the lung, than the share of the population suffering at any time from cancerous hæmoptysis will form but an insignificant fraction of that suffering from hæmoptysis of tuberculous origin."

1290. The relationship of *empyema* to hæmoptysis has already [797] been considered.

1291. "*Simple chronic consolidation of the lung* has not, in my experience, been attended with hæmoptysis to any amount.

1292. "*Acute pneumonia*, accompanied with discharge of pure blood, is almost positively connected with tuberculous disease.

1293. "*Gangrene* of the lung is rarely attended with hæmoptysis in the adult; in infancy (when tuberculous hæmoptysis is very rare) it is rather common.

1294. "I have never known *ulceration of the larynx* productive of discharge of blood to any extent; streaks are not uncommon. But ulceration of the larynx, proceeding from within outwards, seems not to occur as a primary affection: at least I have never seen it except in follicular sore-throat, phthisis (which may be completely latent in regard of the lung), cancer, and syphilis.

1295. "Hæmoptysis arising from *disease of the heart* can with difficulty be confounded, even in itself, with the severer forms of phthisical hemorrhage; while the physical signs of the cardiac disease will point to its true source in such cases of the slighter form. I have never once seen cardiac disease, of such kind as to cause hæmoptysis, coexistent with *phthisis*, using the term in its practical sense; but in a fair number of instances I have seen advanced cardiac disease in persons whose lungs contained *crude tubercles and gray granulations*."²

¹ Nature and Treatment of Cancer, p. 351.

² And also, in rare instances, I would now add, the conditions of retrograde phthisis.

1296. Hence it may be, that the conditions of the system existing in heart disease are unfavorable to the development of tubercle; but the infrequency with which the two kinds of disease are found together doubtless depends, in the main, on the difference in the periods of life at which each is especially prone to occur.

1297. "*Aortic aneurism*, opening into the trachea, may, without proving immediately fatal, give rise to hemorrhage, indistinguishable by its own characters from profuse pulmonary hemorrhage. The history of the case, the physical signs, the age of the individual, &c., commonly establish the diagnosis; but when the aneurism is small, and so placed as to elude percussion, and pressure-signs, both concentric and eccentric [489] are absent, the difficulty of *proving* the presence of aneurism may be insurmountable; the existence of the disease may be divined, but not demonstrated. It is to be remembered that the absence of notable signs of tuberculization does not justify the inference that the hæmoptysis is not phthisical, seeing that a tremendous pulmonary hemorrhage may occur when slight consolidation exists at one apex only, and that such consolidation might be supposed to depend on the pressure of an aneurism.

1298. "It is matter of common belief that in women who menstruate imperfectly and irregularly, the expectoration of a small quantity of blood is insignificant. I think this *perhaps* true where streaks only are concerned; but in every instance I have observed, *except one*, where such succedaneous hæmoptysis reached an ounce or upwards, there has been either evidence, or ground for suspicion, of tuberculization. Similarly I have seen two cases of individuals presumedly in a state of perfect health, who, in a violent fit of passion, brought up a certain quantity of blood from the lungs: *both had latent tubercles.*"¹

1299. I have met with several instances, where individuals, apparently in perfect health, have under violent effort had more or less copious hæmoptysis. In some of these cases rapidly destructive phthisis has ensued: but close inquiry has then invariably disclosed evidences of previous failure of health.

1300. And again, there seems much reason to believe, that where the ascent of mountains produces hæmoptysis, the lungs, heart, or great vessels, are already latently diseased. We cannot, otherwise, understand why so very small a proportion of those, making such ascents, expectorate blood.² In the elevated regions of Bolivia, averaging from eleven to thirteen thousand feet in altitude above the level of the sea, the inhabitants are subject to an affection called

¹ Author's Report on Consumption, "Brit. and For. Med. Chirurg. Review," January, 1849.

² Boussingault, d'Orbigny, and Roulin, make no reference to hæmoptysis as having occurred in their visits to the Andes; and de Saussure observed nothing of the sort in his ascent of Mont Blanc. M. Rémy and Mr. Brenchley, who reached the summit of Chimborazo in November, 1856, suffered greatly from thirst, but specially insist on their having been perfectly free from inconvenience in breathing.

the *soroche*, essentially characterized, as far as the lungs are concerned, by dyspnoea,¹ but not by hæmoptysis, so far as I can learn [1031].² In an interesting paper on "Mountain-sickness" by Dr. Speer,³ "occasional oozing of blood from mucous surfaces" is included among the symptoms of that affection; but the writer is silent concerning actual hæmoptysis [1540.]

1301. The tendency of my experience, then, is clearly to show the vast frequency with which hæmoptysis is in some manner or other an attendant on tuberculous disease. The fact, that individuals are occasionally met with who, after having had more or less profuse hæmoptysis, live on to a good age without exhibiting phthisical symptoms, does not invalidate this result; it simply confirms the inference, clearly attainable also on other grounds, that tuberculization tending to hæmoptysis may, as well as that not so tending, undergo spontaneous suspension.

1302. *Characters, and mode of ejection.*—Hæmoptoic blood from the lungs is in the great majority of cases brightly florid; but it may be of mixed arterial and venous tints; or it may be wholly dark, almost black. Dark tinting indicates stagnation prior to extravasation. The blood is aerated and frothy, unless very copiously and rapidly ejected. When in moderate quantity, the blood is voided by the act of expectoration, it escapes in gulps from the mouth when profuse; or may be ejected with efforts resembling those of vomiting. I have observed some few cases in which hæmoptysis took place solely in decumbency.

1303. *Symptoms.*—Hæmoptysis is very commonly immediately preceded by slight dyspnoea, anomalous sensations about the chest, tightness, weight behind the sternum, or at some other spot of the thorax, to which the patient will sometimes confidently point as the seat of mischief. I have known most urgent dyspnoea attend the discharge—quite irrespective of that produced by the patient's anxiety as to the result. The pulse may be much accelerated or remain at its previous standard. There is a calm and an excited variety *quoad* cardiac action.

1304. *Diagnosis.*—The diagnosis of hæmoptysis in general may be considered in the present place; while we reserve for future consideration any special points connected with its distinction, in particular diseases of the lungs and heart.

1305. Hemorrhage from the *mouth and fauces* can be distinguished

¹ At Potosi, and places of similar altitudes, even the natives find it impossible to speak and walk at the same moment.

² Bonelli, *Travels in Bolivia*, vol. i. p. 210. The effects, in point of fact, are viscerally congestive, and whatever organ may be predisposed will prove the sufferer. A gentleman who has made many excursions in the higher plateaux of the Andes, tells me that in his case, vertigo, cephalalgia, and nausea relieved by epistaxis, with hemorrhoidal flux, were the results. It would appear that, as a rule, hemorrhages of any kind do not occur with frequency until an altitude of 17,000 to 20,000 feet has been reached.

³ Ranking's *Retrospect*, vol. xvii.

by careful inspection of these parts from hæmoptysis. The blood trickles from the mouth as the patient lies sideways, and sometimes may be seen issuing from a point or welling from an islet of surface. In case of doubt, the mucous membrane should be carefully cleansed with a sponge under a strong light.

1306. *Epistaxis*, under ordinary circumstances, cannot be confounded with hæmoptysis; but sometimes blood, instead of coming forwards from the nares, trickles backwards, and may be, from time to time, coughed up. But here, again, close examination of the nares anteriorly, and of the pharynx, will disclose the source of the hemorrhage.

1307. Patients will often persist in assigning to the *throat* hemorrhage, which in reality comes from the lungs, because they first become conscious of the presence of blood, when it reaches the former part: this is a source of fallacy against which the young practitioner must be on his guard.

1308. Hæmoptysis is distinguished from *hæmatemesis* by the following characters.

Hæmoptysis is most frequent between the ages of eighteen and twenty-five; hæmatemesis, unless vicarious from defective menstruation, rare before the thirtieth year: to both these propositions there are, however, numerous exceptions—the most important of them furnished by the hemorrhage of simple chronic ulcer of the stomach in the young female. Sex is valueless as a guide.

The previous history in the one case points commonly to thoracic disease, in the other to gastric or other chylopoietic disturbance.

Hæmoptysis is immediately preceded by a class of symptoms just indicated [1303]; hæmatemesis by weight and uneasiness at the epigastrium, sometimes by nausea. A salt taste in the mouth, with tickling and gurgling sensations in the throat, often precedes actual hæmoptysis; whereas I certainly have never known this complained of in hæmatemesis.

Blood is ejected in severe hæmoptysis with efforts indistinguishable by patients from those of true vomiting; but previously to such "vomiting of blood," mouthfuls have generally been coughed up: while in some cases of hæmatemesis the blood regurgitates, rather than is vomited, and nausea even is wanting. Hæmatemesis is attended by tenderness at the epigastrium; hæmoptysis by none of this. No matter what amount of blood pour from the lungs at once, small quantities continue, as a rule, to be expectorated for a time; when the stomach is at fault, on the contrary, full discharge occurs suddenly, and there is, generally speaking, an end of the matter,—certainly no bloody or stained sputa follow. In hæmoptysis the blood is florid and frothy; in hæmatemesis dark and non-aerated: at least this is the common case. But when large masses of blood are discharged from the lungs, they may be totally frothless: and where hemorrhage occurs rapidly from an artery into the stomach, as in cases of simple chronic ulcer, the blood is vomited

at once, and of perfectly arterial hue; no time is allowed for discoloration by the gastric fluids. On the other hand, the blood of hæmoptysis may be partly, or wholly, of venous tint,—but, so far as I have seen, it never has the grumous pitch-like appearance of blood ejected from the stomach. The blood of hæmatemesis is sometimes of acid reaction; and the blood-disks altered in outline by the action of the gastric fluids: but when these evidences exist, the case will commonly, on other grounds, be a tolerably clear one, Discharge of blood by stool is the rule in hæmatemesis; the exception in hæmoptysis: in the latter case, it comes of blood accidentally swallowed, and is never, so far as I have known, abundant.¹ In hæmoptysis liquid rhonchus may almost invariably be found in some part of one or both lungs; nothing of the sort exists in hæmatemesis. When the lung supplies the blood, the pulse is oftener excited, full, bounding (sometimes *bisferiens*), than when the stomach is its source: in the former case, the pulse is proportionally less quickened than the respiration; still this perversion may occur in hæmatemesis also. Lastly, the diagnosis should never be fixed on without making a careful, and thoroughly unbiassed, examination of the chest. Should the evidence of chronic changes at the apices exist, doubtful opinion in favor of pulmonary origin would at once be strengthened. But the absence of such changes would not exclude the possibility of hæmoptysis; for, as will hereafter fully appear, such discharge of blood may occur before any notable physical changes have occurred in the lungs; nor, on the other hand, does latent tuberculization exclude the possibility of hæmatemesis. The state of the chylopoietic viscera should be examined physically in aid of the diagnosis of hæmatemesis.

1309. *Aneurismal hæmoptysis* is commonly, if a chronic state, of red currant jelly appearance. Where a sudden large discharge takes place in an individual, not previously suspected to be the subject of either pulmonary or aortic disease, the diagnosis will turn mainly, indeed solely, on the physical signs. These may be inadequate to fix opinion in either case: but such inadequacy being the more common in, is an argument in favor of, a small deep-seated aneurism. After rupture of a small sac, discharge for a day or two of bloody sputa is not commonly observed as in pulmonary hemorrhage: but exceptions occur in both directions.

1310. *Treatment*.—The treatment of pulmonary hæmoptysis, during its actual existence, aims (*a*) at removing the conditions causing the flow, or (*b*) at stopping it in spite of the continuance of those conditions.

1311. (*a*) Now if there be evidence of congestion of the lung of an active kind, with febrile excitement and strong cardiac action,

¹ To this there is one exception. Patients, bleeding from the lungs, will sometimes continue steadily to swallow the blood, for the purpose of soothing the apprehensions of those about them; in a case of this kind I have seen really enormous quantities of blood in the alvine discharges.

that congestion should be treated by bleeding from the arm, to an amount measured by the urgency of the symptoms, and the constitution of the individual. Slow local bleeding from the chest by leeches, I believe to be highly objectionable; the rapid abstraction of blood by cupping, however, if the patient be enfeebled by previous disease, is preferable to venesection. The head should be kept high during the bleeding; and, indeed, throughout the progress of the case; a semi-faint state tends in itself to control hemorrhage. Leeches to the anus, or to the feet, followed by the hot pediluvium, sometimes very manifestly control hæmoptysis, where there are evidences of abdominal congestion. Nauseating doses of tartarized antimony, or of ipecacuanha, are by some had recourse to from the first; but the practice is one of which I have little experience. Tartarized antimony, it is affirmed on high clinical authority, has actually caused death under these circumstances; however, it does not necessarily increase bleeding, even though it causes vomiting,—this I have *seen* in the practice of others. The bowels should be freely opened with cooling saline purgatives, and watery evacuations, if possible, kept up for a day or two.

1312. Ligature of the limbs, so as to prevent the free return of blood through the veins, has proved a timely adjuvant occasionally: Junod's exhausting apparatus will be useful on the same principle. Raising the arms over the head unquestionably stops epistaxis sometimes; I know not what effect the position may have in hæmoptysis. Free circulation of cool air, light bedclothes, a hard bed, quietude, and silence are essential aids. Large pieces of Wenhams Lake ice should be allowed to dissolve in the mouth; and the *cautious* application of ice in bags to the spine, or over the heart, I have repeatedly seen (hence I do not value the speculative objections to the practice) almost instantaneously arrest the flow of blood. Heat may at the same time be applied to the extremities. Some practitioners affirm, that the application of cold to the pudenda occasionally proves directly hæmostatic.

1313. Among remedies controlling the action of the heart, digitalis, aconite, and prussic acid claim attention; if the heart be irritable, and the hæmoptysis moderate, the first-mentioned medicine is valuable. Refrigerants, such as nitrate of potass, sulphuric and other acids, may be employed as adjuvants.

1314. (b) The medicines qualified to fulfil the second indication, are the acetate of lead, given in doses of two to four grains with dilute acetic acid and laudanum, every half-hour, hour, or two hours, according to the urgency of the case; alum; ergot of rye (not so valuable, however, as in epistaxis), matico, and gallic acid. My recent experience leads me to place greater trust in gallic acid than in any other agent of the class. But if the hemorrhage be at all severe, the doses must be large and very frequently repeated: twenty to thirty grains should be given every half-hour at first,—the dose and the frequency of repetition being gradually lessened. I

have seen no ill effects from these large doses.¹ If there be excessive anæmia, the liquor of the pernitrate or the tincture of the sesqui-chloride of iron, or sulphate of iron with gallic acid (making a gallate of iron) may be given from the first. In various other astringents, krameria, logwood, kino, catechu, sulphates of zinc and copper, little trust is to be reposed. Nor, useful as it is in some hemorrhages, have I often seen turpentine distinctly efficacious in hæmoptysis: still it sometimes appears decidedly beneficial. A provincial chemist told me some time since, that, on one occasion, when he had in a series of closely following attacks brought up "several pints" of blood, lead and all ordinary remedies failed, while turpentine, taken internally and rubbed into the chest and limbs, distinctly arrested the bleeding. Drachm doses of kitchen salt, either in powder or dissolved in water, appear sometimes (I have seen the fact in three instances) to arrest hæmoptysis very rapidly,—and this, whether they produce emesis or not. Five or six drachms may be given at intervals,—and, as the agent is always at hand, it may at once be used, while other means are in preparation.

1315. The general treatment of hemorrhagic reaction and of sinking is the same in the case of hæmoptysis as of all severe hemorrhages.

1316. Certain cases of tuberculous disease are marked by a tendency to frequent recurrence of hæmoptysis. Although it be demonstrable that, in the mass of cases, frequently recurring hæmoptysis does no serious evil [1487], still in any individual instance, as we know not what may be the issue of a hemorrhage once it sets in, it seems advisable to avert the occurrence if possible. Do we possess the means? Appropriate change of climate seems the most promising. I have known an instance in which grave and frequent bleeding wholly ceased after the adoption, and apparently under the influence, of a diet entirely of fish and vegetables. The time for any faith in the prophylactic efficacy of weekly venesection (as lauded by Cheyne, of Dublin, despite the unfavorable testimony of his own cases) has long passed by.

X.—ADVENTITIOUS PRODUCTS.

1317. The lungs give origin to a variety of adventitious products, which may be arranged as follows:—

¹ The blood expectorated, while gallic acid is taken, often exhibits (as I first observed in a case seen, many years ago, with Dr. D. Fraser) a peculiar green tint, deep, but transparent: a very evident proof that the acid passes through the circulation. Gallic acid may also, in rare cases, produce the same tint in muco-pus wholly free from blood, doubtless from unusual proportion of iron in the pus (Sharman, U. C. H., Males, vol. xi. p. 231). The sputa of hæmoptotic patients taking gallic acid largely may be free from green tint, while the urine seems to eliminate it almost wholly from the system, a soluble salt of iron giving a copious precipitate for some while, even after the gallic acid has ceased to be taken (*e. g.* case seen with Dr. H. Davis and Mr. Flower).

Non-plastic products	{	Saline	{	Concretions.	
		Animalized		Fat. Sugar.	
Plastic products	{	Blastemal	{	Deposits	{ Syphilitic. Typhoid. Melanic. Glanderous and farcinous. Purulent. Amyloid. Tuberculous.
				Growths	{ Hæmatoma. Sarcoma. Cystoma. Fibroma. Osteoma. Carcinoma.
		Germinal	{	Pseudo-tissues	{ Induration-matter. Cartilage. Bloodvessel.
				Entozoa. Entophytes.	

1318. Few of these products, however, require elaborate consideration in a practical work. The history of saline concretions is intimately mixed up with that of tubercle; sugar accumulates only in dependence on certain other fixed diseases. Purulent deposit has already been considered in connection with pneumonia; and induration-matter under the head of cirrhosis. The rest of the series we now proceed to pass in review, with an amount of closeness proportional to the practical importance of each.

A.—SYPHILITIC DEPOSIT.

1319. The lung appears to hold a place among the textures in which the tertiary effects of the syphilitic virus exhibit themselves. Gummata, of the same anatomical constitution as the well-known subcutaneous product, have been described by MM. Ricord and M'Carthy, as forming in the lungs, especially, perhaps, towards their periphery and bases. In the former position they look not unlike nodules of lobular pneumonia.

1320. These gummata soften and are eliminated much in the manner of tubercle—originally having, it is alleged, a consistence rivalling that of scirrhus; they are non-vascular.

1321. I can find no positive answer to the query,—do these gummata ever form independently of other tertiary evidences of syphilis in the bones and cellular tissue? If they do, their diagnosis must be infinitely difficult,—difficult indeed under all circumstances; for the physical signs can be none other than those of solidification followed by softening and excavation, while the local and general symptoms closely simulate those of phthisis.

1322. There is strong motive to suppose that iodide of potassium is the essential remedy, and that mercury is contra-indicated: pre-

cise information is, however, wanting. Cod-liver oil should, of course, not be neglected.

B.—TYPHOID DEPOSIT.

1323. The lung-substance, as well as the tracheal and bronchial walls, becomes in certain cases of typhoid fever the seat of non-plastic deposit identical with that which accumulates under the patches of Peyer and in the mesenteric glands. On the other hand, as long since taught by M. Louis, young persons, convalescing imperfectly from typhoid (Peyerian) fever, not unoften fall into pulmonary consumption of acutely fatal course.

1324. That death does occur in some cases after typhoid fever, with rapid breaking up of the tissue of the lungs, and many of the symptoms of consumption, is indubitable. But it has always been a matter of difficulty to explain the connection between typhoid fever and tuberculization of the lungs. M. Louis, referring the latter to the prolonged pyrexia of the former, can scarcely be said to have settled the point. Is it possible that unusually abundant deposition of typhoid matter may in these cases be the real groundwork of the rapid destruction of the lungs? The question, beset with difficulties, it is true, requires serious investigation. I have occasionally witnessed most remarkable disappearance of local and general symptoms,—recovery, in truth, complete in a practical sense,—where softening of the lung had rapidly taken place under the circumstances referred to. The very perfection of constitutional cure in such cases gives additional probability to the notion that the product eliminated is not genuine tubercle.

C.—MELANIC DEPOSIT.

1325. The lung is a favorite seat of true granular melanic pigment,—the granules either free or contained within cells. Melanic cells never exhibit any tendency even to cohere,—much less to form the basis of a stroma.¹ There is no difference between the melanic secretion which accumulates in the lungs of the aged, and that which infiltrates certain growths. And, again, there is no special form of morbid stroma to which melanic pigment specially attaches itself in the human subject,²—though more frequent in medullary cancer than in any other growth.

1326. The retrograde anatomical changes of phthisis, whether excavation have or have not occurred, are generally accompanied with more or less copious deposition of melanic granules. Hence, abundant melanic impregnation of the phthisical septum is of favorable augury.

1327. The black matter which infiltrates the lungs of the aged, may have another origin: it may be carbonaceous substance intro-

¹ Cycl. of Anat. and Phys., art. "Products, Adventitious," p. 116.

² In the horse a special stroma does appear to exist. Vide art. cit., p. 128.

duced from without, along with atmospheric air,—differing in degree, not in essence, from that found in the “black phthisis” of miners [645].

D.—GLANDEROUS AND FARCINOUS DEPOSIT.

1328. Among the more important changes, in acute glanders, farcy and farcy-glanders, ranks lobular pneumonia, with deposition of specific pus, identical with that contained in the cutaneous pustules of the one disease, or the suppurating lymphatic glands of the other.

1329. The treatise of Rayer contains an engraving of the secondary pneumonic abscesses which occur in acute glanders.¹ In illustration of the farcinous disease, a few prominent particulars of the case of a horse-keeper, aged twenty-five, who came under my notice some years ago, may be given.²

1330. Here, in addition to external pustules and phlyctenæ, phlebitis, lymphatic inflammation, and deep-seated collections of pus and discolored serum in the limbs, without nasal affection, the lungs presented numerous lobular patches of inflammation with softened exudation and pus. No true hepatization existed; while the non-acceleration of the breathing, slightness of the cough, and absence of pain, almost placed the pneumonic affection in the latent class. The foreign accumulation in the lungs with sero-sanguineous œdema, sufficed to raise the weight of the right lung to 27 ounces, of the left to 22 ounces.

E.—PURULENT DEPOSIT.

1331. Pus is a much less common deposit in the lung than is currently supposed. The subject has already, however, been sufficiently considered [1077].

F.—AMYLOID DEPOSIT.

1332. Amyloid degeneration of the lung, as of almost all other organs, has been detected and described by Virchow; but the clinical history of such degeneration, if it possess a distinctive one, is yet a desideratum.

G.—TUBERCULOUS DEPOSIT.

1333. Tubercle in the lung constitutes the anatomical character of phthisis or consumption—a disease which, in the vast majority of cases, runs a chronic, but occasionally an acute, course.

(I.)—CHRONIC PULMONARY CONSUMPTION.

1334. Clinical and anatomical observation shows the necessity of dividing cases of the chronic class into the *progressive* and the *retro-*

¹ De la Morve et du Farcin chez l'Homme, 1837.

² Hill, U. C. H., Males, vol. x. p. 265; 1854.

gressive—those in which the abnormal actions in the lung tend to destruction, and those in which they incline towards repair.

(a.)—PROGRESSIVE CHRONIC CONSUMPTION. *

1335. *Anatomical characters.*—The anatomical changes occurring in the lung in progressive chronic phthisis are referable to three main stages; and these stages sometimes correspond to certain varieties in the symptoms, and always to modifications in the physical signs. There are, then, clinical as well as anatomical reasons for recognizing three stages in the advancing disease, those of deposition with induration of softening and of excavation—stages which present the following characters of clinical significance.

1336. In the first stage, yellow tubercle,¹ preceded or not by the semi-transparent gray granulation, and either accumulated in isolated or grouped masses, or infiltrating the stroma of the lung, affects a special preference for the apex and upper lobe—either spreading thence downwards uniformly, or leaving islets of lung of various sizes unoccupied in its transit towards the base. Exceptions to this topographical mode of progress (on which the diagnosis of the disease so often turns) are infinitely rare in chronic tuberculization—the base of the lung proving the primary seat of the process, not oftener than once in sixty or eighty instances.

1337. Tubercle, as a rule, exhibits little tendency to form immediately beneath the pleura, unless the deeper part of the organ have already been involved. Rare instances, one of them recorded by M. Louis, occur, in which the earliest traces are discovered directly under the serous membrane.

1338. The tissue lying amid the tuberculous deposit undergoes various changes. Exudation-matter, of low plastic force, may infiltrate and harden the parenchyma—a condition to which many of the physical signs are more directly traceable than to the tuberculous deposit itself. Some air-cells undergo occlusion, either from actual production of tuberculous blastema within them, or from the pressure of that deposited on their confines; while, as originally shown by Carswell, adjacent air-cells undergo succedaneous distension. Obliteration of the minute branches of the pulmonary artery takes place—a vascular loss eventually supplied,

¹ Fortunately I am not called on to express an opinion, in a practical work of the present kind, on the intimate constitution of tubercle. Men seem, in truth, at present further removed than ever from any definite notion on the subject. Virchow, for instance, announces the encouraging doctrine, that “the cells present in tubercle may be relics of epithelial cells, or of some other natural product; or they may be related to or identical with exudation-cells, or pus-globules, or to and with the cells occurring in cancerous growths, or in typhoid infiltrations!” (Ranking’s Retrospect, vol. xviii.) So that tubercle may be any conceivable thing, except that which the unassisted eye and clinical observation prove it to be—a distinct and definite product, distinguishable from all others, both in its physical attributes, in its local evolution, and, above all, in the systemic diathesis of which it is the material exponent.

according to the investigations of Van der Kolk and Guillot, by an adventitious rete of vessels, which, at first independent, inosculates with the bronchial arteries, and (through pseudo-membrane in the pleura) with the vessels of the chest-wall.

1339. The second stage is signified by softening and disintegration of tuberculous deposit—and by breaking up of tissue, impaired in its nutrition, imprisoned amid that softening material. In this process the deposit and the tissue act and react on each other; but that tubercle, like clotted fibrin, may *ab origine* soften intrinsically, no reasonable doubt can, I think, be entertained.

1340. The softening process, like that of deposition, spreads from above downwards. The length of time tubercle may remain without losing its consistence, varies so widely, that no rule of clinical utility can be established on the point.

1341. Elimination is the essential feature of the third stage. The softened tubercle, with various products of inflammation, and the macerated and separated parenchyma embraced thereby, are thrown off through the bronchial tubes. The resulting cavities, originally small, increase in dimensions by mutual coalescence, and by advancing destruction on their periphery: so that, eventually, almost the entire area of a lung may be represented by a single huge excavation.

1342. Although chronic tuberculization involves both lungs, as a rule, to which I have never encountered an exception, the progress of deposition and destruction is invariably asymmetrical in the pair. So true is this, that in a case of pulmonary disease of doubtful nature, the fact of uniform distribution of the physical signs (were this positively demonstrable) would be fatal to the diagnosis of chronic phthisis.

1343. But can the relative progress of tuberculization in the two lungs be employed as an element of diagnosis? The following results of the analysis of 143 cases of phthisis throw some light on this question:—

“From these propositions it follows that the disease attains the softening point with not very unequal rapidity in the two lungs. Such difference as exists signifies that the point is more quickly attained in the left than in the right organ; for it appears that softening of the left lung, the right being still firm, was more common, under two distinct points of view, in the ratios of 29.51 to 27.12, and 24.13 to 19.51. I have, however, no means of ascertaining satisfactorily whether this depends on deposition being on an average earlier in the left lung than in the right, while the actual rapidity of subsequent destruction is equal in both; or from the destructive process being more rapidly effected on the left side, deposition being coeval on both sides.

But, as will appear from the subjoined comparison, the laws regulating the disease in males and females probably differ in this respect; they certainly did in these 143 cases.

Tabular comparison of the condition of the two lungs in both sexes. (143 cases.)

MALES.

FEMALES.

(a.) *Right lung*: 24 in first stage, 4 in which the *left* had reached the second or third stage—that is, in 16.67 per cent. of the number.

(a.) *Right lung*: 37 in first stage, 14 in which the *left* had reached the second or third stage—that is, in 37.83 per cent. of the number.

(b.) *Right lung*: 56 in second or third stage, 11 in which the *left* still remained in first stage—that is, in 19.64 per cent. of the number.

(b.) *Right lung*: 26 in second or third stage, 5 in which the *left* still remained in first stage—that is, in 19.27 per cent. of the number.

(c.) *Left lung*: 31 in first stage, 11 in which the *right* had reached the second or third—that is, in 35.49 per cent. of the number.

(c.) *Left lung*: 28 in first stage, 5 in which the *right* had reached the second or third—that is, in 17.86 per cent. of the number.

(d.) *Left lung*: 49 in second or third stage, 4 in which the *right* still remained in the first—that is, in 8.16 per cent. of the number.

(d.) *Left lung*: 35 in second or third stage, 14 in which the *right* still remained in the first—that is, in 40 per cent. of the number.

The propositions marked (b) do not tell in one direction or the other; those marked (a, c, d) depose strongly to the greater rapidity of evolution of the disease in the right lung of males, and in the left of females. Let it be remembered, too, that in the only two instances in which either lung was practically unaffected, it was the *left* lung of *males* that had escaped. Why the disease should advance more quickly on the right side in men, and on the left in women, does not clearly appear: if it be suggested that the greater frequency of pneumonia of the right lung in the male will explain the fact of its becoming a more rapid prey to tubercularization, the difficulty is to explain why the left should be the earlier victim in females."

1344. The stages of destruction may proceed rapidly in one organ for a while—a state of quiescence being then established, the other becomes the seat of rapid disintegration.

1345. Excavations, having formed, may either remain in *statu quo*, secreting tuberculous and purulent matter—or they may undergo certain reparative changes.

1346. The law of the tuberculizing process in the adult, many years since brought to light by the labors of M. Louis—that the presence of tubercle in any organ after the age of fifteen, involves as a necessity its existence in the lung—frequently proves of inestimable clinical value. We must not forget, however, as admitted by its discoverer, an exception to the rule does every now and then occur.

1347. *Physical signs*.—*First stage*: Accumulation of groups of gray granulations or crude tubercles in variable quantity, and with or without intervening simple induration of tissue.—The extent of area occupied by each morbid condition, the tuberculous and exudative, seriously affects the results—and, as a general truth, the induration, rather than the tubercle itself, is the cause of the physical signs during this stage.

1348. The infra and supra-clavicular regions are either unaltered in form, or they are slightly flattened. The former is the more common of the two cases: probably, the diminished bulk of the

apex, produced by deposition of tubercle and closure of *some* air-cells, is at first counterbalanced by the distension of *others*. It falls within the limits of the probable, indeed, that cases may now and then be met with, in which such emphysematous distension shall so predominate as to produce slight bulging over tuberculized lung. Many years ago, Dr. Chambers, without offering any explanation of the circumstance, mentioned to me that he had observed an increase in the antero-posterior diameter of the apex at the very outset of the disease. I have carefully watched for examples of the fact, but have never met with one unless where percussion gave a more or less deep-toned resonance [Type II. 197], and the existence of local emphysema, consequently, became strongly probable. It would appear, as matter of experience, to be impossible that tubercle alone, accumulated to such an amount as to impair in the least degree the pulmonary tone of percussion-sound shall be the cause of bulging [103]. The precise degree of tuberculization, which will produce flattening, varies with many accidental circumstances, such as the relationship of the tubercles to the minuter bronchial tubes (if many of these be obstructed, local collapse of lung-substance will ensue), and the presence or absence of plastic contractile exudation within the parenchyma or on the pleural surface. Atrophy of the tissue of the lung can scarcely occur at the very earliest stage of bronchial obstruction. Flattening may sometimes very positively exist, but, from being equally shared by both sides, escape detection: when present to any extent, the clavicle is thrown into unnatural relief.

1349. Vocal vibration may very certainly be increased in intensity under the clavicle; but the amount of increase is trifling. Its existence is, therefore, with difficulty established under the right clavicle, where there is a natural excess of fremitus; and on the left side, as a sign of incipient tuberculization, increased fremitus commonly fails us, because priority of disease on that side is most common in females, who, unfortunately, from the peculiarities of their voices, have little or no vocal vibration.

Careful admeasurement with the callipers will sometimes detect very slight reduction in antero-posterior diameter at this period. If the deficiency be marked, pleural false membrane is probably present to some amount. The motions of the infra-clavicular region are perverted, to the eye, to the hand, and to the measure. The hand laid flat on the surface, instead of being arched outwards during inspiration, is simply raised upwards; elevation-movement exists, expansion-movement is wanting; nay, more, the infra-clavicular region may actually sink in with inspiration. The first, second, and third ribs, if the pleuræ are agglutinated, may be felt to converge at the same time.¹ The deficiency of expansion-

¹ It is natural these ribs should converge in inspiration [71]; it is unnatural they should converge to an amount capable of being felt with the fingers.

movement under the clavicle is a more valuable sign in the female than in the male, for the obvious reason that it is naturally much more limited in the latter than in the former [49].

1350. The result of percussion may or may not be significant. Slight decrease of pulmonary tone, and slightly increased parietal resistance, may be produced by a very few scattered tubercles at the apex—local collapses of the lungs doubtless contributing to impair the resonance. The deficiency will be earliest caught at the inner aspect of the supra-clavicular and clavicular regions (see Diagram, page 19), where the apex of the lung lies. To detect it, percussion must be very lightly made, and, for purposes of certainty, repeated in various postures both of the patient and of the percussor. Care must be taken to direct the percussion from, and not towards, the trachea: with this caution, percussion is much more conclusive at the inner than at the outer part of the supra-clavicular region. Slight want of pulmonary tone is a more valuable sign in the female than in the male, and more valuable in both sexes at the right than the left side [192].

1351. Habitually a smaller superficial area of disease is required to effect the percussion-sound in the infra-clavicular than the supra-scapular regions; but occasionally the latter suffer even before the former. Sometimes, when tubercles are sparingly scattered through an entire apex, percussion on a broad surface will disclose a difference in resonance, imperceptible when a single finger is used as a pleximeter. Or recourse may be had to the dynamic tests: the increase of pulmonary tone produced by a full inspiration will be, in comparison with that on the healthy side, very trifling; and, on the other hand, there will be comparatively a great decrease of that tone at the close of a complete expiration. As deposition, collapse, and consolidation advance, the sound acquires more and more the characters of Type I. [195], but never becomes totally toneless, or of putty-like flatness.

1352. But instead of the attributes of Type I., the percussion-sound may possess those of Type III. [199]. The volume of sound may be thus actually greater over a tuberculized than a healthy apex—the rise in pitch being the real test of its morbidness. The resonance may be wooden, or even tubular—especially if consolidated tissue reach directly across from the costal surface to the trachea, or large bronchi, and the pleural laminæ be agglutinated at the spot.

1353. Inasmuch as tuberculization exercises a contracting influence on the lung-substance, the morbid resonance at the apex, of whatever type it be, ought not to extend beyond the normal pulmonary outline across the sternum. And in point of fact it never does so but to a very slight degree; the conveyance of the sound beyond the limits of the lung, is then to be explained by horizontal conduction [221].

1354. The fallacy of coexistent emphysema is always more or less to be apprehended during this stage.

1355. The results of auscultation vary widely—so conflicting are the physical conditions, rarefying and condensing, implicating the tissue.

1356. The respiration in the infra-clavicular region, and also usually in the upper scapular, is affected in *intensity*, being weak and almost suppressed in some points, exaggerated in others; perverted in *rhythm*, being frequently jerking; impairing in *quality*, being harsh, bronchial, or even slightly blowing. The value of these states of respiration is directly as the limitation of the area within which they are discernible; if they exist above, and are imperceptible below, the second interspace, they are very seriously significant. Slight harshness of respiration is more valuable, as a sign, in the male than in the female, and notably so on the left than on the right side. If the other causes of jerking rhythm [277] can be excluded, which may or may not be difficult, this condition of rhythm, when limited to one apex (it is rarer posteriorly than anteriorly) becomes a really important sign of tuberculization. My opinion on this point has yearly grown more positive. It is to be remembered that it occurs at a period of the disease when the physical signs generally are few in number, not so decisive as might be wished, and when, of course, every addition to their number is really important. According to my experience, it is a persistent phenomenon. I have not, as Dr. Stokes appears to have done, succeeded in removing it by local treatment, even in cases where other signs, for instance, harshness of respiration, were favorably modified by that treatment. It may exist in the highest degree without any coexistent affection of the pleura; and must not be confound with grazing friction-sound. Prolonged expiration, if unattended with alteration of quality, is insignificant: under such conditions, it is in all probability a normal state; and even coupled with slight harshness and coarseness of quality, it must be cautiously received as evidence in females, and at the right side.

1357. The only rhonchal sound specially belonging to this stage of phthisis is the dry crackling; occurring towards the close, it gradually passes, with the exceptions already referred to [327], into the humid crackling variety.

1358. Occasionally at the close of this stage the peculiar condition I have designated as *cogged-wheel rhythm* of respiration, exists—oftener in the supra-spinata fossa, than below the clavicle [278].

1359. The vocal resonance varies to such an extent in amount and quality, as to make it totally unworthy of clinical confidence: I have known it (where the existence of consolidation was positive, either from other signs, or, in addition, from *post-mortem* examination) of the average characters of health, weak, null, exaggerated, intensely bronchophonic, or pectoriloquous. The state of vocal fremitus, curiously enough, does not vary thus, and is hence, com-

paratively, a more trustworthy guide : but its positive value, we have seen, is next to nothing.

1360. In a doubtful case of tuberculization of the right apex, if the heart's sounds, but especially the first, be more clearly audible near the clavicle on that side than the left, we have herein presumptive proof of consolidation ; but the absence of this sign will not disprove the existence of solidity, of which strong evidence appears on other grounds. Subclavian murmur may be present ; and also systolic murmur at the second left, or pulmonary, cartilage, associated or not with basic systolic, or with subclavian, murmur. To the arterial pulmonary murmur, Dr. Latham attaches much importance as an attendant on tuberculization—but I confess its diagnostic claims do not appear to me to be established : as to its frequent absence, I take it for granted that so positive a fact must be admitted on all hands.

1361. The signs of dry or plastic pleurisy, and of bronchitis and of pneumonia, may occur in connection with tuberculous deposition : they have indirect value, if limited to one or both apices. Tuberculous patients, the *apex* of whose lung is the seat of capillary bronchitis, are of course liable to be seized with idiopathic bronchial inflammation of both *bases* from accidental causes. Under such circumstances, it is curious and interesting to observe the manner in which the upper and lower rhonchi travel towards each other so as eventually, in some rare instances, actually to meet towards the middle height of the lung. Where such union of the rhonchi takes place, the case is of the most serious character. I may further observe, with respect to the symptomatic rhonchi occurring in connection with tubercle at the apices of the lung, that I have found true crepitation, to say the least, singularly rare : that is, unless in cases where the cause of the rhonchus is really extensive pneumonia—such pneumonia as shall during its existence assume, in point of clinical importance, all the characters of the idiopathic inflammation. Under the ordinary circumstances of acute irritation setting up in the neighborhood of the new matter, fine bubbling is the rhonchus audible, and capillary bronchitis the anatomical state present.

1362. *Second stage.*—The signs of the second stage, that of softening, are in part new, in part those of the first stage, either stationary or carried to a higher point. To begin with the latter class : depression, both above and below the clavicle, is now greatly more marked, and may sometimes be really present to a notable amount, but be masked by twisting of the clavicle downwards and inwards on its long axis. When the clavicle thus, as it were, follows the retreating ribs, the callipers, or chest-measurer, supply the only trustworthy evidence as to the amount of depression. The corresponding supra-scapular region, if one apex be more affected than the other, is distinctly hollower than its fellow—a fact apparently so strange, that nothing but repeated observation would justify its statement. The vocal vibration does not increase as a consequence

of the softening process; but as this is, generally speaking, accompanied with extension of induration also, such increase may occur. The semi-circular measurement of the side, and the transverse diameter of the chest in the axillæ, are lessened in consequence of the general deposition of tuberculous matter, atrophy, and interstitial contraction of the lung, together with, in some cases, contraction of pleural false membrane. Morbid resonance under percussion gains in area and in intensity, and is, oftener than in the first stage, wooden or tubular. The respiration grows more extensively and markedly blowing, or remains merely bronchial. Vocal resonance varies as before.

1363. The *new* phenomena in this stage are humid crackling, and thin metallic bubbling rhonchus. When elimination of the softened material commences, the rhonchus may become cavernous on a small scale.

1364. In consequence of the diminution of the mass of the lung, the heart may be elevated above its natural position, the diaphragm raised, and the mediastinum drawn towards the mainly affected side. The heart's bulk gradually diminishes; but its area of superficial dulness may be apparently increased, in consequence of contraction of either, but especially of the left, lung.

1365. *Third stage.*—The signs derived from inspection in the third or excavation stage remain as previously. I have, however, in some rare instances, known extreme infra-clavicular depression, produced in the second stage, diminish somewhat, nay, even give place to slight bulging, when a *capacious* excavation had formed. This will probably occur where the anterior wall of the excavation is excessively thin, indeed merely membranous; the condition becomes one, physically speaking, closely assimilable to local pneumothorax: at all events, of the fact I am positive. Again, in such cases, inspiratory expansion may improve to a certain extent. I have observed this in a case where amphoric respiration gave evidence of the size of the excavation; and the more solidified the rest of the lung, the greater will be the expansion over the cavity.¹ Rhonchal fluctuation may sometimes be detected; and if the cavity be of large dimensions, fluctuation, producible by succession of the trunk, may be felt.

1366. The percussion-results depend less on the fact of cavity existing than on the conditions of the cavity. If it be small, and surrounded with much indurated lung, the sound will habitually be either high-pitched and hard, or wooden, or tubular. If there chance to be a thick stratum of normal tissue between the excavation and the ribs, gentle percussion may be of almost healthy quality,—moderate dulness, slightly tubular, too, is detected on strong percussion. If there be several small excavations, with in-

¹ Green, U. C. H., *Females*, vol. v. p. 148; July, 1850. Expansion is very rarely totally deficient over a large-sized cavity; greatly more rarely than over highly consolidated texture.

durated substance between them, the sound is markedly dull, and somewhat tubular; if one or two large excavations, amphoric or of cracked-metal quality.¹

1367. The respiration, provided the cavity be neither distant from the surface, nor separated from it by a stratum of healthy tissue, is usually divided, hollow, hoarse, blowing, and cavernous, or actually amphoric; and this state alternates or coexists, in the manner already described [303], with gurgling rhonchus. The cough is cavernous or amphoric; and metallic echo, or metallic tinkling in some rare cases, accompanies the voice, cough, and respiration.

1368. There are exceptional cases in which the respiration may be null over a large cavity, at least at its upper part—cavernous rhonchus existing below.

1369. The vocal resonance varies in characters; it may be pectoriloquous, amphoric, bronchophonic, natural, weak, or null: hence vocal resonance should never be trusted to alone in the diagnosis of a cavity. The form of resonance most strongly distinctive of an excavation is *whispering* pectoriloquy: but cavities may exist without this; while resonance of the sort may exist under physical conditions directly the reverse of excavation [411].

1370. A cavity of large size, with hard and smoothish walls, and containing thin fluid in moderate quantity, may not only emit a guggling sound when the trunk is abruptly shaken, but the heart's action, too, if the cavity be near, may produce a similar sound of cardiac rhythm.

1371. Where great loss of substance is effected in the right lung by excavation, and its remaining tissue is much reduced in bulk, the heart may be drawn greatly out of its place, and beat to the right of the sternum—this form of sign is most distinctly marked, however, where, in addition, contraction of a large cavity has set in.

1372. *Symptoms*.—The symptoms of progressive phthisis do not admit of such systematic division into stages as its physical signs: there is no symptom absolutely peculiar to any one of the three anatomical stages. It will be better, therefore, to consider them *seriatim*, under the heads of *local*, *general*, and *incidental*.

1373. *Local Symptoms*.—*Cough*, unless in latent cases, is an essential symptom; habitually unpreceded by coryza, rarely paroxysmal, it is at first either dry (but this, very probably, in not more than about one-tenth of cases), or attended with expectoration. Slight at first, merely a clearing of the throat, the cough gradually grows more forcible, though, as a general rule, the effort to remove the sputa is not seriously strained. In certain rare instances, the

¹ Cracked-metal quality may be found directly over a spot in a state of induration only,—a small cavity, not larger than a walnut, existing at an inch or two distant (Bevan, U. C. H., Females, vol. xv. p. 306). This may be another example of *horizontal conduction* [221]; or of the cracked-metal note of mere consolidation [210].

cough, paroxysmal and excessively violent, is evidently sustained by some exceptional form of irritation, probably a neurosis of the vagus [932]. The cough in phthisis more frequently brings on vomiting or nausea, than in any other pulmonary affection: if a fit of coughing occur shortly after a meal, more or less of this is habitually vomited in the majority of cases that have reached the second stage.

1374. The *expectoration* at the outset is colorless, frothy, watery, or mucilaginous looking. When of the latter appearance, a deposit in small quantity takes place of a thickish, grumous substance, of pale grayish tint, and not unlike the sort of curd that is often seen in barley-water. It has not occurred to me to observe this peculiar appearance except in phthisis.

Gradually, sometimes abruptly, the sputa grow distinctly glairy and muco-epithelial; presently purulent striæ appear amid these, contrasting by their opaque, pale buff or yellow tint, with the lighter colored and more transparent mucous body of the sputum, which grows less and less aerated. Suddenly a total change may occur: the sputum becomes essentially purulent, consisting either of small pellets with jagged, sharply cut outlines, opaque, semi-floating, non-aerated, and of dirty yellowish color (so-called boiled-rice sputum), or of larger masses with ragged edges, or of broad, flat, discoid lumps, darkish green in tint, smooth in outline, and remaining apart if expectorated into water. These different forms of purulent excretion may be variously associated, and, if fresh simple bronchitic irritation supervene, may be mixed with frothy fluid again.

Eventually the sputa acquire an ash color, run together in one mass, totally free from air, and are constituted essentially of pure pus. Occasionally sudden profuse expectoration of purulent fluid occurs, in some cases traceable to abrupt evacuation of a cavity, in others to abundant secretion from the walls of old cavities and neighboring bronchi; both occurrences are to be distinguished from discharge of empyema through a perforation [798].

1375. The odor of phthisical expectoration is nauseous, *sui generis*, not actually fetid. It may accidentally acquire the wet mortar like, or putrid smell of gangrene, under circumstances already described [1224].

1376. The quantity of expectoration varies greatly in a mass of cases: sometimes profuse, especially in the earlier and closing periods, it may be very slight throughout; and I have known cases run their course without any expectoration at all. I once saw a lad, aged fifteen, admitted into hospital with "typhoid" (Peyerian) fever, become tuberculous during convalescence, and, dying within a short period, present large cavities in his lungs, though he had never, as far as could be learned by constant questioning, expectorated a single sputum: he must, of course, have swallowed them all, as *children* almost invariably do.

1377. The microscopical element of phthisical sputa are very numerous. First, epithelium tessellated, cylindrical and ciliated, from the bronchial tubes; salivary fluid, and epithelium from the mouth. Secondly, blood-disks (even when no reddish tint exists to the naked eye), melanic cells and molecules, molecular fat, oil-globules, and saline matter, crystalline and amorphous. Thirdly, exudation-matter in patches, exudation-cells, and pus-cells. Fourthly, fragments of pulmonary fibre, capillary vessel and nerve. Fifthly, dark, molecular matter, soluble neither in ether nor in hydrochloric acid, and probably tuberculous—and, in very rare cases, cells possessing the characters originally assigned by M. Lebert to those of tubercle: I have, at least occasionally, seen, in the opaque buff-colored striæ of comparatively clear sputa, cells non-nucleated and more angular in outline than those of exudation-matter. Sixthly, the vibrio lineola and mycodermatous entophytes.

Now the presence of fragments of tissue indicates breakage of the lung-substance, and may furnish its earliest evidence. The existence of tubercle-cells, if certain, is, of course, distinctive of phthisical disease. Otherwise the characters enumerated have no precise diagnostic signification.

1378. Of the chemical characters of the sputa I know little. Popular prejudice, looking upon the change from saline to sweet taste as of evil import, is probably well founded: for in the outset the sputa, essentially those of catarrhal flux, are markedly saline; with the advance of the disease and obstruction of lung they may become saccharine. Sugar, however, is by no means always to be found.¹

1379. In the course of phthisis calcareous particles and masses, merely gritty or of petrous hardness, and in size from a pin's point to a pea, may be expectorated. I have known this continue for years steadily or interruptedly. But while such expectoration is a clear proof of local retrogression, the tuberculizing and softening processes may in other parts of the lung be actively advancing.

1380. *Hæmoptysis*, including under this term even expectoration simply streaked with blood, is a symptom of extreme frequency, occurring, as I formerly found (*Brit. and For. Med. Chir. Rev.*, January, 1849) in about 81 per 100 of cases. The following general inferences are derived from the examination of 106 cases:—

“*Hæmoptysis* was of very slightly (4 per 100) more frequent occurrence in males than females.—*Hæmoptysis* to a medium amount is about four times less common than to very slight or to profuse amounts—both taken together. Very profuse hæmorrhage from the lungs is more common in males than females.—

¹ Thus the sputa of Nettleship, *U. C. H.*, Males, vol. x. p. 146; and of M. Harris, *U. C. H.*, Females, vol. ix. p. 326, both in the third stage, were boiled for twenty minutes with two parts of distilled water, then treated with acetate of lead and soda; the filtered fluid gave no evidence of sugar with Trommer's, Poggiale's, or the bichloride of tin tests. These results, carefully obtained by my clinical clerk, Mr. W. T. Coster, were confirmed by actual analysis in the Birkbeck Laboratory of University College.

Medium frequency of recurrence of hæmoptysis is materially less common, and this in both sexes, than a single or than repeated attacks. Further, repetition of hæmoptysis is more common in males than in females.—It is materially more common for a first hemorrhage to be more profuse than subsequent ones, than for subsequent ones to be more profuse than the first. Hæmoptysis is more frequently met with (and this independently of any influence of duration of the disease) in persons who have reached the second and third stages, than in those whose lungs have not yet softened. This proposition is more markedly true of males than of females. There does not appear to be any notably greater tendency to hæmoptysis, where the right lung has reached a more advanced stage than the left, *vice versâ*, where the left has taken the lead. It seems improbable that either lung is more effective in causing hæmoptysis than its fellow. The frequency of hæmoptysis increases with advancing years in both sexes. The increase is more abrupt in females than in males, and in the former appears connected with the catamenial function. This greater frequency of hæmoptysis in persons of more advanced years, does not depend altogether on greater duration of the disease; for those, who had had hæmoptysis, had been phthisical for only a mean period of eight months longer than those who had not spit blood. The most common periods for the occurrence of hæmoptysis, were at the very outset, or after the expiration of the first month; it is very rare for hæmoptysis to occur within the first month, unless it has actually appeared as the first, or among the first symptoms. The phrase “first symptom” here is to be understood with a qualification to be by and by explained. In upwards of half the cases of notable hemorrhage (beyond 4 oz.) this occurs, or has occurred, as the “first symptom,” corroborating the inference as to the excess of amount of first over subsequent hemorrhages. Hemorrhage of this amount is rare as a coexistence with other first symptoms (in $\frac{1}{3}$ of these cases) appreciable by the patient. Streaked or tinged sputa are, on the contrary, of very common appearance amongst the earliest symptoms. But streaked or tinged sputa are rarely, or never, the “first symptom” singly and alone. Season does not appear to exercise any marked influence on the occurrence of a first hemorrhagic attack. Hæmoptysis never appeared as the *bonâ fide* first symptom in these cases, the phrase being understood in its absolute sense without qualification; it is so only in the sense that it is the first symptom particularly noticed by patients—the first occurrence that leads them to watch their health.”

1381. The last proposition is important: it leads one to reject, on clinical grounds, the old notion, that phthisis is really caused by hæmoptysis in those cases where it *appears* to lead the way in the train of morbid events—in other words, to deny the existence of “phthisis hæmoptoe.”

1382. The quantity brought up, at any one time, varies between a few streaks and some pints of pure unmixed blood.

1383. The tints in phthisical hæmoptysis vary—venous red is rare; florid red most common: sometimes the sputum is of dark brick-red hue; again, of salmon color, or of a light flesh-like pink.¹ Moulded clots, even of minute size, are excessively rare [575].

1384. Although the breathing of phthisical patients range, as a rule, above par in frequency, positive *dyspnœa*, either objective or subjective, rarely holds a prominent place among the symptoms. Consciousness of obstructed breathing, when felt at all, commonly depends upon exertion of some kind. In the state of rest the frequency of respiration rarely reaches any notable height in the pure

¹ Tagg, U. C. H., Females, vol. ix. p. 108.

chronic disease; and when the act is morbidly accelerated to a serious degree, the pulse also beats with such increased frequency, that the ratio of the two suffers scarcely any change. I have seen few cases of very marked dyspnoea, of which the patients volunteered complaints. In these instances there was either some organic cause, such as great emphysema, with bluish lividity of the face, and general coolness of surface, or pneumonia, to account for the symptom: or, it might be referred to neurosis of the vagus [927], or to hysteria.¹ Hannover found that the absolute amount of carbonic acid generated in the softening stage increased with the number of respirations, while the relative amount (that which is contained in a definite volume of air), diminishes.

1385. Actual *pain*, or distressing sensations within the thorax, exists in the great majority of cases. But severe suffering of this kind is the exception: and hence one of the most obvious reasons, as a rule, why phthisical patients succeed so long in blinding themselves as to the dangerous character of their disease.

1386. The pain may in part be intra-pulmonary [922], true pleurodynic, intercostal-neuralgic, or pleuritic. Local pleurisy is by far its most frequent tangible cause; to local evanescent dry pleurisies are in the main due the wandering chest-pains of these patients, and to more permanent pleuritic changes their comparatively fixed sufferings. But, as already shown, the mechanism of pleuritic pain itself requires elucidation.

1387. *General symptoms*.—Pyrexia, sooner or later, becomes an invariable attendant on the progress of phthisis. Sometimes it arises coetaneously with the very earliest local symptoms; in sixteen of ninety patients observed by M. Louis, acute cases being carefully excluded, such was its time of origin. In the majority of cases it does not set in, until either actual softening, or at least local irritative action, is excited.

1388. The fever, of so-called hectic type, consists in a complete paroxysm of shivering, heat, and subsequent perspiration. But shivering is very rare; mere chilly sensations announce the onset as a rule. Habitually there is but one, an evening, paroxysm; there may be a morning one also. But total freedom from febrile action scarcely exists at any moment of the day—and the real type is remittent.

1389. The profuseness of the perspiration constitutes the chief peculiarity of phthisical hectic. Generally diffused over the whole body, or especially limited to the chest, neck, and head, these perspirations, commonest towards the early morning, are sufficient in some cases to drench the patient's linen and even the bedclothes.

¹ Dr. E. Smith has submitted the pulse-respiration ratio in phthisis to a most elaborate investigation (Med. Chir. Trans., vol. xxxix.); from this it follows that the average neither reached so high as 4:1, nor so low as 2.3:1. It ranged lower in women than men. Pulsation was notably lowered, respiration increased, in frequency, by night; "the deeper the sleep, the more frequent the respirations."

Such sweating may occur independently of any distinct previous heat of skin. Sudamina are, on the whole, rare; their contents may, as in other diseases, give a neutral or even alkaline reaction, while the surrounding perspiration is sharply acid.

1390. Acceleration of pulse, which may rise to 130 or 140 per minute, without proportional rapidity of breathing and elevation of temperature (the skin of the axilla or of the hand marking 100° or 102° Fahr.), flushing over the malar bones, the whole attended with subjective heat in the palms of the hands and soles of the feet, mark the hot stage.¹

1391. Setting aside the period of actual pyrexia, the pulse small, sharpish, quick in its stroke, and habitually, but not invariably, frequent, is of wide range, varying, within my own observation, from 60 to 140 per minute in uncomplicated cases. The frequency sometimes changes remarkably in the same case within a day or two; occasionally an obvious cause, in the shape of some intercurrent attack, can be found for this—quite as commonly it baffles explanation. It has been said the increase of frequency on changing from the recumbent to the sitting and standing postures is less than in other diseases attended with debility: the general statement seems not unfounded, but exceptions are frequent.

1392. The constant apprehension of chill, by interfering with proper ablutions, promotes (especially if the patient neglect free change of under-clothing) accumulation of an oily inspissated perspiration, and effete epithelium. Herein, it has been supposed, lies a favorable nidus for epiphytic growth; and unquestionably pityriasis versicolor is not uncommonly found on the front-chest of the lower orders of the consumptive population.² But as yet we are without any evidence that the cutaneous excreta of phthisical persons *specifically* favor the germination of the epiphyte of that affection.

1393. The *digestive organs* suffer more or less in the great majority of cases; but in the period of their seizure and in the amount of their suffering infinite diversity obtains.

1394. The tongue may remain throughout (except under occasional disturbances, which might occur to a healthy person) perfectly natural in all its attributes. Marked furring is on the whole rare, and generally traceable to passing hepatic obstruction. If there be any state of tongue that can fairly be called phthisical, it is the more or less vividly red, with large and irritable looking papillæ.

1395. Thirst, even in apyrexia, is rarely absent through the whole course of the disease, whether the alimentary canal be free from anatomical change or not.

¹ Mr. S. Ringer has lately shown with precision that the objective temperature begins to rise before the rigors of the hectic paroxysm set in. The quantity of urea and that of chloride of sodium secreted attain their maxima (not in exactly direct proportion) immediately before, and at the close of, the sweating stage. (Med. Chir. Trans., vol. xlii. p. 397, tab. xii.)

² Koch in Virchow's Archiv., bd. x.

1396. Failure of appetite, amounting sometimes to complete anorexia, occurs in an undetermined proportion of cases, and is of very varied, sometimes inexplicable mechanism. It may depend on chronic inflammatory disease of the gastric mucous membrane, on slow degenerative softening, on fatty atrophy of the epithelium,¹ or be purely dynamic. On the other hand, bulimia is occasionally observed in connection with neurotic dyspnoea, and may probably depend on hyperæsthesia of the vagus [931].

1397. As long as the stomach produces digestive juices, these seem to be of good quality: at least chymification, whatever be the ultimate fate of the chyme, is often thoroughly and comfortably effected to the last. I have known the richest lobster-*mayonnaises*, truffles, mushrooms, and all conceivable varieties of so-called digestible food, eaten without the slightest suffering to the final hours of existence. Though such digestive potency as this be confessedly exceptional, I have not, on the other hand, met with, in my own sphere, any marked illustration of the lamentable details concerning phthysical dyspepsia supplied by some authors. True, ordinary fat is often ill-digested, and the phthysical stomach seems often to instinctively repel fatty materials of all kinds [1542]; but though more frequent among tuberculously disposed people than others, this dislike for fatty matters is by no means confined to them.

The secondary processes of digestion, chyle-formation, and hæmatisation, are those essentially at fault. Out of ordinary food the phthysical apparatus fails to evolve either chyle or blood of the qualities of health [1422]. The specific variety of this failure is, of course, peculiar to, and constitutes the intimate and essential manifestation of the tuberculous diathesis; but some failure of the species is an intrinsic element of the entire group of diathetic diseases.²

1398. Pain and tenderness below the ensiform cartilage, with loss of appetite, nausea, and spontaneous vomiting, indicate sub-inflammatory action in the mucous membrane of the stomach, and can scarcely be considered direct symptoms of the primary disease. Vomiting of food brought on by fits of coughing, and unaccompanied by any other gastric symptom, does not indicate any textural change in the organ: it is essentially mechanical. The phthysical stomach is, in truth, not readily nauseated, as a rule; observe, how it bears even rancid cod-liver oil,—and how little disposed phthysical persons are to grave sea-sickness.

1399. Stomatitis, simple or diphtheritic, is not uncommon towards the close of the disease; epiphytic formation occurs, but rarely, in the exudation. Chronic pharyngeal abscess is in some instances met with,—in one case of the kind, that fell under my notice, pro-

¹ Admirably described by Dr. Handfield Jones. Vide also W. Fox, in *Med. Chir. Trans.*, vol. xli.

² Vide *Clin. Lectures on Reciprocal influences of Diathetic and Acute Specific Diseases*, "Medical Times," June, 1855, p. 613.

duced by caries of a cervical vertebra, and assimilable in mechanism to so-called lumbar abscess.

1400. I have twice known uncontrollable frothy salivation form a prominent and distressing symptom of the closing period, without obvious affection of the mucous membrane of the mouth or salivary glands.

1401. In 1847, M. Fredericq drew attention to a red streak at the edge of the gum opposite the lower, and sometimes also the upper, incisors, as one of the earliest signs of phthisis,—the color in highly febrile phthisis being brick-red, in hemorrhagic phthisis blue. Subsequently he professed, that in the latter period of all chronic diseases a blue or red streak will be found. M. Vanoye, in turn, describes a white marginal line;¹ and Dr. Thompson insists upon the red. I believe with M. Fredericq, that the red line is to be found in a variety of chronic blood-diseases, but more frequently in phthisis than others. It may be completely absent, however, to the last hour (stage of the disease seems, indeed, to exercise no influence on its appearance); and is notably more frequent in patients of the lower than of the upper ranks,—a fact to be explained in some measure by habits of cleanliness and the reverse.²

1402. The teeth of phthysical people are said to be subject to transverse cracking, and to be of more than average transparency; but numerical evidence has not been furnished, and seems scarcely worth the seeking.

1403. The state of the bowels varies greatly,—in some rare cases they continue natural, in a certain number constipated even to the last hour, in others relaxed from time to time, in a fourth class permanently loose. Diarrhœa may depend merely on secretive changes in the bowels, on small ulcerations in the ileum and jejunum, or on extensive destruction of the mucous membrane of the colon, as well as of the ileum. In the first case, the symptom is temporary, and easily controlled; in the second, more persistent, and with difficulty arrested; in the third case, absolutely unmanageable. In the last condition, as insisted on by M. Louis, the motions are very numerous, reddish, or putty-colored, fluid, and of putrid odor. If the rectum be ulcerated, the motions may be pseudo-dysenteric. The connection of diarrhœa with chronic peritonitis will be considered by and by.

1404. But, whatever be the efficacy of ulceration, as a rule, in producing diarrhœa, its innocuousness in this respect is in some

¹ Ranking's Retrospect, vol. xii. p. 218.

² The want of real diagnostic signification of the red line here shadowed forth, has been amply demonstrated of late by Drs. Saunders and Draper from an examination of 451 individuals. The main results are as follows: Of 116 phthysical patients, 88—of 335 diseased, but not one phthysical, persons, 257—of 37 healthy pregnant or recently delivered women, 32—presented the line more or less developed. (New York Journal of Medicine, 1857.) The authors have not investigated the effect of mercury, antimony, arsenic, &c., which, from some few observations at University College Hospital, seem to exercise a very distinct influence.

cases equally certain. Not only may pretty extensive ulceration exist in the ileum without pain, either spontaneous or elicited by pressure, but with a confined state of bowels. Again, I have known in a case running an acute course, marked abdominal pain and tenderness conjoined with obstinate constipation, where, after death, the bowels, in spite too of the frequent use of purgatives, contained abundant solid feces, and the ileum was extensively tuberculized and ulcerated.¹

1405. The symptoms of tuberculization and ulceration of the cæcum and of its appendix are sufficiently obscure in the majority of instances. Tuberculous typhlitis may in fact, as I have more than once substantiated post-mortem, be completely latent. Ulcerative perforation occasionally occurs, more frequently in the appendix than in the cæcum itself. If the patient have already suffered from diarrhœa and abdominal pain, the occurrence of perforation may not be marked by any increase of suffering sufficient to seriously arrest attention: local peritonitis, followed by sacculated collections of pus, results. Or fatal general peritonitis cuts off the patient rapidly. Or pus may filtrate into any one of the post-peritoneal sites occupied by intra-pelvic abscesses, and eventually discharge itself through the intestines, the vagina, the abdominal wall, &c.²

1406. The glands of Brunner are sometimes enlarged and tuberculized: sub-acute duodenitis follows, and doubtless plays a part, though an uncertain part, in the phenomena of occasional dyspepsia.

1407. The external lymphatic system, on the whole, rarely undergoes tuberculization in the phthisical adult. An antagonism, not absolute but tolerably well marked, seems to exist between the external and internal tuberculizing processes. In corroboration of this, I have known the cervical and axillary glands, greatly enlarged in phthisical people, rapidly fall to the natural size without suppuration or symptom of any kind, while pulmonary tuberculization rapidly advanced.³ Severe lumbar neuralgia may be produced by infiltrated glands pressing on the nerves: but, common from cancer, this is rare from tubercle. Disease of the mesenteric glands, which are tuberculized in from one-third to one-fifth of phthisical adults, takes part in perverting nutrition,—but in what form, and to what extent remains to be investigated. Mere obstruction of the lacteals is doubtless concerned; in cancer of these glands the lacteals may be seen plugged with stagnant chyle.⁴

1407*. The bronchial glands, often moderately enlarged by

¹ Hodson, U. C. H., *Males*, vol. ix. p. 16. Even the large, as well as the small, intestines may be ulcerated, and yet no diarrhœa exist. Plimpton's case, *Lancet*, loc. cit., p. 579.

² M. Leudet (*Archives de Méd.*, 1859) has collected some interesting information on this subject.

³ e. g., Petrolini, U. C. H., *Females*, vol. v. p. 175.

⁴ Lucas, U. C. H., *Females*, vol. xvi.

tubercle, itself quiescent or retrograde, rarely induce symptoms in the adult.

1408. The functions of the *encephalon*, in the pure disease, undergo less modification than those of any other organ. Cephalalgia, and perversions of cutaneous sensibility, if they occur, are purely accidental. Motor specific alterations are unknown; but irritability of the muscles, under the influence of percussion or other physical stimulus, is carried perhaps to a higher point in the emaciation of phthisis than of other chronic diseases.

1409. Slight wandering at night, on waking out of sleep, sometimes occurs; with this exception the mental faculties retain their clearness in the majority of cases to the last few hours—trifling failure of memory, and inability to follow a train of thought, alone existing towards the close. Not only this, but the perceptive and reasoning powers sometimes acquire unwonted vigor and acuteness, as the disease advances; and the imagination and fancy grow unnaturally vivid,—the individual becomes, as it were, idealized.¹

In a word, when marked cerebral symptoms exist, they always indicate intercurrent disease.

1410. The *temper*, though irritable, is singularly hopeful. Every one has seen cases in which arrangements for future years are made within a few days of death; and I have actually known the question of a change of profession complacently considered within *three hours* of the fatal event. There may be, in such cases, an effort on the part of patients to deceive themselves and those about them, as to the real state of things: but, nevertheless, hopefulness constitutes a special clinical feature of the disease, and cannot by any means always be explained by the absence of pain. How strong the contrast between the phthisical and the cancerous patient in this point of view!

1411. The *cellular tissue* remains remarkably free, as a rule, from serous infiltration. If there be marked cedema even of the ankles, there is almost invariably some morbid state, besides phthisis, to account for the fact; *à fortiori*, if there be general anasarca of one or both lower extremities. Hope was, I believe, the first to draw attention to the occurrence of coagulation of the blood in the femoral vein, from mere sluggishness of current, towards the closing period of phthisis. The clotting process generally limits itself to one limb. I have but once had the opportunity of examining the limbs after death from phthisis, where anasarca and notable obstruction of the veins in a lower extremity had existed; in this instance, the femoral and iliac veins of the right limb were *inflamed* in the most positive manner.² I have, however, within the last few years, pretty frequently observed cedema of the legs in the course of phthisis, disappearing rather

¹ For this phthisical acuteness of the faculties, the ancients invented the term *catopsis*.

² Henry James, U. C. H., Males, vol. v. p. 130; 1850.

rapidly under treatment, and unattended with any great tenderness in the track of the femoral veins. The œdema occurred here independently, in all probability, of phlebitis; yet there was positive venous obstruction in the limbs,—whether produced by sluggishness of current, and altered constitution of the blood, I am unable to affirm.¹

1412. Pains in the lower extremities are sometimes, towards the close of life, the prominent symptom, and may be of agonizing severity: if coexistent with anasarca, the state of the veins explains them; under other circumstances, especially when the limbs are wasted and flaccid, they are inexplicable. It is easy, but scarcely satisfactory, to call them neuralgic: they do not follow the direction specially of the main nerves, but seem to occupy the entire substance of the limbs.

1413. The osseous system has scarcely been studied in the phthisical with necessary care. Tuberculization of the lumbar vertebræ, more rarely of the cervical or dorsal, giving rise to a peculiar form of caries and abscess, occurs in a very small proportion of cases. I have never met with tuberculous periosteitis; but occasionally inflammation, secondary to the deposition of tubercle in the meshes of the endosteum, occurs in the heads especially of the long bones.²

1414. Whether the nutrition of the osseous system of the tuberculous adult undergoes any specific form of impairment, seems to me yet open to inquiry. The bones, like the soft parts, are certainly deficiently nourished; but I have never met with positive osteomalacia in fully grown phthisical persons.

Rufz, of Martinique, earliest threw serious doubt on the long-accredited doctrine of the identity of rickets and scrofula. Tuberculization and rickets are very assuredly rare coexistences; and several modern observers (some on the mere ground of the extreme rarity of tubercle in rachitic children, some for the less convincing reason, that much rachitic chest-deformity must produce venosity of the blood, a crisis antagonistic to that of tubercle), reverse, *in toto*, the notions of our forefathers, and maintain the diseases to be reciprocally exclusive. I have seen mesenteric, bronchial, and pulmonary tubercle in a rachitic child—the two affections, that of the bones and that of the soft parts, appearing to advance, unmodified each by the other's presence. But on the whole, the diathetic essences of tubercle and rickets seem different—their combination purely accidental, as matter of experience uncommon, and of inference unlikely.

1415. *Emaciation* ranks among the most constant and most striking phenomena of phthisis. The alterations in the adipose tissue

¹ The influence of heteræmia is well shown by Mackenzie. (Med. Chir. Trans., vol. xxxvi.)

² The tibia; Univ. Coll. Museum, Wax Models, No. 2909.

are the same as in either forms of emaciation—the cells diminish in size, oil gives place to watery fluid, and crystalline separation of the fat-elements takes place within them.

Inasmuch as emaciation precedes in a fair share of cases all other local or general symptoms, it becomes obvious that the presence of tubercles in the lungs (or the constitutional state, of which those tubercles are the local expression), acts *per se* as an efficient cause of wasting—loss of appetite, vomiting, diarrhœa, and perspirations, are subsidiary in their influence. The agency of the tuberculizing process, in this respect, is not the less real, because in the existing state of knowledge it eludes explanation. The dislike of tuberculous people to fat, whence absorption of their own adipose substance as aliment for respiration ensues, can scarcely be accepted as an hypothesis clearing up the mystery; inasmuch as similar waste, prior to the occurrence of colliquative symptoms, is often observed in cancerous sufferers, who display no special dislike to oily food.

It is not only the external fat and cellular tissue that waste: the muscles, and the parenchymata suffer too; as proved by Louis and Bizot, the weight of the heart and calibre of the aorta are less in the victims of phthisis than of any other disease, except cancer. The weight of the body, as a whole, consequently diminishes, rapidly, surely, and progressively, more especially as no serous accumulations form to give fictitious bulk. But there is a curious fact connected with the emaciation of phthisis, and, for aught I know to the contrary, of other chronic diseases; namely, that it is not an invariably steady process. I have repeatedly found, by placing patients in the balance within short intervals, that there are rises and falls in weight, intercurrent to the general progressive tendency downwards, and occurring irrespectively of any obvious changes in diet, appetite, or colliquative symptoms. The late Dr. Robert Williams, of St. Thomas's, as I several years ago learned from his friend, Dr. Silvester, inferred from a large mass of observations upon this point, that there was a law of periodicity regulating the rises and falls of weight. I have no means of ascertaining what the period established by Dr. Williams was; and my own observations are too limited to supply the deficiency. I feel tolerably sure that the interval is shorter than a month—the period at which Sanctorius, generalizing from experiments on his own person, inferred that a passing increase of two pounds' weight (ascribed to lunar influence!) took place in health.

The thoracic coverings waste most, the facial fat least, rapidly; exceptions to this rule are very rare. As a fact of probably similar import, I may mention that I have occasionally seen the hair on the chest of phthisical males uniformly and perfectly white, while as yet but a few "silver threads" exhibited themselves on the head, and in the whiskers.

1416. But in some instances phthisis runs its course almost to

the end without notable emaciation: the body may be plumply fat, while large cavities exist at the apices, and the disease makes rapid advance downwards. Such retention of fat generally indicates a sound state of the alimentary canal; still I have known plumpness maintained with feeble appetite and occasional diarrhoea.¹ On the other hand, rapid emaciation may take place in persons eating abundantly and free from a trace even of dyspepsia.

1417. Bulbousness of the finger ends; curvation and transverse cracking of the finger nails, and falling of the hair, are observed in a certain share of cases. I have not found, as it has been asserted, that the habit of biting the nails is specially common among the phthisical.

1418. M. Louis has arrived at the conclusion, contrary to what had previously been held, that the sexual appetite in the male undergoes impairment. Menstruation, he found, ceased in the female, when the total duration of the disease was under a year, at about the middle of its course; when the duration of the disease ranged between one and three years, the catamenia continued commonly to appear till the last third. Menstruation, while existent, may remain natural; or disturbances in point of time, quantity, and quality, may occur. The uterus and ovaries present no deviation from structural health, as a necessary condition of phthisical paramenia. Neither is it possible to explain, by the course or predominant symptoms of the disease, the healthy or perverted state of the catamenial function.

1419. It has been generally supposed that pregnancy retards the progress of phthisis, the disease acquiring increased activity after parturition. I have positively observed several cases in which many of the symptoms of phthisis became less prominent during pregnancy. This might be the fact, it is true, without the real pulmonary disease being suspended in progress: but it is curious that I do not remember to have opened, or to have seen opened, the body of a female dying of phthisis and at the same time pregnant. My sphere of observation is, however, not the most favorable for encountering pregnant women. M. Grisolle has lately examined these questions, and comes to the conclusion that the disease is somewhat increased in rapidity of progress during pregnancy; while, after parturition, it is slightly mitigated, or, at least, remains stationary. The number of cases he has collected (and all other persons that I know of are in the same predicament) are quite insufficient to solve the problem.

1420. I some time since numerically examined the question whether the tuberculous diathesis intensifies or weakens the force of fecundity in the female, and of the procreative faculty in the male, and was led, by the facts, to the conclusion *that the procreative*

¹ J. Gonner, Females, Consumption Hospital, Chelsea. This patient retained flesh until Bright's disease, which rapidly destroyed her, supervened.

power of phthysical males is below the average—the fecundity of phthysical females materially above it. Taking the two sexes together, and regarding them as phthysical stock prepared to propagate, the female activity is counterbalanced to a certain extent, though by no means completely, by the male inactivity; 11.82 years of phthysical cohabitation produced a mean of 0.83 children less than 17.48 years of non-phthysical cohabitation.¹

1421. Spermatorrhœa occasionally occurs in phthysical persons; either in moderation, as a result of continence, or to a grave amount, as the effect of dissolute habits. The qualities of the seminal fluid, it may be inferred from the facts concerning male procreative power just referred to [1420], are in the mass of cases in some way defective. But the statement of Davy² that spermatozoids cease to be formed in chronic diseases of fatal character, clashes with direct observation. In sixteen aged persons cut off by chronic disease, three of them by phthisis, spermatozoids were found by M. Duplay.³

1422. The blood in the early period of phthisis is deficient somewhat in red corpuscles, and very slightly in fibrin; the proportions of albumen and water are increased; the serum appears to be less alkaline than in health. With the advance of the disease the blood becomes hyperinotic, presumably from the irritating influence of the tubercles and intercurrent inflammations. Quite at the close the fibrin and the solids generally undergo notable diminution. There is no microscopical character, that I know of, in the red corpuscles, which can be trusted to as the slightest guide in the diagnosis of the disease.

The alleged presence of the polystoma sanguicola, in phthysical blood, must be looked on as exceptional.

1423. In the early stage, when the local symptoms are inactive, and marked pyrexia absent, the urine presents no seriously abnormal characters. When the pulmonary texture breaks up, with marked attendant pyrexia, the urine becomes small in quantity, of strong odor, deep urinous color, and of high, or rather high, specific gravity—1022 to 1028. If the system be impoverished by great loss of blood, or colliquative drain of any kind, the secretion becomes pale, watery, and of low gravity. As a rule, in the active disease, the uric acid ranges more or less above the average of health. Temporary increase of urea may occur; but even where waste of tissue is rapidly going on, and the patient takes nitrogenized food in good quantity, the daily average may range at

¹ For the facts themselves, *vide* Medical Times, July 6, 1850. The above results accord with M. Louis's general statement concerning the failure of sexual vigor in the male; they are totally at variance with an assumption of M. Grisolle that conception is rare in phthysical women. The total number of cases on which my inferences are founded is 91 of phthysical, 220 of non-phthysical persons.

² Edinb. Med. and Surg. Journal, 1838.

³ Quoted by Roubaud, de l'Impuissance, t. ii. p. 605.

about forty or fifty grains¹—Lehmann's average for a healthy male adult, feeding on mixed animal and vegetable diet, amounting to 32.5 grammes. Oil-globules are very rarely to be found in phthical urine; I have never detected them, except where the patient was taking cod-liver oil. Albumen sometimes appears passingly in minute quantities, either probably from indigestion or renal congestion. In a certain proportion of cases, all the symptoms of Bright's disease supervene. Simple pyelitis, with acid urine, deposit of pus, and of casts of the tubuli, with such amount only of albumen as is referable to the liquor puris present, occurs in rare instances; in yet rarer the evidences of tuberculous pyelitis, as proved after death, may be obtained during life.² The urine occasionally contains minute quantities of sugar,³ a fact interesting in connection with the well known tendency of glycohaemia (saccharine diabetes) to terminate in phthisis. On first thought, the existence of so readily oxidizable a product as sugar in the urine, would seem subversive of Liebig's hyperoxidation theory of phthisis; but the fact that in saccharine diabetes gum and alcohol are completely oxidized, while sugar is not, shows that an elective power of oxidizing some, and not all oxidizable materials, exists in the economy. Sugar may be, and commonly is, totally absent from the urine in the most advanced cases of phthisis.

1424. *Micturition* is of natural frequency; but female patients, even while yet young, are often tormented by slight involuntary discharge of urine during fits of coughing. The resistance of the sphincter vesicæ seems enfeebled, and mechanical forcible expulsion results.

1425. *Incidental Symptoms*.—The incidental symptoms of phthisis are the clinical expressions of its "secondary morbid changes." A case of phthisis may run its course without a single one of these ever occurring, or they may appear in various combinations and variable intensity. Sometimes these symptoms are so severe as to throw into the shade those of the pulmonary disease, and monopolize the attention both of patient and physician. The secondary anatomical changes causing them sometimes seem to accelerate,

¹ This would tend to show that the muscular destruction is relatively low. When the wasting process may fairly be supposed to fall specially on the actual sarcous substance, as in cases of irregular convulsive action, choreal or other, the amount of urea, as I long since showed (Clin. Lectures, "Lancet," January 27, 1849), may undergo very material increase.

² Wright, U. C. H., *Females*, vol. viii. p. 195. "Deposit in urine: pus-corpuses, oil-globules, amorphous granular organic matter, cells larger than blood disks, smaller than pus-cells, with granular contents, somewhat irregular and angular outline, and showing no nucleus under acetic acid." One of the pyramids, infiltrated with tubercle, had ulcerated into the renal pelvis, which contained 1 oz. of pus and tubercle-detritus.

³ Arthur, U. C. H., *Females*, vol. vi. p. 51; Feb. 1851. First stage of phthisis passing into second; specific gr. of urine = 1024; weight of patient = 8 st. 3 lbs. on Feb. 19; = 8 st. 8½ lbs. on March 20, when the sugar had disappeared, the patient having meanwhile taken oleum morrhuae in small doses.

sometimes on the contrary to retard, the advance of the primary affection; they may even themselves prove the real causes of death.

1426. *Pneumonia* frequently occurs in the course of tuberculous disease, or at its close. In the former case, it is either a mere local effect of the progress of tuberculization, or it may be extensive, and acquire almost the importance of an idiopathic attack of the disease. But even then it is rarely of serious augury: it is, singularly enough, less fatal than primary pneumonia. What I have observed on this head is in perfect accordance with the observations of M. Louis;—the mean duration of the inflammation, even, is less than when occurring in sound lungs. Some of the most marked examples of rapid resolution I have met with, were in phthisical persons.

M. Louis holds that pneumonia occurring at the closing periods of phthisis, is almost of necessity fatal. But, admitting this, it does not follow that there is any excess of special tendency in the phthisical to death by pneumonia. In point of fact, pneumonia—or conditions of the lung referred to that disease—is a tolerably common appearance in the lungs of persons cut off with all varieties of chronic maladies. The proportion of cases in phthisis is scarcely greater; and when so-called hepatization is found, it has not always been the actual cause of death [1466].

Pneumonia limited to the *anterior* portions of either apex, is in the great majority of cases, tuberculous—not invariably so, however. I have known pneumonic signs limited to the infra-clavicular region, independently of local tuberculous irritation, so far as the eventual disappearance of all vestige of morbid conditions at the apex can be accepted as proof of such independence.

1427. *Pleurisy* we have already met with in the dry and exudative forms, as an attendant on tubercle. Effusion occurs in a fair proportion of cases, and is always a most serious complication; complete recovery is singularly rare; and, in truth, effusion, single or double, not unfrequently hastens the fatal issue.

1428. *Bronchitis*, local or general, invariably occurs in the course of phthisis. The form most peculiar to the disease seems to be that limited to one apex or to one base.

1429. *Ulcerations of the epiglottis* give rise to great dysphagia, especially of liquids, which frequently return by the nostrils. There is fixed pain opposite the affected part. There is no serious swelling of the soft parts around larynx; and I have never met with any material discharge of blood from this source.

1430. Chronic *inflammatory changes in the larynx* are indicated by change in quality of the voice and cough, which grow hoarse, muffled, and cracked; and in proportion as ulceration destroys the chordæ vocales, the voice degenerates into a hoarse whisper. I have never observed absolute aphonia. Pain, stinging, pricking, or shooting, is more or less constant; and a distressing sensation of dryness is experienced. If the epiglottis be free, there is either

no dysphagia, or but very trifling difficulty in swallowing. The physical signs are rough, coarse respiration in the larynx, with sonorous, sibilant, or thin gurgling rhonchus, according to the dryness or moisture of the diseased surfaces.

1431. I know of no positive symptoms of *ulceration of the bronchi*; those of *chronic tracheitis* are obscure. Pain, heat, and dryness, with choking sensation above the sternal notch, are all that I have observed; and these symptoms may exist without tracheal ulcers, while ulcers may exist without them. Intense, so-called "tracheal dyspnoea," must be at the least singularly rare. I once saw perforation of the trachea occur with consequent subcutaneous emphysema.

1432. The symptoms of perforation of the pleura are elsewhere described [900]. The perforating process, instead of inducing pneumothorax in the ordinary way, may make a passage through the previously adherent costal and pulmonary pleuræ to the integuments of the thorax. Eventually the skin may be perforated: whether it gives way or not, subcutaneous emphysema may, or may not, ensue.

1433. Of abdominal incidental symptoms, those indicating *chronic peritonitis* are the most important. Enlargement of the abdomen, pain and tenderness under pressure, ascites, and tympanitic distension of the intestines, are the prominent symptoms. The ascites may rapidly disappear under treatment, while the tympanitis remains, and the outline of the intestines appears on the abdominal wall. Pain may be constant, or occur only at the moments flatus moves in the bowels. All control over escape of flatus may be lost; probably, by a consensual arrangement for the avoidance of pain, the effort, necessary for its retention, is omitted. Diarrhoea is present in the majority of cases, whether the bowel be ulcerated or not. The secondary affection may fall into a quiescent state; but if so, the pulmonary disease almost unfailingly grows more active.

1434. *Fatty disease of the liver*, not a common secondary change in this country, has no special symptom that I know of. It certainly does not give rise either to ascites or to jaundice. Probably it affects the properties of the feces. Its physical signs are those of simple enlargement of the organ.

1435. *Fistula in ano* is, according to my observation, more frequently met with, in males especially, than it has of late been the habit to believe.

1436. Serious as are the evils of ulcerations of the bowels, those of cicatrization may be more so; death may, in fact, be the result of accompanying contraction of the bowel. M. Louis reports a case, where the effects of intestinal stricture, the earliest indications of disturbed health, observed by the patient, proved fatal in about twenty-two months, having throughout kept the chest-symptoms in abeyance, though cavities existed in the lungs.

1437. Occasionally phthysical patients suffer from *tænia solium*; but the relationship seems purely accidental.

1438. Tuberculization of the vagina, uterus, Fallopian tubes and ovaries produces no distinctive symptom: the existence of a peculiar form of leucorrhœa may prove its sole evidence. When the vagina is coated with soft tuberculous deposit, this may readily be removed for examination, so as to place the nature of the affection beyond a doubt.

1439. Tubercle very rarely occurs in the male genital organs. It has been found coating the urethra of phthysical patients;¹ never in the structure of the penis, so far as I know. The prostate may be expected to be tuberculous in about one-thirteenth of fatal cases of phthisis²—in exceptional instances the vasa deferentia and vesiculæ seminales. In fourteen cases of prostatic tubercle, collected by Mr. H. Thompson,³ the same disease existed, at least, eleven times in the kidney, and six times in the testicle. The symptoms of prostatic tubercle are not distinguishable from those of simple enlargement—the tuberculous deposit may soften and “abscess” ensue.

Of the influence of tuberculization of the testicle on procreative activity, little is known but by conjecture.

1440. The existence of tubercle in the meninges discloses itself solely through inflammation of the textures in which it is seated.

1441. The symptoms of *tuberculous meningitis* in the adult scarcely bear the division into stages, so distinctly to be recognized in the child; still, as MM. Lediberder and Louis have admitted, three stages may occasionally be traced.

1442. (a) Cephalalgia, most commonly frontal, vomiting, alternate flushing and pallor of the face, followed by delirium, of the quiet kind, very rarely boisterous or violent, are commonly the earliest indications. At the same time the chest-symptoms abruptly improve or actually disappear—while both pulse and respiration slacken, and the skin becomes cool. I have now observed at least six cases of this affection in the adult, in which a peculiar form of mutism formed a striking, and sometimes the very first symptom. The patients, when questioned, looked steadily in the speaker's face for a few moments, and then, without making the slightest effort at speech, deliberately, but without any sign of petulance, turned their heads away. Whether this mutism be of intellectual, emotional, or muscular mechanism, it is difficult to determine; the first of the three seems the most probable. Photophobia and intolerance of sound rarely occur to any marked amount.

1443. (b) As the disease advances, stolid expression of countenance; somnolence alternating with wild delirium; obtuse, but not annulled, sensibility; partial, rarely hemiplegic, motor paralysis;

¹ Louis on Phthisis, Syd. Soc. ed., p. 118.

² *Idem*, p. 113.

³ The Enlarged Prostate, chap. xi.

and contraction of the pupils, set in. The pulse becomes very irregular. Partial clonic or tonic spasms, facial and other, even sharp convulsions, may occur—ushering in the final stage.

1444. (c) Persistent pallor of face, filmy conjunctivæ, dilated pupils; strabismus, distortion of the features; the body motionless, involuntary discharges, mark the further progress of the disease—somnia passes into fatal coma, or a fit of convulsions abruptly terminates existence.

1445. Such is the ordinary course of the affection; it may commence, however, without previous distinct warning, by severe convulsions.¹ Remission of the cerebral symptoms, simulating convalescence (though I have never seen it so marked in the adult as in the child), may occur towards the fatal issue, which generally takes place in from seven to eighteen days. Whether recovery be possible, will be considered under the head of Treatment.

1446. The development of tubercle in the actual substance of the encephalon or spinal cord of the phthisical adult is exceedingly rare. The symptoms are those of tumor in the nervous centre implicated. The only guide to the distinction of the *nature* of the tumor is to be found in the manifest presence of pulmonary tubercle. But this guide will fail sometimes; for tubercle may exist as a chronic development in the brain or cord of a non-phthisical adult (*vide* also ACUTE PHTHISIS).

1447. Fatal paraplegia of rapid course may be caused by a very small amount of tuberculous deposit.²

1448. Deafness, eventually traced to tuberculous destruction of the membrana tympani, has been noticed among the rarest class of symptoms.

1449. The sight of phthisical patients remains, as a rule, clear to the last; there is obviously no change in the condition of their blood, assimilable to that which in saturnism, scurvy, and Bright's disease, leads to impairment or complete loss of vision. Amaurosis in a phthisical patient would suggest, as a strong probability, the presence of a tuberculous mass within the cranium.

1450. Although popular opinion somewhat exaggerates both the frequency, and the amount, of the glistening brilliancy of the tissues of the eyeball, there is no doubt of its real existence in a certain share of phthisical persons. On what the peculiarity depends is uncertain; but, when well defined, it is not without diagnostic significance.

1451. The period of the primary affection, at which secondary morbid changes and their clinical effects become obvious, varies widely. The appearance of some one or more of the group may

¹ Reynolds (*Diagnosis of Dis. of the Brain*, p. 79) has noted an instance of such form of commencement.

² For instance, by two tubercles, one as large as a small pea, the other as a pin's head, in the gray substance of one-half of the cord in the mid-dorsal region. (*Hewitson, U. C. H., Females*, vol. xvi. p. 63.)

be almost simultaneous with the outbreak of the essential disease; or life may be quasi-extinct, at the moment when secondary phenomena occur for the first time—simply, as it were, to precipitate the fatal issue. This statement holds good of each secondary state in particular. Thus perforation of the pleura may actually afford the first unmistakable evidence of pulmonary disease, or (the patient having been tuberculous for years) precede his death but by a few hours. Laryngeal symptoms may at the very outset take the lead in importance, mask the pulmonary sufferings, and even modify the thoracic physical signs; or the voice may remain firm to the closing hour.¹

1452. *Course*.—The mode of progression, or course of phthisis, varies exceedingly in different cases. Five principal varieties may be established: *steadily progressive, remittent, intermittent, retrogressive, and latent*. Of these the last only will be considered here; the *retrogressive*, the most interesting of the group, will, by and by, be examined apart.

1453. *Latent course*.—Chronic phthisis may, especially in females, for a portion or for the entire of its course, whether this be of medium or considerable duration, remain symptomatically latent. That is, tubercles may exist in the lungs, and slowly work out their ill influences on the organism, through secondary blood-changes, without awakening attention by any of their ordinary local thoracic symptoms, such as cough, expectoration, pain in the chest, and dyspnoeal sensations.

1454. Four classes of cases may be met with referable to this head. (a) To the first belong instances in which violent hæmoptysis, or perforation of the pleura, are apparently the initial symptoms of the disease: hæmoptysis by no means rarely, perforation very seldom, bears this relationship in point of time to the other effects of the disease. (b) To the second belong cases of slow course in which one of the secondary morbid states, such as chronic peritonitis, or ulcerative diarrhœa, masks or really suspends the progress of primary mischief. (c) In a third category we find cases, where an individual is generally out of health, without suffering from local or general symptoms of any severity. (d) In a fourth rank instances where very prominent symptoms exist, such as emaciation, fever, loss of appetite and sleep, with relaxation of the bowels without apparent cause—none of them of obvious pectoral origin.

1455. The local latency of tuberculous disease in some of these cases seems explicable on the principle of *Dubios morbis simul obortis, vehementior obscurat alterum*. But in instances where none of the secondary morbid states exist, the fact baffles explanation.

¹ It is tolerably well known that within the last few years we have had a distinguished contralto and an excellent soprano still singing at Her Majesty's Theatre, while the excavating process advanced in their lungs.

The great points for the observer to bear in mind are, that, while such latency is not only a real, but a frequent, clinical fact, physical signs alone can disclose the true state of things. A single tap above the clavicle will give the ready clue to much that has hitherto proved utterly mysterious. Let him not be diverted from his belief by the assurance of patients that they have never coughed—the assurance will occasionally be given by persons who, at the moment they give it, have *cavities in their lungs*. But unfortunately cases every now and then arise, in which the physical signs themselves want the necessary distinctiveness to justify the diagnosis of tubercle: under these circumstances the expectoration may be applied to in aid—the spirometer can merely show more precisely, what is on other grounds indubitable, that respiration is shallow and non-expansive.

1456. Under circumstances favorable to the general health, all the outward evidences of notable improvement may arise, at the very moment the local disease is advancing at a rapid pace. This is one form of effect sometimes produced by change of climate.

1457. The *modes of relationship of phthisis to other diseases*, its attractions and affinities on the one hand, its repulsions and antagonisms on the other, cannot be wholly passed over. An attempt is provisionally made in the following table to express the chief of these relationships. It must be remembered there is no absolute antagonism, and no absolute attraction, in *any* case. In order to avoid needless subdivisions, the table is so constructed that phthisis must be considered to stand, in some instances, as antecedent, in certain others as consequent, in the order of antagonism: that is, phthisis prevents the development of some of the morbid states named, while some of these *per contra* play the same obstructive part in regard of phthisis.

		ACTIVE PHTHISIS.	
		<i>More or less antagonistic diseases.</i>	<i>More or less attractive diseases.</i>
A.	General diseases .	{ Variola ? Typhoid fever ? Cholera Asiatica. Yellow fever. Ague.	{ Vaccinia ? Typhoid fever ? Influenza.
B.	Diathetic diseases. {	{	{
	I. Of blood origin	{ Carbonaceous disease [647]. Cyanæmia. Leuco hæmia ? Rickets [1414]. Calculous diathesis in general. Gout. Cancer [1612]. Diathetic skin diseases, <i>e. g.</i> , chronic pemphigus. Chronic alcoholism ?	{ Leuco hæmia ? Spanæmia ? Glyco hæmia [1423]. Fatty diathesis. Ulcerative diathesis. Syphilitic cachexia. "Bright's Disease."
	II. Of nervous origin	{ Hysteria.	

C. Local diseases . .	{	Emphysema [967].	
		Pulmonary cirrhosis [1245].	
		Pulmonary apoplexy [1278].	Pulmonary inflammation.
		Active organic cardiac disease [1296].	Insanity.
		Angina pectoris.	
		Aortic aneurism.	

1458. The majority of the relationships thus tabulated are individually touched upon in various parts of this work; there are a few which require special notice here.

1459. (A) MM. Billiet and Barthez maintain that smallpox and tubercle repel each other, and that vaccinated children are more disposed, than those non-vaccinated, to tubercle. They give the subjoined table:—

Of 208 vaccinated children—	Of 95 non-vaccinated—
138 died tuberculous,	30 died tuberculous,
70 “ non-tuberculous.	65 “ non-tuberculous.

These facts are too few in number to command assent to the grave conclusion they directly supply. On the other hand, the attempt to prove from the Bills of Mortality of a century ago, that smallpox is an active cause of pulmonary tuberculization, seems to me to indicate an amount of faith in the diagnostic precision of our forefathers, scarcely warranted either by direct evidence, or by inference from a fair estimate of the acquirements of observers of the present day.

1460. The rarity of active tubercle in the victims of Asiatic cholera and of yellow fever, flows obviously from post-mortem examinations. Typhoid fever rarely occurs in the actively phthisical; but destruction of lung, possibly tuberculous, seems excited by that species of fever [1323].

1461. Although exceptional facts are now and then encountered, observation on a broad basis, in various parts of the world, amply confirms the original discovery of Wells, as to the antagonism of ague and phthisis. Malaria appears to generate a condition of blood, even when the poison fails to induce any of its ordinary effects, almost absolutely incompatible with vigor of the tuberculous diathesis. Removal of persons already phthisical to marshy districts frequently proves favorable, and sometimes even arrests the pulmonary disease, without of necessity afflicting upon them any of the specific evils of paludal poison [1821]. Now, if this be true, inasmuch as marshy districts carry with them one condition favorable to the development of tubercle—namely, proximity to the level of the sea—it would follow the antagonistic influence of the actual air, intermixed with paludal exhalations, must be very strong.

1461*. (B) What precise part saturation of the system with alcohol plays in regard of the liability to pulmonary tubercle, cannot

be said to be as yet satisfactorily determined. Drs. Jackson¹ and Peters² infer that chronic alcoholism exercises a prophylactic influence; the former observer found tubercle in the pulmonary tissue of only five among 35 persons known to have been intemperate in life; the latter in the post-mortem examination of the bodies of "nearly 70 persons," dying suddenly or found dead in the streets, and who had been known drinkers, detected no single instance of actively softening tubercle, but some samples of cretaceous tubercle, and "cicatrices" with crude tubercle. The apparent bearing of these facts undergoes some modification under the sharply critical scrutiny of Dr. John Bell;³ but I confess the documents, cited by this laborious inquirer in turn, fail in my apprehension to wholly justify the last clause of the following, his own, inference—"It seems almost conclusive that the use of alcohol not only has no power to defend those predisposed to phthisis from its attacks, but would, with little doubt, change the predisposition into active disease." It seems to me that, in arguing the question, persons, placed in all other respects under favorable hygienic conditions, should be selected—otherwise the point really examined comes to be, not whether alcoholism directly antagonizes tuberculization alone, but whether it directly antagonizes that tuberculization, and indirectly negatives the activity of all other anti-hygienic circumstances, the influence whereof in generating tubercle is matter of accepted experience.

Now it would appear that publicans, who unquestionably as a class largely consume their own vendibles, are *cæteris paribus* less destroyed by phthisis than persons in various other walks of life [1544].

Still, whatever be the interest in a scientific point of view of determining this question, it is perfectly clear the evidence of the preventive powers of alcohol should be overwhelmingly strong, to warrant the physician in deliberately prescribing an alcoholized regimen. Admitting even, *argumenti gratiâ*, that a life might occasionally be saved to the state by the steady consumption of spirits, how lightly would such gain counterbalance the weighty evil of giving fresh encouragement to the employment of intoxicating drinks,—of impressing the stamp of medical sanction, under the cover of a plausible motive, on the use of that agent which has hitherto proved the profoundest bane against which civilization has had to struggle.

1462. The relationships of leucocythæmia and tuberculization have not, that I am aware of, been made the subject of investigation. *A priori* it would appear unlikely that a crisis of the blood, so markedly defined, as the leucohæmic, should coexist with the

¹ New England Quarterly Journal, 1843.

² New York Journal of Medicine, 1844.

³ American Journal of Medical Science, Oct. 1859.

conditions of that fluid appertaining to the tuberculous diathesis. The cases collected in Dr. Bennett's book,¹ give very unsatisfactory information on the point,—either because post-mortem examination was not made by their authors, or because the state of the lungs is scarcely referred to. As far as my own experience goes, it would depose to the rarity of coexistence of the two affections; but I have seen a slight excess of white cells, with enlargement of the spleen, in active chronic phthisis;² and *vice versa*, have known the life of a leucohæmic patient brought to a close by acute pulmonary tuberculization [1596].

1462*. Hysteria is, on the whole, repulsive of phthisis as a coexistence,—that is, if a woman with hysteria become genuinely phthisical, the nervous affection falls into abeyance. On the occasional simulation of phthisis by hysterical cough, chest pain, emaciation and even night-perspiration, it seems unnecessary to dwell: the physical signs will commonly, at least after the lapse of a short while, settle the diagnosis.

1463. (C) The insane frequently die phthisical. Of 4141 specified causes of death in lunatics, 525 were referred to phthisis,—no other single disease furnishing so large a quota of deaths.³

1464. I reserve for future fuller consideration the question of the alleged antagonism between tuberculization and cyanæmia (or, incorrectly so called, venosity of the blood),—as well as all affections of the heart entailing venous stasis and feeble oxygenation. There is abundant evidence to show that the alleged incompatibility has been seriously exaggerated.⁴

1465. *Duration*.—The mean duration of phthisis has been calculated by estimable observers from the results of fatal hospital practice,—and is approximatively fixed at 23.5 months.⁵ The strong probabilities are—if indeed this be not certain—that in the better ranks of life the disease runs a very sensibly slower course. But, in point of fact, concerning the average duration of a complaint which destroys life at periods so various—which kills in twenty days, or leaves its eventual victim yet living at the end of five-and-twenty years—little of practical utility can be established. Of 307 cases observed by M. Louis, the following arrangement may be made:—

4 died within 1 month.	98 died within 6 months.
15 " 2 months.	160 " 9 "
26 " 3 "	264 " 24 "

Hence, at the end of two years, 43 of 307 patients only survive; so that at the time of seizure in any given case the chances are

¹ On Leucocythæmia. Edinb., 1852.

² Pierce, U. C. H., Females, vol. xvi. p. 19.

³ Robinson, in Ranking's Retrospect, vol. xvii. p. 24.

⁴ Clin. Lecture on Tricuspid Regurgitation, "Med. Times," Feb. 14, 1857.

⁵ In this estimate, the rare cases in which the disease terminates by suspension or practical cure, are of necessity excluded.

about as 6 : 1 that death will ensue before the commencement of the third year ; the chances are only as 2 : 1 in favor of passing the sixth month ; while those of surviving the ninth are against the sufferers in the ratio of 160 : 147, or closely as 1.09 : 1. These estimates refer to the period of first declaration of symptoms, and are derived from observation in hospitals. They refer, also, to past experience : there is fair reason to believe that the introduction of cod-liver oil into practice may have improved the chances of phthisical life. That the ordinary span of tuberculous existence ranges higher in this country than in France I am unable to assert with positiveness, but I am inclined to think it does.

1466. Season does not exercise the kind of influence which might be anticipated in shortening the career of the consumptive sufferer. It may be calculated from the Registrar General's Twelfth Report that the mortality in London during the five years 1845-1849, averaged in the quarter ending March, 1774, in that ending June, 1762, in that ending September, 1593, in that ending December, 1573. So that the mean deaths in the six coldest months rate at 3347, in the six warmest, 3355. Compare these results with those concerning pneumonia [1138] ! From the contrast flows indirect evidence of the non-destructiveness of pneumonia in pulmonary phthisis [1426].

1467. *Mode of death.*—The modes of death in phthisis, singularly various, may be arranged as follows : (A) Death of normal mechanism, through gradually increasing asthenia ; (B) Death of gradually asthenic type in the main, but abruptly hastened by secondary lesions or intercurrent complications ; (C) Sudden and unexpected death.

1468. (A) The gradual asthenic death of phthisis is brought about by exhausting discharges, waste of nutrient fluids, imperfect hæmatisation, insomnia, constant wearing suffering of various kinds, and, often in spite of free consumption of food, failing tissue-reparation.

1469. (B) In this category appear instances of gradual extinction brought to a more or less rapid close by : ulceration of the bowels and profuse diarrhœa ; obstruction of the intestine by cicatrization of ulcers ; chronic peritonitis ; pleurisy with effusion ; pneumonia ; perforation of the pleura ; pain, irritation, and dysphagia from epiglottic and laryngeal disease ; perforation of the trachea and subcutaneous emphysema ; hæmoptysis indirectly by anæmia ; Bright's disease ; tuberculous meningitis ; and simple or tuberculous pericarditis.

1470. (C) When death takes place suddenly and unexpectedly, the occurrence may, as M. Louis has well distinguished, prove explicable, or inexplicable either before life is extinct, or even by the aid of post-mortem examination. In the category of explicable cases, appear sudden deaths by hæmoptysis, either from the amount of blood actually lost, or from asphyxiating obstruction of the air-tubes ; by perforation of the pleura ; by extensive sudden pneumo-

nia of adynamic character; or by œdema of the glottis. In the second category, the fatal issue has been hypothetically referred to "fatigue of the heart," or to general reduction of the consistence of the brain. But the truth is, the clue to these mysterious deaths has not yet been found; I have examined more than one case, where each of the hypotheses proved equally untenable.

1471. *Causes.*—In a work designed to be especially clinical, an inquiry into the general ætiology of phthisis would be out of place. There are, however, some causes, either real or alleged, of the disease, so closely connected with its management, that the practitioner should have, as far as possible, a clear notion concerning them. Much interesting information on the general subject is to be found in Mr. Ansell's valuable work on "Tuberculosis."

1472. (A) Is phthisis a virus-disease? Do its morbid processes generate a specific poison capable of effective transmission from organism to organism through inoculation, contact, or infection?

1473. The inoculation of scrofulous matter has repeatedly been tried without any specific result. Were the identity of scrofulous and tuberculous deposit universally conceded, the failure of such inoculation would by a double involution prove the non-existence of transmission by infection, in the case of phthisis.

1474. Galen believed it dangerous to pass an entire day in the company of a phthisical person; the timidity of Morgagni in regard of even the phthisical corpse has been recorded by himself. At the present day, in the south of Europe, the bedclothes of a defunct patient are destroyed, and in the north, too, a belief in contagion exists; while in France and in this country philosophic incredulity almost universally prevails.

I find the deaths by phthisis of several physicians in France, known to have practised much among the consumptive (Bayle, Laennec, Dance, Delaberge), suggestively ascribed to infection;¹ but the multitudes similarly engaged, who have shown no such symptoms, are forgotten. Curiously enough, of the first three Clinical Assistants I had at Brompton, two died of phthisis, and the third left the establishment with slight hæmoptysis, cough, and chest-uneasiness. The latter is now in perfect health; one of the former had clearly been affected before he came to the hospital. No similar case, as far as I am aware, has occurred during the fifteen years that have elapsed since the opening of the hospital.

But the strongest argument contagionists adduce is founded on the frequent death by phthisis of the husband of a wife herself cut off by the disease or *vice versâ*. The direct aspiration of organic particles into the lungs is supposed to transmit the disease. That such deaths do occur is indubitable: but in some instances, careful inquiry shows the putative victim of infection was already tuber-

¹ Péreyra, Phthisis, p. 81.

culous at the time of marriage, or that he sprang of a more or less thoroughly phthisical stock. The converse cases, long since insisted on by Portal, where a husband has had two, or even three wives successively destroyed by phthisis, himself wholly escaping, are too frequently lost sight of.

Again, the circumstances which bring on the disease in one predisposed person are likely enough to bring it on in another; and, it must be remembered, husband and wife are in a great measure exposed to anti-hygienic influences of the same classes and of the same activity.

There is, besides, the statistical argument, which has never, that I am aware of, been seriously examined.¹ What are the chances that a given individual, either actually phthisical, or manifestly fated to become so, will unite with a consort similarly conditioned? The answer will vary with locality, walk of life, and, above all, the age of the contracting persons; but the chances would, I feel positive, be considerable, if the union took place within the period of existence at which tubercle is most common. Probably one in seven or eight of young married men has a wife who will one day die of phthisis, according to an estimate made by Dr. John Beddoe. Grant, then, that the male is tuberculous, and I apprehend we have a calculable frequency of this form of double phthisical death quite as high as any that has been actually observed. If this be actually so, the influence of contagion remains anything but proven.

1475. But even though the reality of infection be logically unproved, it is wise to segregate the actively phthisical as far as possible; the inspiration by the healthy of the exhalations of the diseased cannot fail to be positively, though not *specifically*, injurious.

1476. (B) *Hereditary influence*.—Some years since I made an attempt to determine the frequency of hereditary transmission of phthisis, by comparing two series of persons, the one phthisical (162 in number), the other non-phthisical (284 in number), and was enabled to draw a certain number of conclusions, some of which may be here set down.² The first general result was, that about 26 per 100 of my tuberculous patients came of a father or mother, or of both parents, similarly diseased. But does this result prove, even in this limited proportion, the reality of *hereditary influence* in the production of the disease? "I think not. It shows that of a given generation (*b*) about 26 per 100 come under certain ascertainable conditions of a tuberculous parent (generation *a*). But this ratio of 26 per 100 might be, and probably is, no higher than that of the tuberculized portion of the population generally. In other words, it might be predicated of any class of individuals taken in hospitals (and of whose history nothing is known, the non-phthisical and the phthisical mixed therefore) that about 26 per 100 of the generation

¹ See, however, Young on Consumptive Diseases, p. 46.

² British and For. Med. Chir. Rev., p. 235, January, 1849.

from which they sprang were tuberculous. Hence there would appear to be nothing in the mere fact of 26 per 100 of my patients having had a tuberculous parent to prove that their disease arose under hereditary influence. Hereditary transmission would be rigidly demonstrated, were the 26 per 100 furnished, generation after generation, by lineal descendants of an original tuberculized stock. But I need scarcely observe that the existence of such lineal transmission has not only not been demonstrated, but not even suspected, to prevail.

"The question, it occurs to me, may be examined under another aspect. The ages of the tuberculous portions of any two succeeding generations (*a*) and (*b*) are (it is legitimately to be assumed) the same. Now we learn, first, from a previous table, that 23 only of 629 phthysical persons in a given generation (*a*) marry under 25 years of age; secondly, in the next generation (*b*) we find, according to the same table, that of 629 phthysical individuals, there will be 263 under that age; now, thirdly, 240 of these 263 do not marry,¹ and hence do not propagate phthisis: yet in the next, or third, generation (*c*), the total proportional number of phthysical persons to the population will be just the same as before,—and consequently there has sprung up in this generation (*c*) an equal amount of phthisis from a less amount of phthysical parentage. Hence either phthysical stock has a great tendency to multiply, or much phthisis is, in each generation, non-hereditary. Now the latter alternative is the correct one; no proof has ever been given that such stock is specially prolific."²

1477. The final conclusion flowing from this analysis of the family history of 446 persons is "*that phthisis in the adult hospital population of this country is, to a slight amount only, a disease demonstrably derived from parents. It is possible (nay, indeed, probable, for, in adults having a parental taint, the outbreak of the disease occurs a mean period of two years and nine months earlier than in those free from such taint) that, were investigation extended to infancy, childhood, and youth, the ratio of cases of parental taint among the phthysical would be proportionally greater than it proves where inquiry is limited to adults. But, on the other hand, there is no single valid reason for supposing, prior to actual experience, that the increase in that ratio would be of more than trifling amount. Again, whether the law differs in the adult portion of the middle and upper classes of society from that holding in the humbler classes (those supplying hospitals) can only be positively determined by an analysis of family histories collected among the former classes; meanwhile it appears justifiable to doubt the reality of any such difference.*"³

¹ A small correction should be made for illegitimate children.

² I have since examined this question numerically, as mentioned in a previous paragraph [1420]; and the result shows that some slight allowance must be made for extra fertility of the phthysical female.

³ Report, loc. cit. in Brit. and For. Med. Rev., p. 254.

1478. It further appeared that females were about 14 per 100 more frequently of tuberculous origin than males; and that a tainted parent is more likely to have children of the same, than of the opposite, sex similarly affected.

1479. (c) *Influence of stays*.—Although it is essential that females, already tuberculized, allow as free play as possible to the lungs, I do not by any means accede to the doctrine, that the use of stays will produce pulmonary consumption. Whether this article of dress shall or shall not inflict mischief on the lungs will probably, as I have elsewhere said, “altogether depend on the amount of constriction. If this be simply sufficient to transfer the maximum chest-play from the base to the apex of the thorax (or, rather, to magnify somewhat the breathing-difference superiorly and inferiorly natural to the female), I cannot very easily descry what evil is to come to the lungs, especially if the stays be cut bias, and be formed of yielding material. If, on the other hand, rigid wood-work or metal plates be used to stiffen stays, of which the main material is hard and cut straight, then it is conceivable, *à priori*, that serious evil may come to the lungs. Remember, however, the wide difference in the statical and dynamic mechanism of the thorax and abdomen, and you will feel at once that the fact of serious compression of the liver being produced by tight lacing, gives no shadow of proof that the pulmonary organs must suffer to similar amount, or even in similar fashion. I know not, as matter of clinical experience, what the mode of disturbance is which constriction of the base of the chest actually and demonstrably entails on pulmonary action or pulmonary structure. Still, such ignorance as this is not commonly avowed; on the contrary, the mass of information on the point is held to be positive and of ominous, most ominous, quality. Dr. Copland, for instance, writes, in a recent and otherwise admirable article, that the use of stiff stays produces ‘ultimately a morbid state of the blood, *tubercular deposition, especially in the lungs, hæmoptysis, anæmia, &c.*’ But, it may be fearlessly asserted, no single proof exists that the abuse of stays produces the specific disease tubercle. Dr. Farr, it is true, speaks thus:—‘Thirty-one thousand and ninety English women died in one year of the incurable malady, consumption. Will not this impressive fact induce persons of rank and influence to set their countrywomen right in the article of dress, and lead them to abandon a practice which disfigures the body, strangles the chest, produces nervous or other disorders, and has an *unquestionable tendency to implant an incurable hectic malady in the frame?*’¹ But Dr. Farr omits to compare the relative mortality of the sexes in elucidating this question. Look at this table giving the mortality from consumption in three years to a million living of each sex in England and Wales:—

¹ Letter to the Registrar-General, 1840, p. 73.

YEARS.	Deaths from Phthisis to 1,000,000 living of each Sex.	
	Males.	Females.
1837	3,771	4,155
1838	3,783	4,077
1839	3,722	4,015

“What evidence does this table give of the dependence of tuberculization on stays? It simply shows that the phthisical mortality of females is somewhere about 300 per 1,000,000 living greater than that of males. Granting that the female excess is really due to stays, does its amount justify Dr. Farr’s strong phrases? I think not. But let me assure you, no particle of evidence exists that the moderate excess of female destruction is really traceable to the abuse of stays. Not a few arguments might be adduced, tending to prove their absolute innocence. Thus in France, as is well known, females rarely use stays until the afternoon; in England, women tighten themselves up the moment they rise in the morning; yet the excess of female phthisical mortality over the male is greater in France than in this country. Again, in certain parts of Europe the men tighten themselves at the base of the chest, so as to produce a tolerably fair image of the figure of a wasp, and yet they do not seem thereby to increase their relative quota of phthisical mortality. Further, it will be conceded that tight-lacing is, as a rule, pushed to greater lengths among metropolitan than among rural female populations; so that, if the influence assigned to stays be other than a figment of the brain, the plus phthisical destruction of women over males ought to be relatively greater in London than in the country. Now, such evidence as I can get at tells in precisely the contrary direction. Thus, examine these figures:—¹

KENT COUNTY.

	Males.	Females.
Population in 1841	232,228	236,885
Absolute deaths from Phthisis	726	778
Deaths from Phthisis for 1,000,000 living	3,126	3,242

METROPOLIS.

YEAR.	Males.	Females.
Population in 1838	913,077	971,767
Absolute deaths from Phthisis	4,057	3,630
Deaths from Phthisis for 1,000,000 living	4,443	3,735

So that, actually, where, by fair inference, the amount of stay-constriction is greatest, and its prevalence widest (in the metropolis), females are destroyed by phthisis to a less degree than males; whereas, amid a country population, which we may honestly assume to undergo a less mean amount of tightening, females die consumptive in notably larger proportion than males.

“No, gentlemen; if the abuse of stays produce consumption, its

¹ Vide Regist. Rep., vol. vii.

power to do so most indubitably remains to be proved; and while the laws of an enlightened pathology point to the excessive improbability of an essentially diathetic disease springing from a mechanical cause, I entreat you not to adopt the popular creed that 'stays cause consumption,' unless on direct and unimpeachable logical evidence. There is quite enough in the demonstrable evils entailed by tight-lacing to justify you in warring against the abuse; you have no need to support your arguments by the unfair appeal to an imaginary mischief."

1479*. (D) A few facts of practical significance concerning the influence of climate on the development of phthisis may here be mentioned. (a), No climatic conditions, which we are acquainted with, render phthisis an impossible disease. (b), The most strongly antagonistic influence yet ascertained seems to be exercised by the climatic conditions of extreme altitudes. Fuchs has collected an extensive series of data to show that in Northern Europe consumption is most prevalent on the level of the sea, and decreases with increase of elevation to a certain point.¹ And a strong body of evidence has been adduced in his remarkable work by Mühry,² tending to establish the conclusion that phthisis diminishes very much in the ratio of vertical elevation, until it finally disappears. And although exceptional instances occur (for example, phthisis appears to be common in Madrid, situated more than 2000 feet above the sea-level), it seems impossible to question the fact that an antagonistic influence in regard of pulmonary tuberculization is exercised by the combined conditions of the atmosphere of lofty regions. The extra development of the lungs, normally occurring at such altitudes [1031], seems to afford a clue to the rationale of the antagonism; more especially as tuberculous deposition is by no means very uncommon in certain other organs of natives of the highest habitable regions. (c), Phthisis occurs in every zone. (d), In certain spots of the torrid zone it is peculiarly prevalent—as thoroughly endemic as in the British Isles. (e), Absolute cold or absolute heat, combined with in each case excess of moisture, is less favorable to its development than variability in these qualities, (f), Yet, in Iceland, where such variability holds to a maximum degree, the disease is singularly rare [1522 note]. And this is but a single illustration of the general truth that there exists, in each of the earth's zones, spots favored by a more or less complete immunity from phthisis, the exemption of which is inexplicable on any acknowledged meteorological principle. Thus, if we attempt to explain the rarity of phthisis in Algiers and in Egypt and Syria by the heat and dryness of the air combined, we are met by the difficulty that the East Indies enjoy a somewhat similar exemption in spite of the marked moisture of their heated atmosphere. And

¹ Quoted by K. Johnson, Physical Atlas.

² Klimatologische Untersuchungen, 1858; or Brit. and For. Med. Chir. Rev., Jan. 1859.

again, Nubia and Chili (but especially the former) are as dry and as warm as Egypt, yet in them phthisis prevails to a considerable degree. (g), Islands and coast districts are said to be favorable to the development of phthisis—yet observe, that the natives of the Azores, Madeira, Iceland, the Feroe Islands, Marstrand on the coast of Sweden, spots climatically various as their sites, suffer very slightly from the disease.

And hence, obviously, although the efficacy of climatic influence in generating phthisis has taken its place among accepted truths, there exists an inscrutable agency beyond, and likely long to remain unrevealed, materially more potent than itself, and capable of completely dominating its manifestations on the human organism.

1480. *Prognosis*.—The first general guide to prognosis is supplied by the facts ascertained concerning the duration of the disease; although the limits be excessively wide, the mean results are fairly applicable in the mass of cases [1465]. The proportion of actual recoveries has hitherto proved so small that they may be ignored.

1481. The disease is commonly held to run a more rapid course in the young than in those of advanced adult years. My results at Brompton tended to show that in all probability (though individual exceptions may occur) age exercises less influence on the result of the disease, and on its amenableness to treatment, than is usually supposed. I may mention the mean age in 9 cases of suspension of the disease was 21.12 years; in 42 cases of death 29.96 years.¹

1482. Complete removal of symptoms more frequently occurred in my male than female patients, in the ratio of 10.00 : 3.69. But, on the other hand, the general results proved slightly more favorable in females than in males.²

1483. Phthisis, if hereditary, commonly runs a more rapid course than that of strictly acquired origin; to this rule I have, however, seen some well-defined exceptions.

1483*. I found, at Brompton, that the chances were “very evidently more favorable for those who had wholly pursued their trades out of, than those who had labored within, doors.”³

1484. Activity of local progress, whether this be shown by rapid passages within a limited area to the third stage, or by quick encroachment of the tuberculizing process on a large mass of lung, is of evil augury.

1485. The presence of antagonizing diseases, while it interferes with the process of genuine tuberculous extinction of the individual, will hasten or retard actual death according to the proper nature of those diseases.

1486. Particular secondary lesions, or even symptoms, may aid us in estimating the chances of life. Chronic peritonitis is almost unfailingly fatal, and pretty quickly so; the tortures of laryngeal

¹ Report Brit. and For. Med. Chir. Rev., Jan. 1849, p. 233.

² *Idem*, p. 229.

³ *Idem*, p. 232.

and epiglottic disease habitually reduce phthisical existence notably below the average. Perforation of the pleura is commonly, but by no means of necessity [914], rapidly mortal.

1487. The prognosis of tuberculous hæmoptysis is a subject of great interest. Hæmoptysis may kill *directly* or *indirectly*; but my analyzed series of 131 cases of phthisis furnishes but two examples of such modes of death. In one, death was direct, but from asphyxia, not loss of blood: the trachea and bronchi, as far as traceable, were plugged with coagula. In the other, death occurred from exhaustion, five days after the hemorrhage. In these, and some other fatal cases that have fallen within my observation in private practice, the patients have invariably been *males*; in this point of view, as well as in certain others [1380], hæmoptysis is a more serious event in men than in women. A first hemorrhage having been severe, it is unlikely that a subsequent one will kill *directly*; for it is not often that a recurring hæmoptysis is more severe than a first severe one, granting that they do not follow so closely upon each other as to appear a mere continuation of one and the same attack. One of the cases above referred to constituted an exception to this rule. It appears from the cases I have examined, that hæmoptysis is frequent in proportion to the duration of the primary disease; if so, the converse of the proposition cannot be evaded; and we are forced to conclude that *frequently-recurring hæmoptysis does not reduce the mean duration of life, after seizure with tuberculous symptoms, in any given mass of cases.* It is not repugnant to reason to admit, then, that in a certain number of instances hemorrhage from the lungs may act as a local therapeutical agent. No doubt the disease sometimes runs on more rapidly after an attack of hæmoptysis; but I cannot help regarding the two conditions as mere coincidences.

1488. The ash-gray purulent condition of sputa [1374] betokens a not far distant close of the struggle, if it occur in a patient under treatment; when found in sufferers, who have greatly neglected themselves up to the time of seeking advice, it is generally rapidly modified by medical care.

1489. Careful watching of the frequency and phthisical character of the pulse [1391], of the pyrexia, and amount of general constitutional suffering, will in the mass of cases deceive less often than too slavish attention to the sole physical signs.

1490. But whatever be the amount of help gained through these various elements of prognosis, the young practitioner must remember, there is a certain condition of general asthenia, in which, though the local suffering be slight and the digestive functions active and fairly reparative, life cannot be insured an hour; nor *per contra* is there any combination of circumstances, clearly apertaining to the disease itself, from which at least temporary recovery may not be established.

1491. The anatomical and physical conditions attending such recovery call for separate description.

(b.)—RETROGRESSIVE CHRONIC CONSUMPTION.

1492. The removal of tubercle from the lungs is conceivable in three different ways: (a), by simple absorption; (b), by absorption combined with so-called "saline transformation;" and (c), by elimination.

1493. (a) With respect to the possibility of simple absorption, the evidence is hardly convincing; the arguments in favor of the occurrence, too long for reproduction here, may be found in the art. *Adventitious Products*.¹ (b) Of the molecular removal by absorption of the animal ingredients of tubercle, while saline matters are deposited in their room, no doubt can be entertained: the gradual change of the tuberculous material may be traced from a condition of mere desiccation, with greasiness to the feel, to that of osteopetrous substance. The production of this change is generally associated with the presence of simple exudation, which hardens into induration-matter or fibroid tissue, and by its contractile force, aids the absorptive process. The saline materials and the induration-matter may eventually be themselves absorbed, puckering of the parenchyma, at a spot where obliterated bronchial tubes and bloodvessels converge, alone remaining as the indelible evidence of the past mischief. These conditions have not unoften been erroneously ascribed to the cicatrization of cavities.

1494. (c) Removal of tubercle by elimination, with loss of texture, having been effected in the progressive disease in the manner described [1341], what comes of the resultant excavations? First, they may increase in size by communication with fresh cavities formed by tubercle softening around. Secondly they may become lined with a pseudo-mucous membrane, and cease *per se* to give serious annoyance. Thirdly, if on a small scale, excavations may probably cohere by their opposed walls. Of the cicatrization of a large excavation, I have in vain looked for an example, and without meaning to assert the sheer impossibility of the event, I must maintain it to rank with the *mirabilia* of morbid anatomy.

1895. In brief, the essential anatomical condition accompanying the suspension or retrogression of phthisis may be set down as follows:—

Tuberculization Arrested in:

First Stage.—Amount of deposit originally small; ceases to take place; tubercle remains as such; collapse of cells and lobules; obstructed bronchial tubes on minute scale, local atrophy of parenchyma; local emphysema.

Tuberculization Retrogressive in:

First Stage.—Absorption of tubercle, previously calcified, or sometimes, in all probability, independently of any such change; much bronchial obstruction; local collapse and atrophy; local emphysema.

¹ *Cyclop. of Anat. and Physiol.*, vol. iii. p. 108.

Second Stage.—Reduced bulk of affected part by contraction of induration-matter, hardening, puckering of surface and substance; collapse and atrophy of parenchyma; emphysema.

Third Stage.—Cavities of various size continue to secrete pus or mucus; bronchial tubes closed beyond them; collapse of communicating tissue; the cavities are lined with a pseudo-mucous membrane.

Second Stage.—Induration, contraction, collapse, atrophy of parenchyma; union of broken surfaces by exudation-matter, producing linear or irregularly puckered cicatrices, provided the breakages of lung-substance have been on a very small scale.

Third Stage.—Great reduction of bulk of excavated portion of lung, substance of which, where not excavated, is more or less replaced by induration-matter; more or less deep indentations of pulmonary surface by contracting fibro-plastic-matter in pleura; more or less marked reduction of area of cavities, but doubtful if actual closure occur, where the original excavation has been on a large scale.

1496. Local suspension or retrogression of tuberculous disease is, at one or other stage, and for a shorter or longer period, one of the most common occurrences in its evolution. I hold, indeed, that anatomical evidences of such retrograde action may invariably be found in the lungs of persons cut off by chronic phthisis. But this is a very different thing from admitting that, clinically, pulmonary consumption thus frequently stops in its onward course. For, the truth is, that on the one hand, while action of a curative import takes place in one part of a lung, fresh deposition of tubercle, or fresh disintegration of tissue, may be advancing in another; and, on the other hand, the duration of the stationary or retrogressive state is often so short, that, clinically speaking, the tuberculized patient is scarcely a gainer.

1497. Nevertheless, in a certain undetermined, but unfortunately very small, proportion of cases, a constitutional change arises in conjunction with local reparation, antagonistic to, or actually preventive of, the fresh deposition of tubercle; in these instances genuine practical cure of the disease is accomplished.

1498. *Physical signs of phthisis tending towards cure.*—The physical signs of arrested and retrogressive tuberculization vary so widely, not only with the stage and conditions of the disease actually present at the moment suspension of its progress was effected, but also with the length of time that has intervened between such suspension and examination of the chest, that it is impossible to establish precise general rules on the subject. I shall consequently simply put down a few specimens of the conditions that have fallen under my notice in particular cases.

1499. Notable depression, supra and infra-clavicular and supra-scapular, imperfect expansion, very weak, harsh respiration, percussion of Type I. [195], exaggerated fremitus, and strong vocal resonance. Here softening signs on a small scale had existed eighteen months before.

1500. Similar depression, imperfect movement and toneless per-

ussion-sound, dry clicks audible with deep inspiration, which is weak and harsh. Here softening signs had existed only six months before.

1501. Want of tone on percussion at the apex, feeble bronchial breathing, with a deep-seated creaking sound in inspiration [345]. Here, nine months before, softening signs were actively present, and both the local and general symptoms seemed to promise a rapidly fatal issue. I have not seen this patient professionally since the above observation was made, and cannot say what the local state may now be (seven months later); but I know by report that her general health is excellent, and that there are no chest symptoms, except occasionally slight cough.

1502. In these three instances suspension, and more or less perfect retrogression, in the second stage, seem to have been accomplished. Here is another example. A girl aged fifteen, one of whose sisters had died of rapid consumption under my care at Brompton, presented in July, 1850, scrofulous keratitis, enormous cervical glands, the signs of enlarged bronchial glands, with toneless percussion at the left apex, front and back, bronchial respiration, excess of vocal resonance, and large-sized thin liquid rhonchus, purulent expectoration and notable loss of flesh.¹ In 1853 this patient was kindly sent to me by Dr. Routh, who had accidentally seen her, with all the attributes of health, her glands in a perfectly natural state, and with the exception of slightly weak respiration at the left apex, not a single morbid physical sign. In October, 1854, she had grown "hugely fat." In March, 1855, marked dullness existed at the left supra-spinous fossa, moderate of the left, very slight at the right infra-clavicular region; under the left clavicle the respiration reached the ear very feeble, high-pitched, and mingled with dry and moist small-sized crackling.

1503. Deficient mass of percussion-tone below the clavicle, with slightly tubular quality, hollow dry cavernous respiration, vocal resonance diffusely exaggerated: I have recently seen a case with these signs, where, from the account given me, I infer that four months previously the progress of phthisis had been most active. At a more distant period, the signs may continue much the same. Thus I saw in May, 1853, a girl (E. Blow) whom I had first known with excavated lung, six years before, and whose history pointed to seizure yet four years earlier, in whom the signs of excavation still existed in the form of hollow respiration with tubular percussion-note; but there was no rhonchus, and the chest had lost somewhat of the flattened phthisical look habitual to it for years.

1504. Contraction of a large excavation on the left side may draw the heart upwards to an extraordinary amount. I have recently seen a case of the kind in which cardiac pulsation was markedly perceptible in the *first interspace*, and positively, though

¹ A. Petrolina, U. C. H., Females, vol. v. p. 175.

feebly, felt against the *first rib*. With the advance of the contracting process the expiration-sound may gradually rise sensibly in pitch [300].

1505. Respiration labored, and of jerking rhythm, weak and bronchial, but without clicks or rhonchal sound of any kind, and with very slightly deficient resonance under percussion. Here there had been, two months earlier, much greater dulness under percussion, respiration of diffused blowing type and cogged-wheel rhythm [278], along with general symptoms of advancing tuberculization. Congestion had probably disappeared, and the tuberculous deposit become quiescent.

1506. Lastly, I have known some instances where the physical signs of induration had existed at either apex to a slight amount, in individuals belonging to a tainted family, where the local and general symptoms of phthisis had made their appearance, and where the signs in question totally disappeared along with the symptoms, leaving behind them merely trivial harshness in the respiratory sounds. These I believe to have been examples, not only of tuberculization, but of phthisis, retrograding in the first stage: a very striking probable illustration of such course will by and by be dwelt upon.

1507. *Diagnosis*.—The diagnosis of phthisis, exceedingly easy in many cases, is in some only to be successfully made by a patient use of all attainable aids—the physical signs, the local and general symptoms, the microscopical characters of the sputa, the nature of existent surrounding changes, and finally certain subsidiary conditions.

1508. The physical signs of the different stages have already been fully described. Now, there is nothing *per se* distinctive of phthisis in any one of those signs; their localization at the apices and gradual extension downwards alone give them pathological significance. In themselves they merely denote condensation, softening, and excavation—and supply no evidence of the nature of these processes.

1509. Clubbed finger-ends and incurvated nails (if empyema and cyanosis be absent) will add to the surety of a diagnosis essentially based on other grounds. The progress of mischief relatively in the two lungs, and in the two sexes [1343], scarcely follows sufficiently fixed laws to furnish real help. The existence of hereditary taint tends to confirm a diagnosis otherwise arrived at. The presence or absence of one or other of the diseases antagonistic or attractive of phthisis may, with caution, be employed as an element of opinion.

1510. The general value of results with the spirometer has already been considered [128]. Their practical significance *quoad* phthisis may be expressed as follows:—If a person, seen for the first time and examined with the spirometer, blow a number of cubic inches exceeding the alleged average of men of his height,

the inference, that therefore his lungs are sound, is justifiable; they *may*, at the very moment, be excavated by tubercle. If, conversely, an individual fail to blow up to, or even nearly to, his computed physiological standard, his lungs may nevertheless be perfectly sound. And conceding, *argumenti gratiâ*, that the failure shows unsoundness of lungs, it throws no light on the nature of the pulmonary disease. They who maintain that phthisis can thus be diagnosed, may, it is true, refer to examples of successful diagnosis on this principle; but, simply on the doctrine of chances, he must often prove correct, who, given a chronic pulmonary affection, pronounces it at once to be tuberculous—such is the vast preponderance of that form of disease.

1511. The direct evidence, deducible from hæmoptysis [1287], and from the microscopical characters of the sputa [1377], may be learned from statements already made.

1512. The secondary morbid changes of deepest diagnostic significance are chronic peritonitis, persistent diarrhœa without obvious extrinsic cause, chronic laryngitis and epiglottitis, a peculiar form of meningitis [1441]; and double pleurisy with effusion. In all these cases it is essential that cancer, syphilis, and Bright's disease be demonstrably absent.

1513. The distinctive marks between phthisis and chronic bronchitis with dilated bronchi [712], pulmonary atelectasis [959], chronic pneumonia [1189], chronic pleurisy [813], cirrhosis [1258], and cancer [1635], will be severally found in the paragraphs here referred to.

1514. The subject may be further illustrated by conditions and combinations arising more or less frequently in actual practice:—*(a)*, A young adult, who has had an obstinate cough, which commenced without coryza and without any very obvious cause, a cough at first dry and subsequently attended for a time with watery or mucilaginous looking expectoration, and who has wandering pains about the chest, and loses flesh even slightly, is in all probability phthisical. *(b)*, Should there have been hæmoptysis to the amount of a drachm even, the diagnosis becomes, if the patient be a male and positively free from aortic aneurism, mitral disease or hypertrophy of the right ventricle, almost positive. *(c)*, If, besides, there be slightly morbid percussion [Types I. or III.] at one apex, with divided and harsh respiration, while the resonance at the sternal notch is natural, the diagnosis of the first stage of phthisis becomes next to absolutely certain. *(d)*, But not absolutely certain: for I have known every one of the conditions in *a*, *b*, and *c* exist (except hæmoptysis, the deficiency of which was purely accidental), where one apex was infiltrated with encephaloid cancer, and no cancer had been discovered elsewhere to suggest to the physician its presence in the lung. *(e)*, If there be cough, such as described, and permanent weakness and hoarseness of the voice, the chances are very strong, provided he be non-syphilitic, that

the patient is phthisical. (*f*), If decidedly harsh respiration exist at the left apex or at the right apex behind, if the rhythm of the act be such as I have called *cogged-wheel* [278], and there be dulness, so slight even as to require the dynamic test for its discovery, there can be little doubt of the existence of phthisis. (*g*), If with the same combination of circumstances deep inspiration evoke a few clicks of dry crackling rhonchus, the diagnosis of phthisis, so far as I have observed, is the next to absolutely certain. (*h*), If these clicks, on subsequent examination, grow more liquid, the transition from the first to the second stage may, as a rule, be very surely announced. But all the conditions of *f*, *g*, and *h*, may be simulated, in infinitely rare cases of combined local simple consolidation and bronchitis: the adjoining induration gives bronchial rhonchi a clear ringing quality. (*i*), If there be slight flattening under one clavicle, with deficiency of expansion-movement, harsh respiration and slight dulness under percussion, without the local or general symptoms of phthisis, the first stage of tuberculization cannot be diagnosticated with any surety, unless there be incipient signs at the other apex also: the conditions in question limited to one side might depend on chronic pneumonia or on thick induration-matter in the pleura. (*k*) The existence of limited, though marked, percussion-changes under one clavicle, with bronchial respiration and pectoriloquy, so powerful as to be painful to the ear, the other apex giving natural results, will not justify the diagnosis of phthisis. I have known this combination of signs, where the apex of the lung was of model health, but a fibrous mass, the size of a walnut, lay between the two laminæ of the pleura. I would even go further, and say that the combination in question is rather hostile than otherwise to the admission of phthisis; as, had tuberculous excavation formed at one side, the other lung would, in infinite probability, have been affected with the disease in an earlier stage. (*l*) Pneumonia, limited to the supra and infra-clavicular region on one side, and not extending backwards, is commonly, but not always, tuberculous. (*m*) Fine bubbling rhonchus, limited to one base posteriorly, is not, as has been said, peculiar to tubercle; it may exist in emphysema and in mitral disease. (*n*) Chronic peritonitis, in a person aged more than fifteen years, provided abdominal cancer can be excluded, involves as a necessity the existence of tubercles in the lungs [1346]. To this law of M. Louis, it is necessary to add the qualification, provided Bright's disease (and this is readily ascertained) be also absent. But the question of cancer is far from easily settled: thus there may be pain and tenderness, evidently peritonic, ascites varying in amount from time to time, now a relaxed, now a somewhat obstinately constipated, state of bowels, vomiting more or less persistent, extreme emaciation, diphtheritic stomatitis, percussion-dulness in the supra-spinous fossæ, muco-purulent expectoration, no external cancer discoverable, and all this in a young female—and yet the peritonitis shall be cancerous, the lungs and bronchial glands being the seat

of calcified tubercle only. The tint of skin may be somewhat cancerous, the face emaciated as much as the rest of the body, the peritonitis may be limited, the ascites trifling, and night-sweats and hæmoptysis absent, it is true, in such a case; but to form a positive diagnosis on these points would be rash.¹ (*o*) Pleurisy with effusion, which runs a chronic course in spite of ordinary treatment, is, in the majority of cases, tuberculous or cancerous: the character of the symptoms, previously to the pleurisy, will generally decide between the two. (*p*) Double pleurisy, with effusion, is not absolutely significant of tubercle; for it may depend on Bright's disease. If the latter affection can be excluded, carcinoma and pyohæmia remain as other possible constitutional causes. Besides, as fully shown elsewhere [164], bilateral pleuritic effusion may be simple, and wholly unconnected with diathetic taint.* (*q*) If a young adult, free from dysentery, and who has not resided in tropical climates, suffer from obstinate diarrhœa, which goes on month after month, with slight remissions or intermissions, even though there be no cough, he is in most strong probability phthisical. If physical signs, to the slightest amount, exist at either apex, he is, almost to absolute certainty, phthisical. (*r*) If a young adult, free from secondary syphilis and spermatorrhœa, and not dissolute in his habits, steadily lose weight, without clear cause, he is in all probability phthisical, even though no subjective chest symptoms exist. (*t*) But he is not by any means certainly so; for he may have latent cancer in some unimportant organ, or he may have chronic pneumonia. (*t*) Nay, more, he may steadily lose weight, have dry cough, occasional diarrhœa, and night-sweats, and present dulness under percussion, with bronchial respiration, under both clavicles, and yet be non-phthisical. I have known all this occur both in cases where the lungs were infiltrated superiorly with primary encephaloid cancer, and where they contained secondary nodules of the same kind. (*u*) Failure of weight becomes less valuable as a sign of phthisis, the longer the thirtieth year has been passed. (*v*) A male has some one or more ill-developed physical signs: maintenance of weight at, or closely up to, the normal standard, will as a rule either prove their valuelessness, or at least show that existing tuberculization is slight in amount and quiescent; but it will not invariably prove either one or the other. (*w*) Abnormal percussion results at both supra-spinous fossæ, cough, abundant muco-purulent expectoration, hæmoptysis (frequently free from, though sometimes presenting, bistre-color tint [1279]), great emaciation, inexplicable except on the hypothesis of tubercle, curved nails, and bulbous finger ends, may all of them exist, and yet not a gray granulation even exist in the lungs. Cardiac disease, chronic pneumonia of the base and pulmonary

¹ All these facts were illustrated by the case of Scott, U. C. H., Females, ætatis 29, vol. ix. pp. 5—111; the left lung weighed only 9, the right 12, oz. I have since seen two closely similar cases in young females; one a patient of Dr. Neil Arnott's.

apoplexy, may alone be present.¹ (*x*) The discovery of cardiac disease with marked symptoms deposes against, but does not exclude, the existence of active tuberculization. (*y*) The existence of cancer in any organ is unfavorable to the presence of tuberculous disease; but tubercle and cancer *may* coexist, even in the same lung. (*z*) Tubercle very rarely, active phthisis still more rarely, coexists with leucohæmia. But acute tuberculization of the lungs may put an abrupt term to the life of a leucohæmic patient [1596]. (*aa*) Constant vomiting of food with the cough, the stomach being sound, though much more common in phthisis, may attend chronic bronchitis. (*bb*) Light hair and eyes furnish no argument in favor of phthisis in a doubtful case; the careful investigations of Dr. John Beddoe, undertaken in 500 phthisical patients, on the contrary, go to show that persons with black hair and black eyes are, in proportion to their numbers in the population, the most frequent victims; next to them those with dark brown, and then those with red or fair hair—the least liable being those with hair of a medium or lightish brown, and with light eyes. (*cc*) A hysterical woman may have frequent, shallow respiration, impaired percussion-tone, cough, expectoration, peculiar watery hæmoptysis, and night-perspirations; she may lose flesh, and this even especially about the chest, and yet be non-phthisical. The existence of well marked hysterical conditions of the spine, intercostal nerves and skin, coupled with the peculiar watery hæmoptysis and the inordinate frequency of breathing, are valuable guides to the diagnosis. But time must be allowed for ordinary tuberculous decay to occur, before a positive opinion can sometimes be formed in one direction or the other.

1515. Patients frequently attach importance to the determination of the apex most affected. This point may be settled on different principles by different persons. The amount of consolidation in a given spot will guide one; the superficial area of consolidation another; the uniformity of consolidation, or the stage of the disease others. Hence arise sometimes apparent differences of opinion between observers of the same case, where none really exist. The disturbing influence of emphysema, and the fact that the disease may suddenly become most active at the apex hitherto most quiet, must not be forgotten.

1516. I would here offer, for the sake of beginners, a few cautions in the application of physical diagnosis in phthisis. Never attempt to give a positive opinion as to the actual state of the lungs, where there has been recent hæmoptysis, or while pleuritic effusion, bronchitis, or pneumonia is present: I of course refer especially to cases where there may, or may not be, signs of the first stage; if excavation exist, its signs may be generally unravelled in spite of these complications. Always examine the supra-spinous fossæ, as

¹ Lewis, U. C. H., Females, vol. ix. p. 342.

well as the clavicular regions. Trust very little, if at all, to the conditions of vocal resonance; accept with great caution the evidence of slight changes in respiration, unless they be corroborated by percussion-changes; place no confidence in jerking respiration (even though local) in any hysterical woman,—nor in harsh respiration, with its prolonged expiration, limited to the right apex in any woman,—nor in very slightly abnormal percussion at the right front apex in man or woman. Lastly, never give a confident opinion, in a nicely-balanced case, from a single examination; make examinations in various postures; and always compare carefully with physical signs the local and constitutional symptoms.

Treatment.—Experience shows that the treatment of the phthisical may, with legitimate confidence, aim at either maintaining a *status in quo*—at producing slight local and general improvement, or marked improvement of this kind—at effecting a total removal of all subjective symptoms, while the physical signs remain partially active—or at accomplishing total removal of the symptoms, and bringing about a quiescent state of the physical signs, while the general health, weight, and vigor have improved to such an extent, that the patient shall believe himself totally free from disease, and that the medical observer might be disposed to share his opinion, did not passive physical changes remain. I say medical art may legitimately aim at these ends, because, on the one hand, these ends have been actually obtained; and, on the other, the man has not yet appeared who can point to results more perfect than the best of these, as the positive, direct, and traceable effect of any known system of medication. This latter clause is not in the least at variance with the well-known fact, that phthisis sometimes spontaneously undergoes permanent suspension of its course.

1518. The following results, which I obtained at the Consumption Hospital, justify the foregoing statements, and furnish guides to *prognosis*—additional to those already set forth [1480]. (1.) Of a given mass of patients entering the hospital in all stages of the disease, and in every variety of general condition—between the actually moribund state and that of but slight constitutional suffering—the number leaving it, on the one hand, *improved* or *unadvanced* was more than double that, on the other hand, leaving it in a *worse state* or *dying within its walls* (the exact ratio is 67.84; 32.16). If the cases in which death was actually imminent at the period of admission, were excluded, the result would be very materially more favorable than this. (2.) In 4.26 per cent. of the cases, complete restoration to health, not only as regards apparent disturbance of the functions generally, but as regards local evidence of active pulmonary disease, was effected. (3.) Complete removal of symptoms was more frequently effected in the male than in the female; but, on the other hand, the results were, on the whole, slightly more favorable in the latter than in the former sex. (4.) All patients whose conditions grew worse, while they were in the

hospital, had reached the stage of excavation on admission; and all patients, whose tubercles were yet unsoftened on admission, left the hospital either improved, or having had a *status in quo* condition kept up. Improvement is more probable than the reverse, even where excavation exists on admission. (5.) In a given mass of cases, the chances of favorable influence from sojourn in the hospital will be greater, in a certain, undetermined, ratio, as the duration of the disease previous to admission has been greater—in other terms, natural tendency to a slow course is a more important element of success in the treatment of the disease, than the fact of that treatment having been undertaken at an early period. (6.) The mean length of stay in the hospital in the most favorable class of cases, nearly doubled that in the least favorable. (7.) The chances of benefit are more in favor of those whose trades are wholly or partially pursued out of doors. (8.) The results did not appear to be influenced by the laborious or non-laborious character of the trade individuals might have pursued. (9.) The age of the sufferers did not exercise any very material influence on the character of the results. (10.) Patients coming from the country have, on an average, a slightly stronger chance of improvement, than the residents of London and the suburbs. (11.) Patients admitted during the warmer half of the year, benefit by a sojourn at Brompton, to a slight extent more than those received during the six colder months.

1519. (§ I.) *Specifics*.—My task in examining the efficacy of various specific agents will be brief. Iodide of iron, chloride of sodium, liquor potassæ, chlorine and iodine inhalations, hydrocyanic acid, creasote, digitalis, are under this aspect disposed of in the masterly analysis of their claims by M. Louis; and naphtha may be allowed to remain in the rather rough grasp of the British and Foreign Medical Review. But cod-liver oil cannot be so lightly dismissed.

1520. I began to employ the oil at the Consumption and University College Hospitals many years ago, urged to the step by the strong advocacy of Dr. Hughes Bennett, and took an early opportunity of testifying to its remarkable powers in tuberculous and other scrofulous diseases.¹ The conclusions at which I have arrived concerning its use in phtthisis are as follows:—

(1.) That it more rapidly and effectually induces improvement in the general and local symptoms than any other known agent. (2.) That its power of *curing* the disease is undetermined; I mean here by “curing” the disease, its power of causing, along with suspension of progress, such change in the organism generally as shall render the lungs less prone to subsequent outbreak of tubercles than after suspension occurring under other agencies.² (3.) That the mean

¹ Nature and Treatment of Cancer, p. 202, 1846.

² That such cures really occur in rare instances (and they are as perfect as in any other organic disease when they do occur) is indubitable. It has been the vanity of late years to deny this absolutely, because a scientific (or pseudo-scientific)

amount of permanency of the good effects of the oil is undetermined. (4.) That it relatively produces more marked effects in the third than in the previous stages. Opinions the most diverse have been held on this point; M. Taufflied¹ taught that it had little or no effect on phthisis if at all advanced; M. Péreyra² reduced the size of cavities in a few weeks by its administration. (5.) That it increases weight in favorable cases with singular speed, and out of all proportion with the actual quantity taken; that hence it must in some unknown way save waste, and render food more readily assimilable. (6.) That it sometimes fails to increase weight. (7.) That in the great majority of cases where it fails to increase weight it does little good in other ways. (8.) That it does not relieve dyspnoea out of proportion with other symptoms. (9.) That the effects traceable to the oil in the most favorable cases are: increase of weight, suspension of colliquative sweats, improved appetite, diminished cough and expectoration, cessation of sickness with cough, and gradual disappearance of active physical signs. (10.) That in some cases it cannot be taken, either because it disagrees with the stomach, impairing the appetite (without itself obviously nourishing), and causing nausea, or because it produces diarrhoea. (11.) That in the former case it may be made palatable by association with a mineral acid; and in the latter prevented from affecting the bowels by combination with astringents. (12.) That intra-thoracic inflammations and hæmoptysis are contra-indications to its use, but only temporarily so. I have repeatedly given the oil within a day or two of the cessation of hæmoptysis without any return taking place. (13.) Diarrhoea, if depending on chronic peritonitis, or secretive change, or ulcerations in the ileum, affords no contra-indication to the use of the oil; even the profuse diarrhoea caused by extensive ulceration of the large bowel is not made worse by it. (14.) That the beneficial operation of the oil diminishes, *cæteris paribus*, directly as the age of those using it increases, a singular fact, which probably may one day, when the textural peculiarities of youth and age are better understood, aid in giving a clue to its mode of action. (15.) That the effects of the oil are more strikingly beneficial when a small extent of lung is implicated in an advanced degree, than where a relatively large area is diseased in an incipient stage. (16.) That when chronic pleurisy or chronic pneumonia exists on a large scale, the oil often fails to relieve the pectoral symptoms. (17.) That it often disagrees when the liver is enlarged

tific?) explanation of the fact cannot be found. I am not one of those who refuse to accept the evidences of my senses because I am unable to comprehend what they teach me, and in this matter echo the sentiments of the physician in a recent French tale, speaking of a phthisical recovery:— “ces miracles de guérison, auxquels la Science ne croit pas, faute de les comprendre, et devant lesquels je me prosterne, en priant la bonne et sage Nature d'en être moins avare.”— Pierre, par Madame Reybaud.

¹ Gazette Méd. de Paris, Nov. 1839.

² Du Traitement de la Phthisie, Bordeaux, 1843.

and probably fatty. (18.) That weight may be increased by it, and yet the local disease go on. (19.) That weight may increase, the cough and expectoration diminish, night sweating cease, the strength which had been failing remain stationary, under the use of the oil, and yet the local disease be all the while advancing. I have known softening on a small scale pass in two months into tolerably extensive excavation under these circumstances—singular proof of the nutritive powers of the agent. (20.) A sensible increase of warmth is experienced by some patients after their dose; but I have not ascertained whether rise of temperature can be objectively proved.

1521. Demonstration will probably be by and by obtainable, from the returns of the Registrar-General, of some diminution in the annual mortality from phthisis. Without claiming for the oil the power of curing the disease, we still must look for this result; for indubitably it does possess the power of prolonging phthical life—an effect which must of course lessen the annual number destroyed by the disease.¹

1522. Of the three kinds of oil—the brown, light brown, and pale—the brown, I believe, as matter of actual experience, to be the most efficacious. But, though taken greedily by infants, it is more distasteful than the pale to the adult palate, and hence in grown persons I have been forced to use the latter less active kind (in fact *gild the pill*), in order to insure oil being swallowed at all. Chemists give no positive answer to the question, on what depends the efficacy of the drug? Its influence on the composition blood is yet undetermined. A single analysis by Simon shows a state of hypinosis, combined with a great excess of albumen, may follow on its use—the solid constituents generally being in large amount. The patient had been bled repeatedly for hæmoptysis. The iodine and bromine of the oil, its phosphorus, butyric acid, gaduine, biliary material, and its mere fatty matter have been severally accorded the chief part in the beneficial results. Recently the presence of phosphorus has been denied by M. Personne; and M. Winckler seems to maintain that the efficacy of the oil depends on its having propyl for its radical, instead of glyeyl, the ordinary basis of oils. The iatrochemical discussions on the subject do little more than exhibit the existing poverty of our knowledge of the intimate action of remedies. On the other hand, the established efficacy of the oil—a substance of which *à priori* views would scarcely have admitted

¹ Dr. John Beddoe has kindly communicated to me the results of a statistical inquiry concerning the above suggestion, which I had made in the edition of 1854. It appears the Registrar's returns do show a marked decrease in the deaths ascribed to phthisis; but at the same time a prodigious increase in those referred to bronchitis—"So prodigious as to compel me to believe that many cases, now registered 'Bronchitis,' would in 1841 have been set down as 'Phthisis.' Moreover, the number of deaths ascribed to 'Atrophy,' and 'Tabes Mesenterica,' is greater than it used to be; and it is among children the apparent diminution of phthisis is greatest." Time will show, if this explanation be just: meanwhile the fact of decrease in the registered phthical death remains.

the possible retention by the phthisical stomach—is another of the conquests of *experimental* therapeutics.¹

1523. The dose of the oil at the outset should never exceed, often fall short of, a drachm; it may be taken immediately before, immediately after, or midway between meals—the idiosyncrasy of the patient will guide to the fittest time. The vehicle may be water, milk, orange wine, infusion of quassia or chiretta, weak brandy and water, or any aromatic water agreeable to the patient. The dose may be gradually raised to half an ounce, twice, or at most thrice, in the twenty-four hours; I have never seen any good, and often observed ill, effects follow the attempt to pour in large quantities. If there be disposition to regurgitation of the oil, the whole daily quantity may be taken with advantage at bed-time.

1524. If the stomach reject oil absolutely, it may be administered in enemata, combined with an astringent, or by inunction. I have, however, found that the rectum grows irritated too soon to allow of sufficient continuance of the enemata; through the skin, the oil acts more efficaciously.² I have seen much improvement in flesh, and diminution of cough and chest-irritation follow the use of inunction with simple olive oil after the warm bath.

1525. The attempts to prove almond oil, cocoa-nut oil, and neat's-foot oil as efficaciously as the oleum morrhæ, seem to me to have failed. Skate-liver oil is probably largely mixed with the commercial cod-oil—and is by some held to be medicinally quite as active.

1526. Some patients, to whom the oil is unbearable, digest cream well: a pint to a pint and a half has been taken daily without gastric disturbance, and with manifest increase of flesh in advanced cases of the disease under my direction.

1527. But a more important substitute for cod-liver oil is glycerine. The agreeableness of its flavor, the readiness with which it is, when really pure, digested, and its easy combination with the salts of iron and quinine,³ are arguments deposing less strongly in its favor, than the fact that it often agrees well, when cod-liver oil proves unbearable, and that it very decidedly, in the mass of cases,

¹ As is well known, cod-liver oil has been a household remedy from time immemorial in the north of Europe. To the extensive use of fish-oil may possibly be due the singular immunity from phthisis enjoyed by the Icelanders in spite of the anti-hygienic conditions, climatic and other, in which they live. See Schleisner, B. and F. Med. Chir. Rev., April, 1850. On the oil contained in the fish depends the faith in the "frozen fish" cure employed in Siberia. See "Revelations of Siberia," by a banished Lady.

² As is well known, the Romans ranked the process of oiling themselves, and then basking in the sun, among their most important hygienic luxuries. The reader will remember the reference to the habit in the letter of Pliny the Younger to Tacitus, describing the catastrophe of Pompeii and the death of his uncle, the Elder Pliny. For very complete details on this point, see the erudite essay of Prof. Simpson in Edinburgh Monthly Journal, 1853.

³ A variety of beautiful preparations are manufactured by Messrs. Price of Belmont, Vauxhall.

especially in childhood, increases weight. I have no evidence of its ameliorating special symptoms.

1528. Helicine, of relatively recent introduction, has already fallen into merited oblivion.

1529. On iatro-chemical grounds phosphate of lime has been recommended of late; satisfactory clinical evidence in its favor has yet to be furnished; nor does the theory seem very profound which assumes that, because retrogressive tubercle calcifies spontaneously, ergo, if calcareous salts be taken into the stomach in active phthisis, advancing tubercle will assimilate them, and forthwith retrograde.

1530. The latest plan of medication referable to the iatro-chemical category, is that suggested by Dr. J. F. Churchill.¹ The proximate cause of the tuberculous diathesis being ascertained to be none other than decrease of oxidizable phosphorus in the system, the specific remedy becomes obvious—phosphorus in the lowest possible state of oxidation, and in a form easily assimilable. The hypophosphites of soda and lime (in doses varying from ten to sixty grains per diem) best fulfil these indications. And, in truth, it scarcely appears likely they will be readily excelled, if with the rest of the world, as with Dr. Churchill, they succeed in not only curing the disease symptomatically, but in “removing altogether its physical signs” in 22.3 per 100 of cases in the second or third stages!

1531. Ergot of rye, occasionally useful in hæmoptysis, has no shadow of influence on the progress of tubercle.

1532. (§ II.) *Hygienic management.*—Equal in importance to the medicinal treatment of the consumptive is their hygienic management. We proceed to indicate the various aspects under which valuable aid may be afforded to these sufferers by attention to extrinsic conditions.

1533. *Atmosphere.*—Pure, warm, moderately dry air is that suggested by theory, and proved by experience, to be the best adapted for the tuberculized lung and phthisical system. Lehmann insists on the importance of moisture, and maintains we may “perhaps” benefit a phthisical patient as much by recommending him to breathe such air, as by giving him cod-liver oil.²

1534. The climate of our own island is, in the winter months, for a variety of reasons, much more from its fog, damp, gloom, and changeableness, than its absolute cold,³ unfit for the consumptive invalid. And as matter of experience, change of climate unquestionably proves, in many cases, when resorted to in the early period of the disease, of fundamental service. Transference to a more genial atmosphere than that to which the invalid has been accustomed, in some rare instances permanently arrests the disease; in others pro-

¹ Ranking's Retrospect, vol. xxvi. p. 41.

² Physiol. Chemistry, by Day, vol. iii. p. 382.

³ I have known phthisical patients, born in England bear the bright clear cold of Canada and of Sweden well.

longs life; and in a third class relieves symptoms strikingly, and renders the close of existence comparatively comfortable.¹ True, there is a fourth series of persons, whose sufferings are aggravated, and end hastened, by the toil of a journey, and the want of home luxuries and associations.² But these are cases in which disorganization is at once extensive and active in the lungs, while the general symptoms indicate that profound constitutional disturbance, which no art can rectify.

1535. In the selection of a climate for any particular case, the dry or moist character of the attending bronchitis, the natural liking of the individual for relaxing or bracing air, and the general tendency to the *strictum* or the *laxum* in the organism, furnish the best guides. (See Appendix.)

1536. A sea-voyage, more especially in the case of young adult males, occasionally works more effectual change in the phthisical organism than any other single influence, or any combination of influences, that I am acquainted with. Not only have I seen the local disease stayed, and the damaged lungs attain the maximum of possible repair, but the whole constitution undergo such remodelling, as to render a fresh outbreak of the tuberculizing process an unlikelihood.³

1537. Where circumstances render change of climate impossible, the winter may be passed without danger in-doors in England in an artificially managed atmosphere, provided proper precautions be taken in regard to ventilation. Air heated to a fixed temperature,⁴ and perpetually renewed by a scientific system of ventilation, such as Dr. Neil Arnott's, forms an excellent substitute for the naturally soft air of milder climates than our own. If, on the one hand, there be the drawbacks of fog, gloom, and want of open-air exercise, there are the counterbalancing advantages of the comforts and familiar friends of home, and the escape from the privations and labor of

¹ "Yes," said a patient arguing on the question of a final winter in Madeira, "I know I go there to die,—but to die amid the glories of beautiful nature, cradled in an atmosphere as balmy, as redolent of flowers, as its sun is gorgeous. Here too I should die,—but die cribbed and confined in a room, narrow as sunless,—smoky, foggy, cheerless."

² These are the refined representatives of Byron's valet Fletcher, who, thorough John Bull in spirit, tortured the poet with his "perpetual lamentations after beef and beer,"—people who travel from Dan to Beersheba, and find that all is barren.

³ The conclusion at which M. Rochard (*Mém. de l'Académie de Méd.*, t. xx., 1856) has arrived, that sea-voyages much more frequently accelerate, than slacken, the progress of pulmonary tuberculization, scarcely seems to flow legitimately from his premises. But even if it were logically sound, the truth of the statement in the text would remain unshaken. M. Rochard's experience is drawn from the French navy,—from individuals certainly at sea, but in vessels having special duties to fulfil,—and hence often in latitudes most unfavorable to the pulmonary organs. He indeed admits that advantage may accrue to patients whose sea-route is chosen with reference to season and atmospheric vicissitudes.

⁴ Some latitude may be allowed, of course, for individual taste; but, as I found from questioning upwards of one hundred patients at the Brompton Hospital, an atmosphere at all below 64° Fah. is disagreeable to the majority.

travelling—advantages which, as already admitted, prove to persons of some temperaments immense.

1538. The arrangements of the tropical department of the Crystal Palace at Sydenham, as affording a genial, yet not over-close, atmosphere for the exercise of the consumptive invalid, appear to me not to have been utilized to the extent they desire.

1539. Whether there be any atmosphere specially fitted for the consumptive, irrespectively of its meteorological characters, is yet matter for inquiry. The air of the Mammoth Cave in Kentucky, of extreme purity and specifically exhilarating properties, is unfortunately of low temperature: besides, the absence of sun-light will probably prove fatal to the success of its phthysical Sanatorium. The rapid fattening of the lower animals in the Cave, independently of any change of food, seems an established fact.

1540. Has the amount of pressure of the atmosphere, taken alone or in conjunction with necessarily associated conditions,¹ any distinct influence on persons already phthical? That extreme rarefaction of the air produces pulmonary evils of its own, is sufficiently certain [1300]; but this is no proof that a specifically antagonistic influence might not be exercised on the tuberculizing process in the lungs. And I find some remarkable instances recorded, unfortunately by lay writers, of apparent recovery from phthisis due to sojourn on very elevated plains, e. g. at 8000 or 9000 feet above the sea-level.² It is, besides, certain that patients who become phthical at Lima and elsewhere on the coast of Peru, are usually sent to some places in the Andes varying from 9000 to 10,000 feet above the level of the sea.³

1541. On the other hand it is strongly asserted that the increased atmospheric pressure obtained in the compressed air-bath, exercises a very favorable influence on the local and general state of phthical patients; the evidence on this subject will be glanced at in the Appendix.

1542. The diet of the consumptive should be simple and nutritious; very strict rules as to special articles of food are uncalled for, unless the stomach have exhibited signs of imperfect power. It is advisable, however, to encourage the ingestion of fat. Dr. Hooker affirms that "of persons dying of phthisis between the ages of 15 and 45, nine-tenths at least have never used fat meat,"—and further that the few persons, who, having eaten fat freely, nevertheless become phthical, derive no benefit from cod-liver oil.⁴ As respects the quantity of animal food allowable, no general rule can

¹ With diminution of barometric pressure, the temperature of the air falls, its density lessens, its evaporating force and dryness increase.

² Ruxton's Adventures in Mexico, p. 288.

³ A. Smith, Br. and F. M. Chir. Rev., Oct., 1856. The question is a very different one from that already glanced at [1479*], of the alleged immunity, more or less frequent, of the natives of elevated regions from phthisis.

⁴ Trans. Amer. Med. Assoc., vol. viii. 1855.

be laid down; so much as each stomach can digest, without local suffering or systemic disturbance, may not only be safely permitted but positively recommended [1397]. Without being an advocate of the forced "mutton-chop and porter" plan, I am perfectly convinced that a low diet is seriously injurious.

1543. In the ordinary class of phthisical patients, I have not, as a rule, observed ill effects ensue from the tempered use of stimulants,—wine, spirits, or sound malt-liquor, according to the previous habits of the individual. If these agents excite cough, increase the frequency of the pulse, or raise the temperature (if already too high), they probably do more harm than is counterbalanced by either the sense of increased vigor and general comfort they passingly bestow, or by the theoretical views that will by and by be adduced in their favor.

But in special and exceptional cases of phthisis, either apyrexial or attended with very slight febrile reaction, the claims of alcoholic beverages to the consideration of clinical observers become very much stronger. In examples of the disease of this class, marked by habitual coldness of the skin, lividity of face, dyspnoea, and general languor instead of the constitutional erethism, commonly characteristic of phthisis, I have prescribed brandy medicinally in daily doses varying from half an ounce to two ounces, with the good effects of raising the temperature, lessening the lividity of surface, and relieving the dyspnoea. Perhaps the notion that brandy supplies pure aliment for respiration may explain the fact, that habitual spirit-drinkers (*placed otherwise under favorable hygienic influences*) do sometimes suffer less, and live longer, with excavated lungs, than sober persons. I have seen some three or four most remarkable examples of the kind,—examples, indeed, which first led me to a cautious use of brandy medicinally.¹

1544. And, in truth, there are apparently strong *à priori* grounds for the moderate use of alcohol in phthisis generally. Böcker found that a teaspoonful of spirits of wine, taken daily, led to diminution in the quantity of the solid and fluid urinary excretion, as also of the carbonic acid exhaled by the lungs. No increase in any other of the excreta took place,—and therefore the inference seems unavoidable, that alcohol saves waste of tissue. But sugar

¹ Dr. Stokes relates a striking example of recovery from phthisis (every local and general symptom existing in the highest degree) in the instance of a gentleman, who knowing he had been condemned to die, determined to enjoy his brief tenure of life in his own fashion—one great element of his happiness consisting in the consumption of *seldom less than seven tumblers of whiskey punch per diem*. (Dublin Med. Press, Nov., 1854.) Now it is plain enough, a single case of this kind wholly fails to prove the curative powers of alcohol; for it may fairly be objected, that recoveries of this exceptional character do every now and then take place under all conceivable varieties of combination of hygienic and medicinal conditions. But on the other hand, the case suffices to show beyond the possibility of cavil, that where the disposition in the phthisical system to arrest and repair is strong even outrageous abuse of alcohol will not counteract, or even injuriously modify, that disposition.

and gum arabic seem to exercise similar effects, while their consumption is not open to the grave moral objections that attach to alcoholic fluids; they should be allowed largely as articles of food at once calorific, and, if not directly, at least indirectly, plastic.

1545. The mucilaginous material of the Carragheen and Iceland mosses is useful, as satisfying appetite somewhat without exciting the pulse.

Donkey's milk is very readily assimilated by the phthical stomach, and aids distinctly in nutrition: caution in its use is requisite in London, in consequence of the noxious manner in which the donkeys are sometimes fed. Galen¹ recommended lactation by a robust woman.

Sarsaparilla agrees well as a diet drink, and occasionally acts beneficially as an alterative.

1546. The habit of smoking, if indulged in with moderation, has not appeared to me specially injurious in phthisis; it is not impossible, indeed, that the infinitely minute quantity of nicotin inhaled, may exercise a locally soothing effect. But the profuse use of tobacco is decidedly injurious to the health of the phthical, as of the non-phthical.

1547. Moderate and frequent exercise in the open air, either active (riding or walking), or passive (carriage, swinging, or yachting), is essential. Gentle gymnastic exercises, especially of the upper extremities, the use of light dumb-bells, and in childhood of the "chest-expander," tend to counteract the contracting influence of the disease on the volume of the lungs. So, too, does the habit of taking deep inspirations, of reading aloud, and of moderate singing: any tendency to implication of the larynx would of course render quietude of that organ essential.

1548. The bath, tepid or warm in cold weather, cool in the summer, should be used twice a week, and followed by free friction of the skin, with or without subsequent inunction, local or general. Concerning the specific utility of the Turkish bath I am yet undecided; facts are wanting.

1549. Flannel should be worn next the skin; but several layers of such covering, often seen, especially among the humbler orders, are useless. All compression of the thorax by stays, or otherwise, should be avoided.

I have known most severe inflammation of the epiglottis follow within twenty-four hours, the removal of beard under the chin.

1550. Exchange of profession or trade, from the sedentary and laborious, to those moderately active physically, and but slightly taxing the intellect, is advisable.

1551. Medical counsel will often be sought by consumptive persons, as to the propriety or feasibility of marriage. The question obviously concerns not only the phthical individual, but also the

¹ Cabanis, *Rapports du Physique et du Morale*, p. 475, éd. Paris, 1843.

proposed husband or wife, and the expected progeny. First: of the legal competence for marriage of the phthysical there can be no doubt. The sexual aptitude of the male is certainly not below par, though the seminal fluid may be impaired in potentiality, and the procreative faculty, as I have already stated, reduced [1420]: the fecundity of the female exceeds the average.¹ That, especially during the earlier periods of the disease, frequent sexual excitement of necessity exercises a damaging influence on the phthysical, I possess no proof; but I have had cognizance of one case where hæmoptysis, occurring *in actu coitûs*, proved indirectly [1487] fatal. Secondly: marriage cannot be logically discountenanced on the ground of contagiousness of the disease [1474]; and whether the toil and privations, and probable impairment of health, entailed by the prolonged nursing of an individual specifically diseased, shall on the one hand be inflicted, and on the other hand be accepted, is a matter on which the pair immediately concerned are alone entitled to decide. Thirdly: a couple, of whom one is phthysical, marries with the calculated surety that, on the lowest computation, 26 per 100 of their offspring will inherit the same disease. Beyond this, the chances of rickets, and of the external acknowledged forms of scrofula, exist in a certain but undetermined ratio. Nor is idiocy to be forgotten as a possible infliction; out of 484 idiots, observed by Dr. Maxwell at Redhill, 14 (out of 86 who were fatherless, motherless, or both) had lost a parent from phthisis,—a considerably greater number than that from any other individual disease.²

But so widely is the phthysical element diffused among us, that if tubercle were regarded as a barrier to marriage, a diminution of the population, sufficiently sensible to prove of serious political import, might shortly be anticipated.

1552. On the other hand, does the grave development of phthisis, in either individual of a pair who have contracted to marry, furnish an efficient plea, either to the non-phthysical or to the phthysical of the two, for refusal to fulfil that contract? It must be understood, the existence of phthisis has only become apparent subsequently to the engagement.

1553. To the non-phthysical the dangers of uniting with a tuber-

¹ That there exists a greater proneness to early marriage among the phthysical than the non-phthysical appears to follow from the subjoined table from the author's Report on Consumption (*loc. cit.*).

Table showing the proportion of the total number married who were under ætat. 35.

	PHTHISICAL.		NON-PHTHISICAL.	
	Males.	Females.	Males.	Females.
Percentage of total number married who were under ætat. 35	47.86	57.69	30.13	40.24

² From the active fecundity of the phthysical female, as compared with the relatively feeble procreative powers of the phthysical male [1420], it follows that the marriage of the tuberculous female inflicts a greater amount of mischief than that of the male.

culous consort are certain—though they do not demonstrably involve that of infection. Besides, conscientious scruples may very conceivably arise as to the morality of taking part in a union the proceeds of which must come into the world with a fixed, calculable chance of being phthisical, rickety, or idiotic. But the question has not, that I am aware, been ever submitted to a legal tribunal in this country; and it may be doubted that, conceding the plea might satisfy a jury, it would stand good in point of law.¹

1554. As concerns the party to the contract who has become phthisical, all will depend, in the medical point of view, on the conditions of the disease. If tuberculization have reached an early stage only, and, more especially, if the local and general symptoms be of mild character, the pulmonary affection clearly furnishes no legitimate ground of severance of contract. But if the general suffering be grave, if *asthenia* be carried to extremes, and if there have occurred attacks of *hæmoptysis*, *per se* more or less dangerous to life, it seems to me unquestionable, on grounds deducible from facts already referred to [1551], that a fair medical plea for non-fulfilment is established.

And, accordingly, I gave evidence to this effect² in a remarkable case, the only one of the kind on record, where the male defendant far advanced in active phthisis, pleaded that the fulfilment of the contract would endanger his life.³ The jury found "the facts true," and gave a verdict in his favor. But various points of law arose, the main one being, whether the defendant was justified in withdrawing from his contract because its fulfilment would have placed his life in jeopardy. The question seems to have thoroughly puzzled the Bench—six learned judges deciding in the negative, five in the affirmative⁴—the cause now (February, 1860) standing in such position that the defendant, cast by a majority of one, may appeal to the House of Lords, and "either party be at liberty to apply, after the appeal to the House of Lords has been determined;" and this after two years' litigation! Meanwhile, to the mind unversed in forensic subtleties, the argument contained in the judgment delivered by Chief Baron Pollock in favor of the defendant seems of irresistible cogency.

¹ Justice Williams seems clearly to hold that the female might decline to fulfil her contract, if the male had become gravely enfeebled by phthisis, on the ground of his presumable sexual inefficiency. (*Law Times*, Jan. 7, 1860, p. 236.) But the question of substantial inefficiency could only be decided by medical evidence.

² In conjunction with Mr. Mackie, of Heighington.

³ *Hall v. Wright*, before Justice Erle, Queen's Bench, Dec. 1857.

⁴ *Sittings in Error*, from the Queen's Bench, "*Law Times*," *Hall v. Wright*, p. 230, January 7, 1860. Unfortunately the legal technicality of the defendant's having, or not having, given notice in proper time to the plaintiff, of necessity mixes itself up with the broader views influencing the decision of some of the judges. Long before the Bench announced its opinion, the death of the defendant had taken place (May, 1859); so that, as one of the judges observed, "the defendant's plea was, he could not marry without dying, but he died without marrying."

1555. (§ III.) *Palliative Treatment*.—The agents mainly useful in palliating the sufferings of phthisis, may be set down as follows:—

1556. Counter-irritation, in the various forms of repeated flying blisters, ammoniated liniments, croton oil, the strong acetic acid and turpentine, is an important remedy for the relief of local pain, cough, dyspnoea, and wasting expectoration; tartarized antimony is the least valuable agent of the class. Special irritability of skin and very great emaciation are the only barriers to the employment of such counter-irritation, which I prefer as a rule to permanent blisters, issues, or setons, under the clavicle. The addition of tincture of iodine in variable proportions has appeared to me beneficial; and a blistering alcoholic solution of iodine and iodide of potassium, cautiously applied, appears not only to relieve pain, but actually to promote absorption—at least I have found the respiration and percussion-sound improve locally under its use.

1557. Although sceptical as to the solvent theory of its action, I have seen benefit derived from liquor potassæ combined with a sedative and bitter tonic. Digitalis and hydrocyanic acid are both useful in cases where the heart is irritable—checking sometimes, indeed, to a very remarkable degree, various symptoms dependent on that irritability. Where a general state of erethism exists, opium, in some of its forms, must be employed, independently of necessity for it as a hypnotic or anodyne. I have never observed results justifying faith in iodide of potassium as an internal remedy; but the syrup of the iodide of iron, especially if there be the least anæmia, is a valuable medicine; it does not increase fever, and sometimes enables a patient to bear cod-liver oil, who had previously failed in the attempt to take this. Mineral acids, with light vegetable bitters, improve the appetite, and control undue action from the skin. Quinine is often not borne well, and produces no specific effect on the hectic fever.

1558. Whatever the theory of Broussais may plead to the contrary, general experience recognizes not only the inutility, but the actual mischief, of bleeding, general or local, with the idea of curing consumption. True, intercurrent congestions and inflammations in the thorax may require, both for themselves and to avert their possible consequences, slight abstractions of blood; but it is remarkable how effectually minor attacks of the kind may be counteracted by dry-cupping, blisters, and antimony.

1559. The treatment of phthisis by daily emetics (supported by a peculiar, but only partially correct, theory of the site occupied by tubercle) cannot, I fear, appeal to rigid experience in its favor—though strongly recommended by Giovanni de Vitis, Carswell, Todd, Thomson, and Burslem. Unquestionably it does less mischief, however, than the morbid anatomy of the stomach in the disease would lead us to expect.

1560. I have no experience of inhalation of oxygen, hydrogen

or carbonic acid; and but little of moist inhalations, chloruretted or ioduretted: the latter, I have recently found, relieve some forms of phthical bronchitis. Inhalation of dry iodine-vapor certainly controls excessive secretion from the tubes—and has occasionally appeared to improve the constitutional state. The inhaled vapor of warm water, impregnated with emollient herbs, such as *althæa officinalis*, with narcotic extracts, or creasote, palliates cough, dryness of throat, and laryngeal irritation.

1561. A palliative influence appears to be exercised in the early stages by the mineral waters of Ems, Oeynhausen, Eaux-Bonnes, St. Sauveur, and Cauterets.

In the Appendix is considered the question of injecting irritant fluids into the trachea.

1562. (§ IV.) *Secondary conditions*.—The secondary conditions of phthisis often require special treatment. *Hæmoptysis* has already been spoken of. The relief of *cough*, which has resisted opiates and ordinary medicines, may often be effected by the application of three or four leeches above the sternal notch.¹ *Dyspnœa* may be mitigated by inhalation of small doses of chloroform.² *Naphtha* sometimes succeeds, sometimes fails, in diminishing *expectoration*: when successful, hæmoptysis may be the immediate result.

1563. *Nausea and vomiting* may be controlled by effervescing draughts, Seltzer water, plain iced water, by prussic acid, or by a combination, which I have found very useful, of creasote, stramonium and hop; if there be acidity, by liquor calcis or liquor potassæ; by blisters and sinapisms; or, if there be tenderness, by leeches to the epigastrium. *Diarrhœa* may be arrested by soothing laxatives (rhubarb with magnesia, or castor oil, cajuput, and tincture of opium) when dependent on irritant matter in the bowel. Sometimes diarrhœa, without evidence of inflammatory action, is more or less amenable to the whole class of astringents—among which I may specially refer to sulphate of copper and opium, kino, bael and acetate of lead; and enemata of starch and laudanum, or of hæmatoxylon, krameria, or tormentilla. If there be evidences of sub-inflammatory action, friction of the abdomen with rubefacients, or the application of a few leeches either to the tender part of the abdomen or to the anus, sinapisms, blisters, and emollient poultices, are advisable. The hip-bath is very hazardous. Where the large bowel is extensively ulcerated, remedy after remedy will probably be tried in vain. I have seen some benefit, even in these cases, from the sulphate of zinc in two grain, and the nitrate of silver in one grain, doses: enemata of the latter, in solution, are also sometimes useful. In all forms of diarrhœa, except when it has become confessedly irremediable, the diet should be low and as dry as possible: attendant thirst may be mitigated by dissolving small pieces

¹ Hall, U. C. H., *Females*, vol. ix. p. 128.

² S. Wells, *Med. Times*, Oct. 11, 1851.

of Wenham-lake ice in the mouth. *Perspiration* may be controlled by avoiding much drink and using light bedclothes; the chest may be rapidly sponged at bedtime with tepid vinegar and water, or with decoction of oak-bark. Bark, zinc, the mineral acids, gallic acid, and lead, have, as medicines, the most perceptible effect. But, too often, all efforts to control the cutaneous flux fail. I know not whether the theory be sound, or the practice likely to succeed, which have lately been put forward by Dr. E. Smith, who argues and advises thus: "As profuse perspirations occur in phthisis during sleep, and as, during both day and night-sleep, the pulse is lowered, and that to a very great extent in the night, it is probable that the former must depend upon the latter. With this impression I have administered food with wine or cold tea in the night with great advantage in preventing the perspirations."¹

1564. *Inflammatory and ulcerative changes in the larynx* may be stayed by local leeching, blistering, counter-irritation with equal parts of spirits of turpentine and croton oil,² or an issue to the side of the neck or nucha. Some benefit, even temporary improvement in the voice, occasionally follows stimulation of the upper surface of the larynx, with strong solution of nitrate of silver (one or two drachms to the ounce of water); but I have never seen more than temporary benefit from the process in phthisical laryngitis. *Chronic peritonitis* requires the application of leeches, and blisters, which may be dressed with morphia, when the pain is severe, and friction with ioduretted liniments; emollient poultices with laudanum, if not too thick and heavy, relieve pain. If there be marked ascites, diuretics are indicated; but they often fail. In point of fact, this is one of the conditions of tuberculization the least really controllable by art; though it sometimes undergoes a questionable kind of spontaneous cure. Cod-liver oil, if not already in use, should, of course, be administered: the existence of diarrhoea is not a contra-indication.

1565. *Tubercular meningitis* is yet more difficult of cure; moderate local bleeding, cold irrigation of the head, counter-irritation, purgation, and other revulsive measures, and calomel internally, are alone to be trusted to. I have as yet seen but one even apparent example of recovery in an adult where the symptoms of tubercular meningitis seemed established: a few prominent particulars of the case may here be given:—

John Stoner, ætat. 25, admitted U. C. H. for second time, in third stage of phthisis, April 10, 1849. The chest-disease gradually advancing. June 2. Peculiar mutism [1442], semi-stupor, is with difficulty roused, dysphagia, drink pouring back through mouth, but not nose, pupils sluggish, no distinct convulsion, lower extremities drawn up, no paralysis, sensibility blunted, fixed frontal cephalalgia; seems conscious of all that is passing around him; P. 102, R. 44.

¹ Med. Chir. Trans., vol. xxxix. p. 190.

² This combination must be very cautiously used—three or four drops only being rubbed in with a piece of flannel for a single minute at a time.

June 4. Since this seizure, cough almost gone, scarcely any expectoration; alternate pallor and flushing of cheeks; no rigidity or convulsions, no screams, no strabismus; complete insensibility of dorsum of hands; tendency to rigidity of knee-joints; fingers firmly clenched, when unclenched by bystanders contract again; P. 142, R. 44. June 8. Sensibility returned, still speechless. June 9. Spoke as usual for first time. This man was treated with mercurials, but not to ptyalism. Discharged on July 13th, he was readmitted August 18th, and died of his pectoral disease, the cerebral functions being perfectly natural, on October 11th, 1849. *Post-mortem*: No morbid appearance at fissures of Sylvius; over both anterior lobes fine florid injection, numerous granules, opaque, grayish-white, size from pin's point to pin's head, lie under cerebral arachnoid of these lobes; convolutions here appear drawn together, as if from deep-seated contraction in the sulci; membranes here generally opalescent; dura-matral arachnoid adherent posteriorly to cerebral arachnoid of left hemisphere; membranes thicker than natural; anterior convolutions at the curve forwards, especially at left side, somewhat opaque; those of left side not materially softened, those of right firmer than natural.

1566. I have since found calcareous matter in the pia mater of the sulci in a person cut off by phthisis.¹

My actual experience on the question, whether *fistula in ano* should be cured in phthical patients, is small; such as it is, it deposes emphatically against interference, unless (what is very rare) there be wasting discharge and serious suffering.

(II.)—ACUTE PULMONARY CONSUMPTION.

1567. When phthisis proves fatal in from twenty days to ten or twelve weeks from the first appearance of symptoms, it may fairly be said to have run an acute course.

1568. Phthisis, passing thus rapidly through its clinical phases, may be either a primary independent disease, or appearing in the guise of a secondary affection, hasten the fatal termination of some pre-existent complaint.

(A.)—PRIMARY ACUTE CONSUMPTION.

1569. *Anatomical characters*.—In cases of death from primary acute phthisis I have seen the three following anatomical states: (a) limitation of tuberculous deposit, softening and excavation to the apices, just as in ordinary chronic phthisis—no peculiarity existing in the anatomy of the disease to account for the rapidity of death—which, however, I have not observed in this form earlier than the eleventh week; (b) general accumulation of crude tubercles, or tuberculous infiltration of lobules, through both lungs, with irregular softening, small excavations existing in various parts, and patches of hepatization presenting themselves here and there (*acute softening form*); (c) general studding of both lungs with semi-transparent gray granulations, coupled with the first stage of pneumonia, that of bright arterial injection [1071] or with hepatization (*acute*

¹ Osmond, U. C. H., Males, vol. iv. p. 355.

miliary form), or with normal coloration of tissue.¹ The forms *b* and *c* may coexist in the same lung.²

1570. The form (*c*) is more especially than the others characteristic of genuinely acute phthisis. Acute emphysema sometimes exhibits itself beside and amid the gray granulations.

1571. In the third case (*c*) of acute miliary tuberculization, inspection, mensuration, and application of the hand, give results either completely negative, or those observed in acute bronchitis, results more calculated, consequently, to mislead than to enlighten the observer. Neither does percussion furnish any trustworthy sign; the conditions of dulness are not only, absolutely speaking, very slight in amount, but they so equally, or so nearly equally, pervade both lungs, that any trifling defect of resonance discoverable would naturally be ascribed to individual peculiarity. At the outset the percussion-sound, just as in acute bronchitis, may acquire the characters of Type III.—fall in pitch and increase in mass of tone. The respiration uneven, harsh, high-pitched, mingles here and there with dry bronchial, or with fine bubbling rhonchi: vocal resonance gives no sign.

1572. The florid-colored stage of pneumonia has no more positive signs than those set down previously [1083]; if hepatization supervene, which is rare in this form of acute phthisis, its signs, in the main those of the simple disease, will want much of their characteristic definiteness.

1573. *Symptoms*.—The symptoms of acute phthisis in the forms *b* and *c*, are those of a febrile affection, with more or less positive functional implication of the lungs. The invasion, sometimes occurring in a state of apparent health, or preceded remotely by various depressing influences, such as anxiety of mind and overtoil, and immediately by exposure to cold and wet,³ is marked by rigors, followed by acrid heat of skin; the rigors may recur on several successive days, and there may subsequently be perspirations with abundant crops of sudamina. I have seen one or two specks on the abdomen having some, but by no means all, of the characters of the papular special eruption of typhoid or Peyerian fever:⁴ and wholly doubt the correctness of an opinion ascribed by M. Leudet⁵ to M. Waller, of Prague, that the true lenticular spots of that fever are to be found in some cases of acute phthisis. Petechiæ do not appear. Epistaxis, followed by coryza, may occur on the second day of seizure.⁶ Prostration sets in early—in a few days the patient may be unable to stand. Thirst; total anorexia;

¹ Tilbury, U. C. H., Males, January, 1858.

² Knowles, U. C. H., Males, vol. x. p. 18.

³ Hodson, loc. cit.

⁴ Garrett, U. C. H., Females, vol. vi. p. 146; May 3, 1851.

⁵ Phthisic Aigue, Thèses de Paris; 1851. M. Reudet does not share in the opinion.

⁶ Garrett, U. C. H., loc. cit.

epigastric tenderness; dry lips and tongue; dental sordes; all signify digestive disturbance: but the form of the abdomen is natural, there is no gurgling in the iliac fossa; diarrhoea is rare; and constipation may be extreme, though there be abdominal pain and ulcerated intestine.¹ Restlessness, insomnia, cephalalgia, vertigo, tinnitus aurium,² diurnal wandering, and nocturnal delirium, bespeak cerebral sympathy.

1574. Pain in the chest, variable in seat and never intense; cough (sometimes preceding, sometimes following the fever in order of development) paroxysmal or not, and either absolutely dry or accompanied with expectoration of clear or yellowish and opalescent mucus, or, in rare instances of viscid sputa, slightly stained with blood, without actual hæmoptysis; dyspnoea of considerable amount, indicated not only by the absolute frequency of breathing, but by perversion of its ratio to the circulation, and lividity of the face, constitute the chief of the thoracic symptoms.

1575. The relationship of the pulse to the respiration, however, varies; the average, in my cases, has proved 3 : 1; but I have known it once fall to 1.45 : 1 (80 : 52).³ The heart and its membranes remain unaffected. The urine, of medium specific gravity, has the characters of febrile urine generally; it contains neither albumen nor sugar.⁴

1576. In the first named case (*a*), there is nothing peculiar in the signs or symptoms; the progress of the disease, except in regard of its rapidity, is exactly the counterpart of that observed in chronic phthisis; and a lurking suspicion frequently remains in the observer's mind that tubercles may have existed in the *latent* state, for a greater or less time, before the outbreak of symptoms. In the second and third cases (*b* and *c*), there is not only a still greater rapidity of course (death may occur in less than three weeks from the outset), but the signs and symptoms are peculiar, and far from being as significant of the existing disease as might be wished.

1577. *Physical signs*.—In the case (*b*) where the lungs are more or less crammed with softening tubercle, the physical signs are as follows:—Inspection discloses nothing special; the semi-circular width of the mainly affected side, especially if pneumonic infiltration have occurred, may be slightly increased; application of the hand may detect some increase in vocal vibration,⁵ and some deficiency of chest motion; but it is impossible to say in what part of the chest this deficiency may be most marked. The resonance under percussion is more or less impaired—at first in some limited

¹ Hodson, U. C. H., loc. cit. Vide note, p. 455.

² Garrett, U. C. H., loc. cit.

³ Garrett, loc. cit. But there were some hysterical symptoms; and the ratio soon changed to one of 3 : 1.

⁴ Garrett, loc. cit. pp. 150, 151.

⁵ Hodson, U. C. H., Males, vol. ix. p. 16: vocal fremitus increased in some spots, impaired in others.

points, subsequently over the surface pretty generally; but to the last hour various spots may give resonance not positively abnormal. The quality may be markedly tubular in some places, independently of excavation: with cavity, even on a small scale, amphoric. The inspiration weak in some points, exaggerated in others, assumes bronchial or even faintly tubular quality over the most densely consolidated parts; but the highly marked sniffling metallic breathing of hepatized consolidation may be wanting, even where the entire lung is very closely infiltrated with softening tubercle¹—doubtless because the air is never so completely expressed from the vesicles in the latter as in the former case. I have known the breathing at first distant, high-pitched, as if hissed between the teeth, subsequently fall in pitch considerably.² Bronchial rhonchi dry and moist of various sizes and abundance are heard; if the condensation be very dense, the bubbling rhonchi may acquire a ringing character. If excavations form, thin metallic echoing hollow rhonchus may be caught. The characters of the vocal resonance depend on the closeness and extent of consolidation; null, weak or bronchophonic, but not snifflingly so, as in hepatization, it may be whisperingly pectoriloquous over the site of a small deep-seated excavation with intervening condensed and infiltrated texture.

1578. *Diagnosis*.—Taking the symptoms now enumerated in connection with the physical signs of each form of acute phthisis, can the diagnosis of either be established?

1579. The softening form (*b*) may at first be diagnosticated through the intensity of the general symptoms, contrasting as they do, strongly with the slight amount of pectoral disturbance—the ordinary signs of pneumonia, intense bronchitis, and pleurisy, being absent; while general and increasing dulness, or other perversion of normal resonance under percussion, coupled with the signs of breaking up of tissue, eventually renders error difficult. I say renders error difficult, because double pneumonia, proceeding to exudative or suppurative destruction of tissue, could alone, besides acute phthisis, produce such physical signs; and had such pneumonia existed, it would have been revealed at first by the signs of its early stage.³ No help will be obtained from the characters of the urine; deficiency of chloride of sodium will habitually be noted in both affections.

Acute cancerous infiltration of the lung may destroy life in less than four months, and simulate acute phthisis: but that disease is limited to one lung commonly, is attended with signs of tumor

¹ Hodson, U. C. H., loc. cit., case fatal in nine weeks.

² Connor, U. C. H., *Females*, vol. xiii. p. 201.

³ Pneumonia may, however, exist at first, furnish its own signs in more or less perfection, its rusty sputa, and perverted pulse-respiration ratio, and give place to acute tuberculization. Hodson, U. C. H., loc. cit.

about the main bronchus, often with peculiar hæmoptysis, severe local pain, and diminished width of the side.

1580. The diagnosis of the miliary form (*c*), where gray granulations accumulate sparsely through the lung, with intervening arterial injection of tissue, though greatly more difficult, may commonly be effected through the following considerations. In idiopathic asphyxiating bronchitis the skin is warm only, or slightly cool and moist, its color generally cyanotic or livid; bronchial rhonchi, dry and moist, are more abundant than in acute phthisis, and the moist class most prevalent in the former disease inferiorly, in the latter often superiorly; the pulse-respiration ratio is less perverted in primary bronchitis than in acute phthisis; in the former full muco-purulent expectoration soon occurs, fails to appear in the latter. Neither the percussion-note nor the respiration-sounds afford positive help in the distinction of the two diseases: in both affections the percussion-results may to the last maintain the attributes of health.

1581. Again, pleurisy cannot be supposed to be present, for its physical signs are wanting. And if for the first two or three days, the perverted ratio of the respiration and pulse might lead to the diagnosis of pneumonia (which, be it observed, exists in a certain state), the lapse of twenty-four hours will prove that the disease is not common idiopathic pneumonia—for the signs of hepatization are not an iota more obvious than the previous day.

1582. But singularly enough, the chief chance of error is not to be found in pectoral disease; certain affections *primâ facie* most unlikely to be confounded with acute phthisis, affections holding no direct relationship with the thorax, are precisely those of which the satisfactory distinction may prove most difficult. These are typhoid (Peyerian) fever, simple meningitis, delirium tremens, pyohæmia, and acute glanders. This difficulty, almost peculiar to the miliary form (*c*), may, however, arise in connection with the acute softening form (*b*).

1583. The simulation is closest, and hence the clinical difficulty greatest (the point has already been touched upon by M. Louis) in the case of typhoid (Peyerian) fever. Dyspnœa, prostration, bronchitic rhonchi, duskiness of face, febrile action, dry skin, adynamic state of the tongue, delirium, and stupor, not only exist both in miliary phthisis and in Peyerian fever, but may do so to similar amounts. If pneumonia be present, it affords no help in the diagnosis; for it may be supposed secondary to the typhoid fever. The abdominal symptoms and the peculiar eruption of typhoid fever draw the line, to all appearance, positively—but only in appearance: for abdominal symptoms and enlargement of the spleen may be present in acute phthisis, if the intestine be undergoing acute tubercularization; and although eruption probably exists in all cases of typhoid fever, it certainly escapes detection, possibly from its slight

amount, in a few instances. All these difficulties were well illustrated by a case, of which I subjoin the main facts:—

H. Manning, admitted U. C. H., Aug. 9, 1850 (Males, vol. v. p. 168), ætat. 23 (unable to give account of himself, subsequently known from friends to have been taken ill, July 19); prostration, stupor, dingy face, nails livid, skin warm, P. 120, R. 42, tongue dry and cracked, sordes on teeth, *spleen* $1\frac{1}{2}$ hand's breadth high, tenderness in right iliac fossa, abdomen of medium prominence, and generally tender, *diarrhœa* for last two days; no sudamina; no distinct typhoid specks; general percussion-dulness at left back, with diffused blowing respiration; same signs less marked at right back; sputa viscid, somewhat transparent, of faint tobacco juice tint; heart's size and sounds natural. *Diagnosis: Typhoid fever with secondary pneumoniâ* (the difficulty about the want of eruption being noticed at the time). *Death*, Aug. 14 (the 28th day). There was double hepatization mainly of the lower lobes; and the entire of both lungs were profusely studded with semi-transparent gray granulations (some growing opaque in the centre); a stratum of recent lymph in the left pleura was similarly studded; the spleen, 6 in. high, weighed 11 oz.; liver fatty; Peyer's patches contained crude yellow tubercles, here and there, size of pins' heads.

1584. The obscurity, thus arising from tuberculization of the intestine, has not been referred to, so far as I know, by any author. But here is even a more difficult combination. A maid-of-all-work, aged twenty-one, about one year in London, is seen, on from the seventh to the tenth day of an acute attack, unable to stand, somewhat thinned (having, on the second day, had epistaxis, followed by coryza); with brown furred tongue, epigastric tenderness, slight vomiting, one or two doubtful typhoid specks on the abdomen, vertigo, tinnitus aurium, cough, with very little expectoration, slight limited dulness at both posterior bases, a pulse-respiration ratio of about 1.56 : 1 (80 : 52), and constant decumbency on the back. It is true, neither gurgling in the iliac fossa, *diarrhœa*, nor sudamina, existed; but the two first are often wanting in typhoid fever; and it was too early, on the seventh day, to expect sudamina, on the hypothesis of typhoid fever. The pulse respiration ratio was valueless, because the woman had hysterical hyperæsthesia of the skin. Yet this case shortly proved to be one of acute phthisis, running a peculiar course, to be by and by referred to; the meninges were free from granulations.¹

1585. Where mingled excitement and adynamia are more than usually marked, acute phthisis might be mistaken for acute simple meningitis; but the following characters of the latter disease will be wanting—vomiting at the outset, incoherence, violent delirium, wild glistening eye, photophobia, and intolerance of sound, strabismus, alternate flushing and pallor of the face, convulsions and muscular rigidity or paralysis.

1586. I once saw a patient after a week's illness (a hard drinker, who had frequently had attacks of delirium tremens), with moist tremulous tongue, foul breath, confined bowels, total anorexia, cephalalgia, excited unquiet countenance, general tremors, moist

¹ Garrett, U. C. H., Females, vol. vi. p. 145.

skin, and various delusions: he coughed, it is true, expectorated some muco-epithelial matter, and his breathing was hurried; but these symptoms were thrown into the shade completely by the class indicating a mild seizure of delirium tremens. However the cerebral symptoms yielded in a few days; the pectoral grew more severe, and death took place in six weeks, under all the conditions of acute phthisis, the symptoms of which had at first been modified by the habits of inebriety of the individual. The patient, I learned, had previously exhibited symptoms of phthisis, which had remained perfectly quiescent for at least twelve months.

1587. The prostration and delirium of acute phthisis are scarcely marked enough to simulate those of pyohæmia at the outset; still, I have found it satisfactory to be enabled, by the history of the case, to exclude the latter affection from consideration.

1588. Acute glanders may in regard of its chest-manifestations so closely simulate acute phthisis, that it is fortunate in respect of diagnosis, the nasal and cutaneous conditions exist to mark the distinction.

1589. *Prognosis.*—The ultimate prognosis of acute phthisis is of necessity almost absolutely fatal—not so, however, the immediate. Thus one of the patients just spoken of, seized at the close of April, suddenly improved to so marked an amount in July, that convalescence from the first attack must be admitted to have set in; she walked about the wards, and had scarcely any symptoms. In August another acute attack supervened, which cut her off on the tenth of October.

1590. *Treatment.*—The treatment of acute phthisis is far from being well understood—the rarity with which the disease is diagnosed explains this. M. Leudet, as matter of experience, lauds the expectant method.

1591. The tendency to pneumonia justifies cautious use of the lancet, or in doubtful cases, the local removal of blood by cupping. Counter-irritation at a certain distance from the thorax will probably be serviceable: large blisters to the chest itself are injurious. Purgation must be avoided, from the danger of exciting the tuberculizing process in the intestines. Diaphoretics and sedatives are advisable; and acetate of lead and digitalis have some claim to trial. The inclination to failure in strength, from the first almost, renders the propriety of exhibiting antimony more than doubtful; mercury seems a more hopeful medicine, and has certainly not yet been fairly tried. The acute symptoms having been successfully combated, the management of the disease becomes that of its chronic form.

(B.)—SECONDARY ACUTE CONSUMPTION.

1592. Acute phthisis may suddenly destroy the life of persons laboring under the chronic disease at a period when the symptoms of the old-standing tuberculization may have fallen into a state of

quiescence or even latency. Or acute pulmonary consumption may form the terminal phenomenon of various slowly destructive maladies. In the latter remarkable aspect, acute phthisis had not, so far as I am aware, been even glanced at by writers, until the subject was touched upon in the last edition of this work. Tuberculization may, in this aspect, imitate pneumonia, and bring to a sudden close the career of lingering sufferers.

1593. The following are the most striking illustrations I can refer to.

1594. Two men, of middle age, dying of paraplegia, had myelitis, sharply limited to the dimensions of an oblong, horse-chestnut looking mass developed in the spinal meninges. In one of these cases the tumor had the microscopical constitution of tubercle;¹ in the other those of low exudation-matter.² In the former instance the patient died with symptoms clearly traceable to the acute tuberculization found in the lungs; in the other instance the tuberculizing process remained latent. In both patients the anatomical characters of acute phthisis were perfectly developed.

1595. I have seen death rapidly caused by acute miliary tuberculization in a man who had for years labored under attenuated dilatation of the heart and chronic vesicular emphysema. Pulmonary apoplexy and œdema, with intense turgescence of the surface, showed the grave amount of cardiac obstruction.³ This case alone would suffice to prove that "venosity of blood" constitutes no absolute obstacle to the tuberculizing process.

1596. Acute tuberculization may abruptly destroy life in leuco-hæmia;⁴ or similarly close existence in cases of pre-existent tuberculization of unconnected organs. Thus, a man aged 35, in whom the texture of the supra-renal capsules had long been destroyed and replaced by huge masses of crude tubercle, was rapidly struck down by acute phthisis.⁵ When acute deposition in the lungs closes life in cases of general tuberculization, the pulmonary symptoms may be very slight.⁶

H.—HÆMATOMA.

1597. Hæmatoma, or tumor composed of fibrin, colored or not, and arising from past hemorrhage, occasionally occurs in the lung as the final issue of nodular apoplexy—or as the persistent condition of coagulated blood in a tuberculous excavation.⁷

1598. Clinically, hæmatoma in the lung is without importance.

¹ Anson, U. C. H., Males, vol. ix. p. 254.

² Knowles, U. C. H., Males, vol. x. p. 18.

³ Mr. H., seen with Mr. W. Bailey.

⁴ Wilkinson, U. C. H., Females, vol. xiii. p. 145 (died at her own home).

⁵ Hannant, U. C. H., Males, vol. xiv. p. 179. This man's supra-renal capsules were converted into huge masses of tubercle; but the skin was free from bronzed tint.

⁶ Tilbury, U. C. H., Males, loc. cit.

⁷ U. C. Museum, No. 2213.

I.—SARCOMA.

1599. Sarcoma, or fibro-plastic tumor, ranks among the rarer pulmonary formations. Nodular masses, passing for cancers to the naked eye, are sometimes thus composed. They have little disposition to intrinsic softening, rarely excite irritation in the surrounding tissues, and consequently produce symptoms on the mechanical principle almost solely. Their clinical history is identical with that of scattered cancerous unsoftened nodules.

J.—CYSTOMA.

1600. I have never seen a simple serous cyst within the lung. Laennec's case, often referred to as proving their occurrence, was in infinite probability, according to his own admission, acephalocystic.

1601. A case narrated by Mohr,¹ in which several cysts of various sizes were found in the left lung, containing (exactly as in pilous cysts of the ovary) free tufts of hair, and hairs attached to the lining membrane of the cyst by well formed bulbs, stands so far without a parallel.

K.—CARCINOMA.

1602. Cancer of the lungs forms, in rare instances, the solitary local evidence of the diathesis. When associated with cancer elsewhere (and such association has been found in every conceivable variety) the pulmonary formation is generally secondary: the lung, so ready to afford a nidus to cancer-blastema, circulating from another source, exhibits but little proneness to affect distant parts with its own disease. And visceral contamination, secondary to cancer of the lung, is greatly less common than that of the bones or subcutaneous cellular tissue of the chest.²

1603. Cancer in the lung appears to be particularly common as the secondary development, where the testicle has been the primary seat of the disease.

1604. Encephaloid ranks as by far the most usual species; scirrhus is rare; of colloid there exist but one or two recorded examples. Blood-infiltration and melanic deposition are not uncommon.

1605. Secondary cancer implicates both lungs, except in infinitely rare instances: primary cancer affects a well-marked preference for the right, scarcely ever involving both organs.

1606. Secondary cancer commonly occurs in the nodular form: I have, however, seen infiltration where the secondary character could not be doubted. Primary cancer may infiltrate the tissue,

¹ Berliner Med. Zeitung, 1839.

² Minute, subcutaneous, and periosteal pisiform cancers shortly before death in Jennings, U. C. H., Females, vol. xv. p. 64.

spread from the root of the organ in irregularly tuberous form, or hang in pedunculated masses from the surface of the lung.¹

1607. The weight of a cancerous lung may rise to four, five, or even six pounds. The bulk does not increase *pari passu*: a lung weighing two pounds and upwards, may be smaller than natural—a fact on which much of the physical diagnosis of the disease hinges.

1608. Cancerous nodules do not necessarily entail structural change in the surrounding tissue, they simply push it aside; and, though not truly encysted, may commonly be easily enucleated. In the case of tuberous masses with infiltration, the cancerous matter seems to replace, molecule for molecule, the pulmonary texture, so that the outline of lobules is distinctly retained; in like manner the bronchial walls may be represented by a cancerous tube.²

1609. The intrinsic progress of cancer obeys the same laws in the lung as elsewhere: softening commonly proceeds from the centre.

1610. The ultimate branches of the pulmonary artery and vein sometimes undergo obliteration through external pressure. The trunk and larger branches of both pulmonary artery and vein, as also the inferior cava, may contain encephaloid substance, or coagulated fibrin. The nerves have not been carefully traced; but from analogy may be presumed to be infiltrated and destroyed, or rendered atrophic by pressure.³

Either a main bronchus, or the tubes of secondary order, may be closed by pressure of a growth from without, or by the enlargement of a portion of this within the tube, after it has perforated the wall.

1611. *Local effects.*—Pneumonic consolidation, diffuse pulmonary apoplexy,⁴ gangrene, rupture of the pleura, with escape of blood and diffuent encephaloid into the serous cavity, pneumothorax, hydrothorax, empyema, all of them take place among actually observed local effects. Lateral detrusion of the heart, trachea, and œsophagus, may ensue from pressure of an associated tuberous mass, if this be large: or, in consequence of lessening bulk of the lung during the process of infiltration, the main bronchus and the trachea may be notably, the heart slightly, drawn towards the diseased side.⁵

1612. *Coexistences.*—Tubercle and cancer, as I long since showed numerically,⁶ rarely coexist. There is, however, no absolute constitutional antagonism between the two diseases. I have seen

¹ Dewing, U. C. H., Males, vol. v. p. 19.

² Jennings, U. C. H., Females, vol. xv.

³ Case of Smith, Subcutaneous Cancer, "Med. Times and Gaz.," August, 1852.

⁴ Carswell's Framed Drawings, U. C. Museum.

⁵ Jennings, U. C. H., loc. cit.

⁶ Cyclopedia of Surgery, vol. i. p. 623; 1840.

growing encephaloid and softening tubercle seated side by side in the same lung. Gout may coexist with pulmonary cancer.¹

(A.)—SECONDARY NODULAR CANCER.

1613. *Symptoms*.—Secondary nodules may be perfectly latent in regard of symptoms. Pain has not occurred within my observation; the breathing may be free, and cough absent. Where the accumulation becomes extensive, either in point of number or size of the nodules, dyspnœa may, however, occur, and even acquire extreme intensity: yet, *per contra*, even under these circumstances the respiration may remain free almost to the last hour.²

1614. If these masses be of small size, they are with difficulty detected by percussion; and may not produce pressure enough on the lung-substance to modify the respiration-sounds. I know by experience, however, that some three or four masses, about the size of walnuts, scattered about the infra-clavicular and mammary region, may very sensibly raise the pitch and harden the quality of the percussion-sound, weaken the respiration at the spot, and impress upon it harsh bronchial quality beyond. I believe, on the other hand, that where numerous scattered nodules exist in the parenchyma, the general percussion-tone of the chest may be of the exaggerated Type II. [197];—the probable result of the imprisonment of air by nodular pressure on the tubes and consequent pulmonary distension.

1615. Bronchitis occurs sometimes; but may be totally absent even where the nodules are sufficiently close and bulky to cause

¹ Jennings, U. C. H., Females, vol. xv.

² A theomaniac, of the melancholy class, and belonging to the sect of "Ranters" (J. K., æt. 49, Males, U. C. H.): "About six months previous to admission into the hospital, on Dec. 21, 1858, became subject to failure of memory and fits of rage, sometimes threatening to murder his wife. Took to his bed three weeks since from bodily weakness; has since been drowsy and stupid, but has hardly slept at all. Whilst in the hospital, he lay on his back, with a dull expressionless countenance. He was with difficulty got to answer any question, and then only in a low tone and with extreme slowness; it was elicited that he had slight headache, but no pain of any description elsewhere. He had no paralysis, no rigidity of any of the muscles. He lay still in bed, asking for nothing, and passing his motions and urine under him, but, as it seemed, merely from disinclination to move. After being in the hospital about a week he began to refuse his food, which, however, was forced down him, with wine, bark, &c. He gradually became weaker, and died on January 11, 1859, apparently from inanition. No other symptom occurred before death, except that the breathing had become rather labored during the last few hours. He was quite conscious up to the last, and had no paralysis, and no impairment of the senses: he had resisted receiving his medicine shortly before death, endeavoring to push the glass away with his hands, and, after the medicine was got down, his face put on an expression as of disgust with the taste. He had no cough, nor any other symptom directing attention to the chest. *Post-mortem*: the right lung infiltrated, throughout its lower half, with encephaloid cancer; the left lung crowded with nodules of the same, from a pin's head to a pea in size. Brain presented numerous rounded cancerous masses, studded throughout its whole substance; these varied in size from a small pea to a large nut; there were certainly more than twenty of them." From notes by my clinical assistant, Mr. Hickman. The negative symptomatology of this case was not less remarkable in regard of the lungs than of the brain.

very distinct deficiency of tone and rise in pitch of the percussion-sound.

(B.)—PRIMARY PULMONARY CANCER.

1616. *Physical signs.*—The physical signs of primary infiltrated cancer of the lung are numerous. The affected side is flattened, or even generally retracted, and the intercostal spaces slightly deepened; the respiration-play impaired,—the interspaces, nevertheless, sinking with inspiration; the vocal fremitus increased, if the infiltration be slight, diminished, or even annulled, if it be extensive, or, especially, if coupled with tumor non-adherent to the chest-wall.¹ The heart's impulse may be felt, too distinctly, through the lung. The percussion-sound varies. The most common condition is that of Type III. [199],—raised pitch and hard, wooden, or tubular quality. But simple dullness may be the prominent character. Sometimes this difference depends on difference in the density of the cancerous structure, sometimes on the relationship of the diseased parts to the trachea and large bronchi. With the increase of the mass a tubular note may change to a toneless one.² Whatever be the morbid condition present, it may extend across the middle line, whether there be, or be not, mediastinal tumor; in the latter case the phenomenon, much less marked than in the former, depends upon horizontal conduction [221].

1617. The respiration, coarsely blowing or bronchial and loud, so long as the channel of the tubes is not encroached on, becomes weaker and weaker as that encroachment advances, retaining bronchial and hollow quantity as long as audible. Over the unaffected lung, and non-implicated parts of the diseased organ, where the tubes remain free, the respiration grows more or less exaggerated. Should softening and elimination of the infiltrated texture occur, cavernous respiration and rhonchus supervene, unless there be accidental closure of the main bronchus by pressure from super-added tumor.

1618. The vocal resonance varies widely; it may be diffusely and strongly ringing, but only within the chest,—or may travel to the ear and produce vibration of the concha; or no form of bronchophony may exist.

1619. In a case of moderate infiltration of the right lung, in a female, with added mediastinal tumor, the measurements of the two sides were—

	Right.	Left.
Above mamma	14½	14½
Below "	14½	15½

1620. The diaphragm may be considerably raised on the affected side; the heart is rarely much displaced by tractive action.

¹ Jennings, U. C. H., *Females*, vol. xv. p. 65; the impediment extended to the axilla.

² Jennings, *loc. cit.*

1621. The non-cancerous lung (for the disease is limited, in the great majority of cases, to one organ) gives signs significant of health, of hypertrophy, of emphysema, or of bronchitis.

1622. *Symptoms.*—(a) *Local.*—It has occurred to me to see one case of genuine encephaloid infiltration unattended by pulmonary symptoms: the affection ran a latent course. But here the infiltration was on a very limited scale, and the patient's life abruptly brought to a close by unconnected disease. It seems to me improbable, as matter of reasoning as well as of experience, that extensive infiltration can for any length of time remain unannounced by symptoms. Yet the singular case, just referred to [1613], shows the wisdom of a cautious view on this point.

1623. In ordinary cases, pain of variable duration, intensity, character, extent, and constancy, apparently occurring either in the cancerous lung itself, in the pleura, or in the intercostal nerves, and often attended with cutaneous hyperæsthesia, is a very constant and sometimes has proved the first, symptom.

1624. If the disease be limited to pure infiltration, the breathing may continue easy, almost to the close of life: but especially where tuberos formation coexists, dyspnœa, continuous or paroxysmal, slight or intensely grave, and in the latter case accompanied with asphyxial tint of skin, constitutes a dominant symptom: orthopnœa may exist for weeks before death. The dyspnœa arises at once from blood-alteration [1704], irritation of the vagus, mechanical obstruction of vessels, and encroachment on the lung-substance and tubes.

1625. Cough, an invariable symptom, is, in very rare instances, dry; in the great majority, attended with expectoration. The sputa may be simply catarrhal, purulent, or bloody. In the latter case, the blood seems thoroughly mixed with serosity, mucus, or muco-pus; and the sputa, commonly opaque, sometimes slightly translucent, are of the color of red or black currant jelly (and not very unlike those substances), or pink. Encephaloid detritus has in rare instances been expectorated, of cognizable physical characters; and cancer cells been occasionally found microscopically, where the naked-eye characters had failed to appear.¹ The frequency and peculiarities of cancerous hæmoptysis have already [1289] been dwelt upon. Excessive fetor of the breath or sputa, with or without obvious local gangrene of the lung, occasionally occurs.

1626. The decumbence is most frequently diagonal on the back and affected side; sometimes solely on the affected side: not within my experience on the sound side alone; though, under the improvement produced by treatment, temporary power of lying on that side may be acquired.

1627. Infiltrated cancer produces no centrifugal pressure-signs

¹ Dr. Ransom, of Nottingham, tells me he has found the ciliated bronchial epithelium fatty.

[489], and the only centripetal signs of the kind which it appears, unassisted by tumor, to have positively entailed, are dysphagia and obstructed breathing. If associated with mediastinal tumor, the various pressure-signs of that disease will be more or less prominently present.

1628. (*b*) *General*.—The general symptoms are sometimes slight. Emaciation, though slow in appearing, once established, advances with a rapidity sometimes extraordinary. The loss of flesh is notably more sudden than in phthisis.

1629. The pyrexia, at first slightly, eventually becomes highly, marked. The pulse may not exceed 110 to 120, however, to the close; and a pulse-respiration ratio of 3:1 or 2.5:1 obtain. If the mediastinum and root of the neck be free from tuberculous growth, no difference can be detected in the carotid or radial pulses on the two sides, or in the state of the pupils [498]. Night-perspirations sometimes occur copiously; but, on the whole, they do not reach by any means the phthisical average: just as in phthisis, the more profound the sleep, the more profuse the cutaneous flux.

1630. Even where other organs are cancerous, the skin may to the last fail to exhibit the true cachectic coloration of the disease,—the asphyxial tint predominating. Sometimes, however, the genuine straw-like or waxy shade appears.

1631. *Mode of death*.—Increasing dyspnoea and cough, insomnia, failure of assimilative power, sometimes attended with anasarca of the lower extremities (which, however, rarely occurs to any extent unless tumor be present), put a term to existence.

1632. *Duration*.—The mean duration of cancer of the lung, I formerly found, might be estimated at 13.2 months; the greatest 27 months; the least 3.5 months.

1633. *Diagnosis*.—Infiltrated cancer can only be confounded with diseases lessening the bulk of the lung; these have already been enumerated under the head of CIRRHOSIS [1255], where the distinctive marks between that disease and cancer will be found.

1634. Cancer is distinguished from *chronic pneumonia* by the notable amount of flattening of the side; by the occasional extension of morbid resonance beyond the median line,—which never, so far as I know, occurs in *chronic pneumonia*; by any sign of centripetal pressure present, as dysphagia or weak respiration from bronchial pressure,—for such never occur in pneumonia; by the progress of the disease, which, stationary in pneumonia, leads to excavation in cancer; by the peculiar jelly-like or cancerous expectoration in the latter affection, and by the much greater severity of its local symptoms.

1635. From *tubercle* cancer differs by the signs of extensive consolidation being unattended with rhonchus; by the absolute limitation of the disease to one lung, which, common in cancer, is infinitely rare in tubercle; by any signs of centripetal pressure, as gradual suppression of respiration on the affected side; the jelly-like

expectoration; the less severity of the constitutional symptoms, and the total absence of the secondary morbid states of phthisis. If the cancer have softened, the microscopical characters of that product may be found sometimes in the sputa.

1636. From *chronic pleurisy with retraction*, cancer will be distinguished by the less amount of deepening and narrowing of the intercostal spaces; the greater respiratory play; the less irregularity of surface; the greater amount of respiratory sound, especially in the inferior regions;¹ the natural position of the shoulder, scapula, and spine; the absence of friction-sound; by any centripetal pressure-sign that may be present; the peculiar expectoration; by the greater severity of the local symptoms as a whole; and by the history of the case, indicating in the one instance a disease on the increase, in the other on the decline.

1637. The distinctive marks between collapse of lung and cirrhosis [1256*] will avail in the separation of cancer and collapse.

1638. The existence of external or visceral cancer may aid in the diagnosis in any of the above cases.

1639. *Treatment*.—Cancer seated in the lungs is even less under the control of remedies than when occupying some other localities. No evidence exists of the utility of arsenic or conium; cod-liver oil deserves a trial. Symptoms must be relieved, as they occur, by ordinary measures. Dyspnœa is best mitigated by dry-cupping and blistering; small bleedings give temporary relief, but they cannot, of course, be often repeated.

(C.)—PRIMARY PULMONARY AND MEDIASTINAL CANCER.

1640. Cancer of the lung is more commonly associated with the disease in the mediastinum than solitary and independent. Hence, in actual practice the characters of solidified infiltration of the parenchyma of the lung and of mediastinal tumor are, as a rule, more or less commingled; those of the one or the other predominating, according to the extent and topical relationships of each. To describe all the variations in the signs contingent on their mode of association would be an endless labor: the student must in difficult cases consider well the probable relative power of the *contracting* influence of the infiltrating form of the disease, and the *dilating* influence of the tuberous variety, on the thoracic walls.

L.—INDURATION-MATTER.

Vide CIRRHOSIS.

M.—CARTILAGINOUS TUMORS.

1641. The growth of true cartilage in the lung must be an infi-

¹ On the right side, however, the base may give very little respiration in consequence of encroachment of the liver, which is drawn up by the contracting lung: this was well seen in Jennings's case, frequently referred to.

nately rare phenomenon. I am acquainted with but one case of the sort,—that recorded by Mr. Paget.¹

1642. A man, castrated in January, 1855, for a cartilaginous growth in a testis and its lymphatics, died suddenly three months later. The sole symptom, connected with the chest, appears to have been breathlessness, as that of a man "panting after rapid running." Diminished percussion-resonance existed below the clavicles and at the posterior bases; the respiration, bronchial below the clavicles, was mingled with loose crepitation inferiorly.

The weight of the lungs had risen to 11½ pounds from the growth within them of nodular masses of true hyaline cartilage, varying in diameter from less than a line to an inch and a half, scattered irregularly but pretty equally through all parts of both lungs, and embedded in healthy lung-substance, from which they were easily enucleated.

1643. In all clinical respects these tumors were accurately assimilable to secondary cancerous nodules: the effects of both are purely mechanical.

N.—BLOODVESSEL.

1644. The adventitious production of bloodvessels in the lung has not yet acquired sufficient practical significance to justify further consideration than that already [1338] incidentally given it.

O.—ENTOZOA.

ACEPHALOCYSTS.

1645. Acephalocysts, furnishing the habitat of echinococci, may be found in three modes of relationship to the lung. They may form primarily in this organ;—they may appear secondarily, as far as can be ascertained, to similar entozoa in the liver, but without any direct connection with these,—and, lastly, are found in transitu outwards from a cyst seated in the liver. Under all these conditions acephalocysts may, or may not, be expectorated during life.

1646. *Anatomical characters.*—The anatomical characters of the echinococcus, of the acephalocysts it inhabits, and of the mother-cyst, are the same in this organ as in their more common seat, the liver. The mother-acephalocyst sometimes lies in direct contact with the pulmonary tissue, and is rarely surrounded with thickened cyst-like wall. The sac rarely attains great size, and commonly contains fluid of the same physical aspect as that of hepatic acephalocysts,—hence probably of the same very low specific gravity, slightly albuminous, and markedly saline, composition. Though occurring in all parts of one lung only, or of both lungs,

¹ Med.-Chir. Trans., vol. xxxviii. p. 247.

acephalocysts exhibit a preference for the bases: in one remarkable case, the pulmonary veins afforded them a nidus.¹

1647. Acephalocysts may be found in the midst of perfectly healthy tissue: this is very rare. Bronchitis, pneumonia, pleurisy, gangrene, perforation of the pleura and pneumothorax, singly or variously combined, have been met with as local effects. A case recorded by Laennec renders it highly probable that a pulmonary sac may make its way through the diaphragm, and discharge its contents through the intestines. In M. Andral's case where the entozoa occupied the pulmonary veins, the right heart underwent dilatation with hypertrophy, probably from the obstruction in the venous circulation.

1648. Acephalocysts in the lungs may be the sole organic disease existing; or they may be associated with acephalocysts in the liver, mesentery, and spleen. In one certain instance they coexisted with tubercles in the lungs—in another with cancer of the uterus—in another with ascarides lumbricoides.

1649. *Signs and symptoms.*—The clinical aspects of the disease differ so materially when the lung alone is implicated, and when perforation of that organ from a hepatic sac occurs, that they must be separately considered.

1650. (I.) *Acephalocysts limited to the lung, or at least not directly connected with a hepatic sac.*—There may be a total deficiency of subjective symptoms—the disease, in fact, being *latent* provided the cyst be of moderate size, and have not irritated the adjacent tissues. In a case of this sort Andral had found exaggerated respiration, inexplicable during life, on the side where the sac existed.

1651. But the rule is that symptoms, essentially phthisical in character, occur. Cough, dyspnoea, more or less severe chest-pain, and inability to lie on one side; expectoration, catarrhal or bloody, followed by that of fragments of their walls, or of perfect acephalocysts of various sizes, gives at length the special character to the disease. Night-sweats, but especially emaciation, may become extreme. The hydatid expectoration generally occurs paroxysmally, and may, on each occasion, be preceded by suffocative dyspnoea and great general anxiety: the quantity of entozoal substance voided at any one time varies from a few microscopical fragments up to a pint and more of unbroken acephalocysts. Neither bile nor urine is expectorated.

1652. Expectoration of acephalocysts may continue in such cases through a period of several months: generally serious pulmonary symptoms precede their first, and follow their final, elimination.

1653. So long as a sack remains unbroken, the physical signs simply indicate solidification; the quantity of respiration-sound

¹ Andral, Clin. Méd., éd. 2, t. ii. p. 412.

will vary with the existence or absence of pressure on an important bronchus. If breakage take place, and the sac communicate with the bronchi, tubular or amphoric percussion-note, and the whole class of cavernous auscultatory sounds, will ensue on evacuation of the mother-cyst.

1654. *Diagnosis*.—The diagnosis from phthisis will in many cases probably prove impossible, unless acephalocysts be discoverable in the sputa; such discovery, too, will alone distinguish gangrene produced by this disease from gangrene of other kinds. From the observations of Dr. Peacock ("Edinburgh Journal," 1850), it may be expected that the microscope will prove of service in this way: the hooklets of the echinococcus may sometimes be distinctly recognized in the sputa—probably, too, when the naked-eye evidences of the entozoa are deficient.

1655. *Causes*.—Of twelve cases belonging, the majority certainly, the small minority very probably, to the present category, seven occurred in males of a mean age thirty-three—five in females, of a mean age thirty-one. No clue is afforded by past experience to the ætiology of the affection.

1656. *Prognosis*.—The prognosis is far from very unfavorable in this form of the disease. In nine cases here were the results. Three ended fatally; but in one of these tubercles existed, and in another death was not even accelerated by the hydatids: the issue was doubtful in a fourth: while in the remaining five, perfect recovery took place. In every instance expectoration of hydatids had occurred.

1657. (II.) *Acephalocysts entering the lung from the liver, or, originally pulmonary, communicating secondarily with a hepatic cyst*.

1658. *Signs and symptoms*.—In cases of this class more or less obscure hepatic disturbance has been noticed for a variable period before the outbreak of severe symptoms indicating communication with the lung—intermediate pleurisy sometimes occurring before the pulmonary tissue itself has been involved. The signs of hepatic disease have been epigastric pain, occasional nausea, and vomiting without obvious cause, failure of appetite, pains about the right infra-axillary and scapular regions, evidences of enlargement of the liver, and dingy earthy yellow or actually jaundiced skin, with icteric urine and feces. But the real nature of the hepatic disease has, in recorded cases, scarcely even been suspected.

1659. When the lung becomes involved, the following very serious symptoms ensue: inability, from pain, to lie on the affected side; jactitation, pinched anxious countenance, and dread of death; jaundice of variable depth of hue; loaded tongue, sickness, vomiting of food and bile, anorexia, thirst, constipated and subsequently diarrhoeal icteric stools; cough of paroxysmal character—the paroxysms attended with lividity of face, cold extremities, clammy surface, dysphonia, and all the signs of semi-asphyxia, until relief

is obtained by copious expectoration of acephalocysts,¹ more or less deeply bile-tinged, perfect or in detritus, mixed or not with mahogany-colored fetid fluid, sometimes even with cognizable shreds of sloughed lung; excessively frequent, small unsteady pulse, and fluttering palpitation of the heart; icteric urine; muttering delirium, nocturnal and diurnal: all these symptoms taken together make error in diagnosis impossible.

1660. The physical signs are those of more or less extensive lung consolidation, followed by those of excavation—tubular, amphoric or cracked-metal percussion-note, hollow metallic cavernous respiration, pectoriloquous echo and thin metallic ringing rhonchus.

1661. *Terminations.*—An acute seizure of this character may prove fatal within a few days; or the patient may struggle through one or more attacks of subacute pneumonia, continue to expectorate hydatids from time to time for some weeks, and eventually recover. Permanent change of voice remained in one case recorded by M. Andral. But death has been the common sequel of such attacks; and the progress is greatly more unfavorable than when the lungs alone furnish the hydatids.

1662. Of nine cases belonging to this class, two occurred in males of the mean age of thirty-one at the time of observation; seven in females, whose age averaged thirty.

1663. *Diagnosis.*—The precise nature of the attack can of course only be diagnosticated by careful examination of the matters expectorated. Bile-stained hydatids, whole or in fragments, even microscopical particles, such as the hooklets, settle the question of nature and seat at once—they exclude simple hepatic abscess, and perforating pyelitis.

1664. *Treatment.*—Of the specific treatment of pulmonary, as of other hydatids, little is known. Chloride of sodium and iodide of potassium, presumedly deleterious to hydatid life, should be tried. But admitting the vitality of existing echinococci to be destroyed, the elimination of the acephalocysts remains to be effected—unless in the defunct state these entozoa cease to act as irritants to the lung. Natural cure of hydatids by accumulation of plaster-like material within the mother-cyst has not been observed, as far as I am aware, in the lung.

1665. Should an external swelling appear, it seems advisable to open it. M. Freteau (*Ann. de Montpellier*, t. xi.), forty years ago, opened a sac in the right dorsal region; upwards of four hundred fragments of hydatids were discharged by the wound, and fifty expectorated: the patient, a male, recovered.

¹ I have known nearly a hand-basin full of acephalocysts discharged in this way by an adult male, without immediately fatal results. The asphyxial state clearly depends on temporary obstruction of main bronchi, and is identical in mechanism with that observed in some cases of plastic bronchitis.

P.—ENTOPHYTES.

1666. Some while since, Dr. Hughes Bennett figured an entophyte allied in appearance to the *Penicilium glaucum* of Link, and found on the walls of tuberculous cavities: the jointed tubes of the entophyte had been expectorated two days, at least, before death.

1667. Virchow found an abundant crop of *Sarcinæ Goodsirii* in a gangrenous portion of lung: they must have grown where found. More recently, Zenker gave the particulars of a case where, though found in the lungs, the *sarcinæ* might, as a bare possibility, have made their way into the trachea before death from vomited matters, containing the entophyte in abundance. The discovery has no practical significance at the present day.

SECTION VII.—DISEASES OF COMPOSITE CHARACTER.

I.—ASTHMA.

1668. Asthma is a title conventionally applied to dyspnoea, at once grave in itself and paroxysmal in character. Understood thus (and the acceptation is the widest that can possibly be allowed), asthma may depend upon the bronchial tubes, the blood, pulmonary substance [928], the heart, or the great vessels.¹ The two first forms of the complaint only, will be treated of in the present place.

A.—BRONCHIAL ASTHMA.

1669. Bronchial asthma may depend on a *plus* or a *minus* state of the contractility of the muscular fibres of the bronchial tubes: in the former case it is spasmodic, in the latter paralytic.

(1.)—SPASMODIC BRONCHIAL ASTHMA.

1670. By spasmodic asthma is clinically understood paroxysmal dyspnoea, immediately dependent on more or less extensive obstruction of the smaller bronchi, itself caused by tonic contraction of the circular fibres. The immediate cause of this contraction is, in turn, under all circumstances, perverted innervation, affecting the trunk or branches of the vagi or sympathetic nerves. And lastly this perversion of nervous influence may arise independently of, or on the other hand in direct connection with, anatomical change in the bronchi or parenchyma. Spasmodic asthma is in other words a primary or a secondary neurosis of the tubes.

1671. When a primary neurosis, the paroxysms may be of direct or reflex mechanism: direct, when dependent on centric excitation in the medulla oblongata, or irritation of the trunks of the vagi or sympathetic nerves: reflex, where sequential to gastric or intestinal

¹ The *soroche* or, so-called, "mountain-asthma" [1300], which depends not on any defect of the respiratory apparatus, but on the qualities of the air admitted into the bronchi, cannot legitimately be placed among asthmatic diseases.

disturbance,¹ uterine or ovarian irritation, spinal irritability, intercostal neuralgia, hepatic congestion, hepatalgia and pure hysteria.

1672. When a secondary neurosis, the paroxysms are excited through the reflex irritant influence of bronchitis or emphysema. The bronchitis is chronic, commonly sub-acute, and in nowise specially characterized anatomically: and as multitudes of similar cases of chronic alteration of the tubes exist unattended with asthma, there is evidently something special in the diathesis of those who suffer. In these associated cases the patient may first have been the subject of pure spasm, and eventually become bronchitic; or bronchitis may have led the way, and by degrees generated the nervous irritability. The connection of emphysema with spasmodic seizures is certainly sometimes, possibly always, dependent on intervening irritative or passive congestion of the tubes.

1673. These varieties of mechanism may be thrown into tabular form thus:—

Immediate excitant of fit: perverted innervation of vagus [and sympathetic].	{ A.—No local anatomical change (<i>Primary neurosis</i> B.—Local anatomical change exist (<i>Secondary neurosis</i>).	{ Direct . Centric . Reflex .	{ Irritation of vagus or sympathetic trunks. Excitation of medulla oblongata. Irritation of spinal visceral nerves.

1674. In the class A of primary neuroses it must be remembered that although theoretically, and sometimes as matter of observation, we are called on to admit the direct and centric mechanisms, examples of these at the bedside are excessively rare—the bulk of cases being of reflex origin.

1675. The extrinsic causes of a paroxysm in the two classes, A and B, differ. In the first, where purely neurotic, any sudden impression on the nervous system will suffice. In the second, some direct irritation of the mucous surface is generally discoverable—the inhalation of air irritant from its chemical or physical composition, from its temperature, its weight and various other qualities. But no one condition is uniformly productive of paroxysm in different persons, nor even on all occasions in the same person. Any

¹ In all cases of asthma where irritation of the terminal filaments of a distant nerve is the cause of the seizure, special predisposition must be admitted: without this, asthma will not occur. Thus in the case of a young female with tetanic spasms, so severe, that in one of them the neck of the femur snapped in two (the attacks were completely cured by mechanical removal of scybalæ from the rectum), there was no semblance of disturbed breathing. On the other hand, in predisposed persons, I have known ordinary constipation of a few days' duration suffice to bring on a severe paroxysm.

² A foreign body in the tubes will produce reflex spasm by the same mechanism as bronchitic irritation: of this truth, a most remarkable illustration, occurring in his own person, has been given by Dr. Nooth (Trans. of Soc. for Improvement of Med. Knowledge, vol. iii.).

mechanical difficulty in the pulmonary circulation, such as arises from mitral disease, or from distended stomach and bowels pushing up the diaphragm and encroaching on the chest, facilitates the action of more direct causes.

1676. *Mode of seizure.*—A paroxysm may, then, be preceded by a variety of disturbances, digestive or other; or take place independently of any one of them. Under either class of circumstances a sensation of oppression and discomfort in the chest (whether from an actual commencement of spasm, or from mere paræsthesia of the vagus, it is difficult to say), may be the immediate precursor of the fit; or this may occur suddenly without the very slightest warning. As in all diseases where the excito-motory system plays an important part, seizures frequently take place during sleep.¹

1677. *Symptoms.*—And it is then, perhaps, the symptoms are the most strikingly defined. The patient starts out of sleep with a feeling of suffocation or constriction about the chest. The efforts at inspiration, convulsively violent, and painfully ineffective, are accompanied with sinking of the epigastrium, falling in of the lower part of the sternum, and elevation of the diaphragm—evidently from the diminished mass of air in, and consequent collapse of the lower parts of, the lungs. The expiration is prolonged, but comparatively easy. Both acts, but chiefly the former, are attended with wheezing. Various postures are assumed to facilitate the attempt at filling the chest—the patient stands erect, with the head thrown backwards, seizing some solid object to give greater vigor to his efforts—or leans the head forwards between the hands, or places himself on his knees and elbows, or rushes to an open window, and gasps wildly for air. The eyes are prominent, staring, watery, and suffused—the face flushed, livid, or pale—the nostrils dilated—the look anxious and imploring. The temperature of the general surface falls, that of the chest may actually rise; clammy perspiration breaks out over the head and face, or in various parts.

1678. The pulse, small and feeble, sometimes grows distinctly irregular, though the patient be free from heart-disease, and there be no actual palpitation at the time.

1679. The urine, pale and abundant during the paroxysm, becomes scanty, high-colored, and loaded with lithates at the close: in some persons, however, free watery diuresis continues for twelve hours and upwards after the cessation of the fit.

1680. Although the outward indications, that usually accompany venous congestion of the brain, especially loading of the capillaries and venous radicles of the face and scalp, invariably become more

¹ Still it must be confessed there is not the great predominance of nocturnal seizures which implicit faith in Marshall Hall would lead us to expect. The same is true of pertussis, as also of the much graver disease epilepsy, where, according to the elaborate inquiries of Leuret, cases of attack, limited to the day and to the night respectively, are of precisely equal frequency; while Herpin actually found twice as many seizures by day as by night.

or less marked in the paroxysm, the cerebral symptoms are as a rule slight—headache, vertigo, tinnitus aurium, photopsia, and some temporary disturbances of vision comprising all that is observed. Convulsions do not occur, within my experience, even in the worst specimen of pure asthmatic paroxysm.

1681. The physical signs are by negation significant and important: they prove the absence in the pure disease of organic affections of the lungs, heart, and great vessels. There is much labored and jerking elevation-movement of the thorax, little or no true inspiratory expansion; retraction, on the contrary, of the anterior base may attend inspiration, while expiration, removing the abnormal retraction, may be said, *pro tanto*, to expand the walls. The gradual evacuation of the supplementary, and in some measure even of the residual air [122] which takes place in both lungs during the paroxysm, slightly impairs the resonance under percussion.¹ True inspiratory sound may be almost completely deficient, sibilant or sonorous rhonchus (probably generated at the constricted points of the bronchial tubes) taking its place, and holding the same relationship to the spasm of asthma that the crowing inspiration does to that of laryngismus stridulus and pertussis. In true asthma, be it ever so severe, the spasm never implicates the glottis. As Laennec originally pointed out, if the patient be directed to speak, without drawing breath as long as he possibly can, so as to exhaust the chest as completely as possible, the next two or three quiet inspirations produce well-marked and very natural respiration-sound: obviously the tidal air advances deeply into the tubes, and under these special circumstances may be supposed even to reach the vesicles; at all events a fall back of the residual air occurs. This can only depend on temporary relaxation of spasm; but why the process described should effect such relaxation is not so clear. However this may be, bronchial dry rhonchi (if there be no bronchitis present) will then, for the moment, disappear, in the same manner, though less perfectly, than they do under the influence of chloroform [1698]; an incidental proof of the occasional purely spasmodic mechanism of those rhonchi [316].

1682. A paroxysm may last some ten or fifteen minutes, or be protracted to twelve or twenty-four hours, or even upwards: in these severer cases there is some slight remission, sometimes even an intermission, in the symptoms, from time to time before the final close. The fit may terminate by expectoration or not (humid and dry varieties), leaving, on its cessation, a sensation of fatigue and prostration.

1683. Where the disease is purely neurotic, the patient, during the intervals between the seizures, may enjoy very perfect health,

¹ This I repeatedly ascertained in a girl, named Harmer, a patient both of the Consumption and U. C. Hospitals; but, on the whole, this sign is rarely to be established.

as far as the lungs and breathing are concerned. Where, on the other hand, chronic bronchitis or emphysema exist, the symptoms of these states are more or less obscurely, their physical signs very plainly, to be discovered. Subjectively, however, even in these cases, the intervals may be passed by the patient in comfort and unconsciousness of ailment; it is not uncommon to hear habitual asthmatics boast of their perfect breath at a time when wheezing is audible at a distance, and all the physical signs of emphysema and chronic bronchitis exist in perfection. Habit, the great physiological modifier, gradually reconciles the system to a minimum supply of oxygen.¹

1684. Repetition of asthmatic fits tends to induce marked permanent cyanæmia, and may lead to dilatation of the right heart, and insufficiency, without structural change, of the tricuspid valve; but this latter effect is very rare, unless there be emphysema, as a permanent malady.

1685. *Causes.*—The mechanism and immediate excitants of a fit have been considered; what are the predisposing conditions of the disease?

1686. Trustworthy returns showing the influence of age are yet wanting. The deaths registered in this country, under the head asthma, at twenty-four periods of life,² include a vast number of cases where pulmonary and cardiac disease coexisted. It is safer to limit ourselves to the assertion that asthma is a disease commonly of middle and advanced life. It is more frequent in the male than in the female.

1687. Climatic and atmospheric conditions are inexplicably conflicting in their influence, and obviously acknowledge the control of idiosyncrasy. In the mass the air of towns is unfavorable, as compared with that of the open country: indeed in the Registrar's returns, asthma stands at the head of the list of diseases relatively more fatal in urban than rural districts. In some persons the occurrence of a fit at a given time becomes a habit; the fit is looked for, and (just as in the case of ague) as surely comes.

1688. I know of no diathetic disease which promotes the occurrence of true asthma: in assigning such disposition to "albuminuria," Romberg appears to me to have confounded hæmic dyspnoea [1705] with spasmodic asthma. I am without proof that even the gouty diathesis generates the complaint.

1689. *Course.*—Genuine asthma occasionally disappears spontaneously: I have met with several instances among young persons; but, generally speaking at least, some other evil takes its place. The worst example of wasting azoturia I ever saw, originated

¹ Hugot Arnott, it is said, was one day, while panting with asthma, looking out of his window, and was almost deafened by the noise of a fellow with stentorian voice crying oysters. "The extravagant rascal!" said Hugot, "he has wasted in two seconds as much breath as would have served me for a month."

² Tenth Annual Report, Abstracts of 1847, p. 290.

shortly after the total cessation of asthmatic fits to which the patient had been subject for years.

1690. Asthma is essentially a recurring affection—that one paroxysm has occurred is a reason why others should follow, independently of a repetition of the original excitant, at least in its full intensity. Probably one fit of spasm permanently modifies bronchial muscular irritability. But that such modification is not indelibly impressed on the fibre follows from what has been stated in the last paragraph. Cases are indeed recorded in which, it is alleged, a fit of asthma has never been repeated: the exciting cause, if the observations be correct, must have been at once powerful, peculiar and rare.

1691. The occurrence of certain acute specific and diathetic diseases occasionally frees the patient from asthma, either permanently, or for a variable time: I have known this take place after erysipelas of the face and scalp, after variola among the former, and after purpura among the latter, affections. The influences, protective and curative, exercised by local tuberculization, have already been spoken of.

1692. *Diagnosis.*—The essential points are to exclude, by means of the absence of their special signs, all pulmonary statical diseases, especially bronchitis and emphysema, and affections of the heart. The special characteristics of hæmic dyspnoea are easily to be substantiated.

1693. *Prognosis.*—Spasmodic asthma not only does not directly destroy, but is compatible with remarkable prolongation of life: the popular adage likens the possession of the disease to a “lease of a long life.” The blood-state in asthma is, probably, unfavorable in the main to the occurrence of grave diathetic diseases; while the habitual caution, the patient is forced to observe hygienically, saves him from acute inflammatory disorders. The large annual return of asthmatic deaths is, I believe, explicable in the manner already mentioned.

1694. *Treatment.*—The treatment of spasmodic asthma embraces that of the fits, and of the constitutional tendency to their recurrence.

1695. *In the fit,* our effort must be to relax spasm. In a first attack, if there be great congestion, bleeding may be advisable; but in the case of habitual seizures, it is altogether inadmissible. Nauseating expectorants, ipecacuanha, lobelia, squill, or colchicum (if the patient be gouty), or an emetic of sulphate of zinc, sometimes cut short a fit very obviously; various anti-spasmodics, sulphuric æther, assafœtida, musk, and very strong coffee mitigate the intensity of the paroxysm. Of narcotics, stramonium, datura tatula, cannabis indica, belladonna, and opium, are the most effectual: of these opium is *facile princeps*. Inhalation of the fumes of burning paper, saturated with nitre, sometimes shortens a paroxysm, by inducing copious expectoration; true, it oftener fails: but I have

known old sufferers from asthma confide implicitly in it, to the exclusion of other remedies—as others have their special affection for cigars of stramonium and belladonna—yet others for coffee.

1696. Artificial reflex irritations, such as that of ammonia to the nostrils—the cold water-dash over the shoulders, draughts of cold water, swallowed while the feet are immersed in a mustard foot-bath—are all agencies that occasionally relieve.

1697. The effects of the electro-galvanic current, directed from the nape of the neck to the epigastrium, vary. Sometimes immediate mitigation of the suffering (not, as far as I have seen, actual relaxation of spasm) ensues; sometimes, on the contrary, aggravation of the dyspnoea so distinctly follows, that the patient cries aloud to the operator to discontinue. These varying results used to be explained either by the supposed idiosyncrasy of individuals, or by presumed association variously of spasm and of paralysis of the bronchial fibres. But recent discoveries in physiology concerning the so-called “inhibiting system of nerves,” show that another explanation may be looked for—that the very same nerve, stimulated by the very same agency, say, electricity, will, according to the intensity of this, exalt or depress function in parts to which it is distributed. While gentle stimulation excites, strong stimulation may arrest, muscular action.¹ The use of galvanism is in truth a double-edged sword.

1698. The effects of chloroform-inhalation, commenced after the invasion of the fit, and pushed to narcotism, are variable. I have seen three kinds of result: total relaxation of the spasm during the continuance of insensibility, with immediate return of dyspnoea on restoration of consciousness—gradual return of the difficult breathing, after consciousness is restored—and suspension, or at least mitigation, of the paroxysm for the time being. The last effect is the rarest of the three; but, on the other hand, the temporary relief afforded by chloroform is sometimes more complete and more rapid than that effected by any other agent. Small quantities of chloroform, inhaled when the sensations precursory to a fit are felt, sometimes effectually ward this off; and there is reason to believe that, in some cases at least, the repeated use of chloroform after this plan, may eventually break the paroxysmal habit altogether:² this effect can, however, only be hoped for, where the disease is a pure neurosis.

1699. An *impending fit* may, also, be averted by a cigarette of

¹ Pfüger, the discoverer of the phenomenon of nervous inhibition, affiliated it to a supposed special set of nerve fibres; but the ingenious experiments of Mr. Joseph Lister (Proceedings of Roy. Society, 1858) make it greatly more probable that, as stated above, the same fibres *excite* or *inhibit* according to the amount of the stimulus they convey; that there is an inhibiting *function*, though not an inhibiting *system*, of nerves. Similarly Kölliker (Med. Times, Sept. 1856) has found that strychnia paralyzes the motor nerves of the voluntary muscles by exciting them to too energetic action.

² J. R. Reynolds, M. D., in “Lancet,” Oct. 29, 1853.

stramonium and belladonna, by strong coffee, by mental excitement or amusement, or by heating the body generally to as high a degree as can be borne. Sedatives and excitants of the peripheral nerves seem to have the same influence on those of the lungs.

1700. The *tendency to paroxysms* may sometimes be removed by counter-irritants to the dorsal spine, or to the nucha, by strychnia in very minute doses, by gentle electro-galvanism steadily repeated in the course of the vagi and phrenic nerves, by great attention to the state of the alimentary canal, caution in eating both as to quantity and quality, and the use of certain metallic tonics, especially the chloride or iodide of arsenic, the nitrate or oxide of silver, and the valerianate or sulphate of zinc. If there be chronic bronchitis, the measures, advisable for that disease, must of course be enforced.

1701. Change of air is most important; but the kind of change that shall prove beneficial can only be learned by experience. Some sufferers lose their paroxysms south of the "olive line;" others are easiest in a cold atmosphere; moisture, the bane of some, greatly mitigates the disease in others; any notable fall in the barometer induces a paroxysm in one, wards it off in another. A sea-side atmosphere protects some from seizures, excites them in others. The air of towns suits some, that of the country others; the relatively clear suburban air of London is infinitely more noxious to some asthmatic persons than the foul atmosphere of the worst-cleansed and most densely-peopled localities of the metropolis;¹ occasionally an individual will be found who is tortured with asthma in one room of a house, free from it in all the rest—and this without any distinct explanation being found either in the aspect, the drainage, or any other known condition. The amount of insolation is not without its influence; and complete darkness has been observed to promote seizure in some individuals.

(II.)—PARALYTIC BRONCHIAL ASTHMA.

1702. Laennec ascribed the peculiar air-distension of the lungs, found in persons asphyxiated by the mephitic gases of cesspools, to paralysis of the vagi nerves; Mr. Swan noticed similar distension in animals whose eighth pair had been divided in the neck (*vide* NERVOUS APNŒA). In both cases the contractile force of the bronchial muscles, concerned in expiration, is more or less completely annulled.

¹ A man, one of the greatest sufferers from asthma I ever saw, lived in the neighborhood of Chalk Farm, the pure air of Hampstead blowing across his house. I tried, I believe, almost every known remedy, in vain, for his relief. He was accidentally detained one night in the foul region of the Seven Dials; feeling persuaded he could not possibly survive till morning, so great was his dread of the close atmosphere. He not only lived through the night, however, but enjoyed the first uninterrupted sleep he had known for months. He took the hint; removed to the Seven Dials for the benefit of the air; and when I last saw him, some six months after the removal, continued, though still a wheezer, perfectly free from serious dyspnœa.

1703. If then, as we have seen, there be motive to believe that nervous asthma commonly depends on spasmodic action of the bronchial muscular apparatus, here are speculative reasons for presuming that paralysis of the apparatus may cause a variety of the affection. Clinically, too, we meet with examples of asthma in which the comparative facility of inspiration, and difficulty of expiration coupled with the deficiency of the usual amount of dry rhonchi, suggest of themselves the probability of a minus rather than a plus state of power in bronchial contractility. Possibly such cases are those habitually most benefited by strychnia and galvanism.

B.—HÆMIC ASTHMA, OR DYSPNŒA.

1704. Difficult or distressed breathing, produced by morbid conditions of the blood, is far from rare. Some of its varieties deserve brief mention here, were it only for the purpose of guarding the student against errors of diagnosis. In all such morbid conditions, known clinically to produce disturbed breathing, the act is increased in frequency to make up for the deficient amount of oxygen supplied to the system by each separate inspiration.

1705. The different species of hæmic dyspnœa may be arranged, as follows, on the basis of the dominant existing defect in the blood :—

(a.) Element deficient	}	Anæmia.
		Leucocythæmia.
(b.) Arterialization imperfect	}	Cyanæmia.
(c.) Proportion and quality of chief ingredients changed	}	Scurvy.
		Purpura.
(d.) Abnormal ingredients added, <i>plus</i> other changes	}	Uræmia. ¹
		Cholera Asiatica.
		Icterus.
		Pyohæmia.
		Diabetes mellitus.

1706. In all these species the dyspnœa possesses the same essential characters. It impresses a bystander like the breathlessness following over-exertion in health; and among the varieties of dyspnœa from organic causes most nearly resembles the cardiac. The respiration is, absolutely speaking, not frequent in the degree of its objective labor, and is not seriously out of proportion with the pulse: the ratio, indeed, may be 5 : 1,² usually the subjective sensation of want of breath is, comparatively speaking, little felt.

1707. The respiration, exaggerated, somewhat raised in pitch, and dry in quality, remains free from rhonchal sound of any kind:

¹ Association Med. Journal, Nov. 1853, p. 1010.

² Ellis, U. C. H., Males, vol. xi. p. 110. Uræmic dyspnœa: "breathes like a man out of breath from running, noisily; says feels short-breathed; does not look as if suffering therefrom; Pulse 112, Resp. 22."

the percussion results prove either normal, or indicative of excess of air in the cells.

1708. The mechanism of this hurried breathing is probably in all cases reflex; but the immediate rationale of the excited action must clearly vary. In anæmia and in leucohæmie, for instance, the mere instinctive sense of want of oxygen appears to hurry the act; in diabetes and anæmia the morbid elements in the blood probably play the part of excitants to elimination by increased frequency of respiration.¹ Cyanæmia, the state of blood existing in cases of permanent obstruction through the heart and in cyanosis, adds its share to the causes of difficult breathing in those affections.

1709. The *diagnosis* of this form of dyspnoea is to be made in the main *per viam exclusionis*: the absence of disease of the lungs,² heart, and great vessels, and of spasm of the tubes, must be substantiated, while to this negative evidence must be added the presence of the specific signs of some one or other of the blood diseases named.

1710. Should there be any real suffering with this form of dyspnoea, it may be mitigated by opium.

II.—EPIDEMIC CATARRH, OR INFLUENZA.

1711. Epidemic catarrh, or influenza, holds a place among general, or acute specific diseases, and obeys the laws of the group. Considered in its local anatomical conditions, it claims relationship with affections of the respiratory passages rather than any other, though its morbid influence be by no means limited to these.

1712. *Invasion*.—The seizure of influenza is in the mass of cases strikingly sudden; but may be preceded by general uneasiness of two or three days' duration. The disease sets in with lassitude, chilliness, slight shivering, very rarely actual rigors, and aching pains in the limbs, sometimes of much severity. At the outset the specific irritation quite as frequently affects the mucous membrane of the throat and palate as that of the nose and air-passages.³ Nausea and vomiting may prove the symptoms of invasion, preceding all others, and showing that the upper part of the alimentary canal participates from the first in the disease.

1713. *Symptoms*.—The Schneiderian membrane, at first dry and

¹ The ordinary difficult breathing of scurvy (and which I presume to depend, when there is no hemorrhage into the lung, on the composition of the blood) may give place to intense and fatal dyspnoea of a peculiar kind, plausibly referred by M. Perrin (*Union Méd.* 1857) to scorbutic brawny induration of the diaphragm.

² It must not be forgotten, too, that pulmonary affections may arise as insidiously as suddenly in various blood diseases—as, for instance, œdema of the lungs in uræmia.

³ Some writers, for instance Toulmouche (*Gazette Méd. de Paris*, 1847), recognize two forms of the disease: the one affecting mainly the nostrils, larynx, and throat; the other, the gastro-intestinal and pulmonary mucous tracts. In the epidemics which I have witnessed such distinct dissection of the symptoms of the different mucous membranes could not certainly be detected.

subjectively hot, soon becomes the seat of flux, watery, saline, and profuse; epistaxis rarely occurs; mid-frontal cephalalgia, sometimes very severe, and attended with a feeling of internal rawness at the spot, probably depends on implication of the lining membrane of the frontal sinuses.

1714. The chest-symptoms are: cough of variable severity, sometimes intensely violent, at first dry, then accompanied with expectoration, scanty and pituitous, eventually free, copious and mucopurulent; slight dyspnoea, tightness, soreness, and uneasy pain behind the sternum; irritation in the trachea; intercostal neuralgia; thoracic myalgia, and pain, with or without tenderness, in the costal bones and periosteum.

1715. The tongue red at the tip and edges, creamily furred at the centre, with tenderness under pressure, and sensation of rawness at the epigastrium; nausea, occasional glairy, very rarely bilious, vomiting; loss of appetite even to complete anorexia; diarrhoea, generally of but trifling importance, succeeding to constipation, prove implication of the alimentary canal.

1716. Frontal and intra-orbital headache; vertigo; tinnitus aurium; restlessness, perhaps slight wandering, at night are commonly present.

1717. The pyrexial symptoms wear a more or less adynamic character: the pulse, though at first it may be full, becoming small and feeble at an early period, rarely grows very frequent, sometimes slackens, with the advance of the disease, the pulse-respiration ratio perverted but slightly,—for instance, to 3.3 : 1; the urine of febrile type; the skin at first dry and hot, subsequently variable in temperature, and never acridly burning to the touch.

1718. Lastly, pains in the neck, scalp, and over the malar bones; extreme general uneasiness; aching pains and soreness of the limbs and trunk,—all combined with excessive depression of spirits, and an amount of debility and prostration totally out of proportion with the local ailments (syncope sometimes occurs in the erect posture)—complete the list of symptoms of the established disease in its ordinary and pure form.

1719. The *physical signs* are those of bronchitis (dry rhonchi with loose bubbling on a limited scale at one or both bases), or there are none of positive character; I have noticed this deficiency of notable bronchial signs, even where cough and post-sternal pain existed to a very appreciable amount.

1720. There are exceptional cases where violent headache, flushing of the face, and low muttering delirium, with adynamic fever, are the prominent symptoms; others, where the digestive organs suffer almost solely, and in the upper parts; others marked by diarrhoea or pseudo-dysentery; and yet others, where, erethism or actual catarrhal inflammation of the urinary passages¹ (pyelo-cysti-

¹ I have seen this, however, once only,—in an old sufferer from stricture of the urethra.

tis) is the main phenomenon. In all these cases there is, however, a substratum of the ordinary naso-bronchial symptoms.

1721. *Terminations.*—Pure influenza generally terminates in three or four days in mild cases, lingering on in the severer ones to the end of the first or even second week. Commonly diaphoresis,—much more rarely some form of herpetic eruption¹—sometimes a copious deposit of lithates—ushers in convalescence. Recovery long continues imperfect,—extreme general debility, dislike to mental and bodily exertion, peevishness of temper, and want of appetite, mark the enduring effects of the disease on the system at large. Great local annoyance is sometimes occasioned by rheumatic periosteitis of the bones of the face, with considerable tenderness under pressure, holding on for days, or even weeks, after the other symptoms have yielded.

1722. *Complex cases.*—It seems not to appertain to the essence of influenza to produce either bronchitis *per se* severe, pneumonia or pleurisy; but, especially in certain epidemics, any one of these affections separately, or two or all three of them in conjunction, are sufficiently common. When occurring, are they to be regarded as evidence of complete evolution of the influenza-poison, as secondary lesions, or as complications? The data for settling this very important point in the theory of the disease have not yet been collected: meanwhile the practical significance of the two former, especially, of these inflammations renders it necessary to briefly consider them apart.

1723. *General and capillary bronchitis.*—Absence of acute pain, well-toned pulmonary resonance in spite of accumulating secretion, showing marked general lung-distension, notable disproportion of the dyspnoea and asphyxial signs to the apparent physical disturbances in the chest, exist in the capillary bronchitis of influenza as in the idiopathic disease. But the prostration of strength is of yet earlier occurrence, and more marked in amount. Collapse of lobules is perhaps even more frequent, and the secretion in the tubes more viscid, than in the simple primary inflammation. Death occurs more rapidly than where the influenza-element is wanting,—generally taking place between the sixth and twelfth or fourteenth day.

1724. The *pneumonia* of influenza differs from the disease in its primary form by the greater freedom from pain,—the less amount of perversion of the pulse-respiration ratio [1115], in consequence of the relatively greater increase in frequency of the pulse,—the absence of acrid heat of the skin,—hence generally by a disposition to latency); and by the frequent association of capillary bronchitis.

1725. In the Paris epidemic of 1837, especially towards its close,

¹ Herpes labialis sometimes occurs without any change either for better or worse in the pyrexial symptoms.

the bronchi of the hepatized lobes, according to M. Nonat,¹ often contained moulded casts, as in plastic inflammation; but it does not appear to have been known to that writer that these casts occur, though rarely, in primary pneumonia [1076]; their specific significance may hence be questioned.

1726. *Relapse and recurrence*² are both common. It seems to be commonly conceded that the symptoms in cases of recurrence need not be the same as in the primary seizure,—that “angina, intermittent fever, and various anomalous local affections,” occurring after an attack of ordinary influenza, may simply be a new form of expression in the workings of the old poison. This is a piece of pathological doctrine involving consequences probably unforeseen by those originating it,—one resting on simple conjecture, and to be absolutely rejected until something like proof of its soundness be tendered.

1727. Somewhat allied to this idea is another which may be glanced at here. It is matter of certainty that during the prevalence of influenza, other acute disorders often assume what may be called an influenzoid *character*. The cause of this peculiarity (not limited to epidemics of influenza) is mysterious enough; but whatever that cause be, the fact seems to explain a notion, which has found defenders, that the poison of influenza may produce typhoid (Peyerian) fever, and various grave abdominal diseases. That the poisons of influenza and of typhoid fevers are thus interchangeable, seems to me a heresy undeserving serious refutation.

1728. *Sequelæ*.—Influenza almost invariably leaves, as its sequence, more or less abiding debility,³ and, in many cases, chronic bronchitic cough. That the symptoms of phthisis have occasionally first become apparent after an attack of influenza, is unquestionable; and the fair inference is that it accelerated the outbreak of the tuberculous disease,—but that influenza, unassisted by the phthisical diathesis, can produce consumption, cannot be admitted.

1729. *Mortality*.—Influenza is indubitably one of the epidemics that, once developed in a locality, spreads most extensively. The Registrar-General⁴ calculates that one-fourth, Sir H. Holland⁵ one-half, of the population of London, suffered in the epidemic of 1837. These calculations, resting on no solid foundation, are in all likelihood exaggerated,—still the number of persons seized is generally immense. Fortunately the virulence of the disease falls

¹ Recherches sur la Grippe; Archives de Médecine, 1837.

² By the former being understood return of the specific phenomena of the disease before, by the latter after, the completion of convalescence.

³ A favorite piece of belief is that this general weakness gives a proclivity to seizure by all varieties of adynamic virus- and miasm-diseases; but far from this being certain, such debility may, for aught that has been established to the reverse, actually constitute a protection against all such affections.

⁴ Report on Influenza.

⁵ Medical Notes and Reflections, 3d ed., p. 327: “Perhaps few escaped the influence altogether.”

far short of its activity,—two per cent. of those attacked being probably a fair estimate of the average mortality. Influenza, in truth, scarcely ever kills those it affects, unless, aged and debilitated, they have already one foot in the grave. Among this class of the population, the mortality has sometimes proved very serious: still, inasmuch as these persons were already in a condition to be cut off by a variety of other diseases, it turns out that an epidemic of influenza, except in rare instances,¹ feebly raises the average rate of mortality. Females appear to die in greater proportion, both to the population and to the number seized, than males. Death is much more frequently due to capillary bronchitis than to pneumonia: the converse statement could only have arisen from the long subsisting confusion between peripneumonia notha and true pneumonia in the aged.

1730. *Dissemination*.—Epidemics of influenza have been recorded for upwards of three hundred years; successive visitations have occurred at excessively irregular intervals; their course, though uncertain, has in the main been from east to west; rapidity of dissemination, ubiquity, and simultaneous outbreak at spots widely distant, have always been striking features. The sea offers no barrier against the advance of the disease—it has occurred in solitary mid-ocean islands, as in ships far from land.

1731. *Duration*.—The duration of past epidemics in a given locality appears to have averaged about six weeks. Obviously the cause lingers in spots after the disease has disappeared—for new comers are often seized some time after the inhabitants (all susceptible individuals, it may be presumed, having passed the ordeal) have ceased to suffer.

1732. Epizootic diseases of essentially the same characters sometimes coincide with, precede, or follow epidemic influenza: horses, dogs, sheep, and cows, seem to have been the chief sufferers.

1733. *Ætiology*.—The study of precursory peculiarities in the public health, and in meteorological conditions, affords no clue to the causes of these outbreaks: every condition *à priori* conceivable has actually precluded an epidemic. What boots it to show that a certain epidemic was preceded by intensely cold and stormy, when “with warm and apparently genial” weather,² the disease may be almost universally diffused? Obviously there is something beyond the indications of the barometer, thermometer, and hygrometer, to be looked to in explanation of the disease. The connection of particular electrical states with its appearance is less clearly established than was at one time supposed, and that ozone really acts as the exciting cause is more than problematical.

1734. The sudden, almost simultaneous occurrence of the disease

¹ An epidemic at Rome in 1580 is said to have destroyed 9000 persons; but the estimate is probably to be taken *cum grano salis*.

² At the Cape. Herschel, in H. Holland, loc. cit. p. 328. The London epidemic of 1831 occurred in May, June, and July.

in various distant places—the seizure, almost at the same hour, of different and wholly disconnected portions of a population—the certainty that people occasionally freely mingle with affected families and escape, while others arriving in an influenza district are seized before they have held communication with the inhabitants—the absence of proof that the disease has ever sprung up in an unaffected district, or even street, immediately on the arrival of persons who have suffered or are yet suffering from it—the want of evidence as to the existence of a period of incubation:—all these circumstances show that influenza is not a virus disease, transferable by an affected person to an unaffected person,¹ but that the seizure of each individual is wholly independent of the suffering of his neighbors—that the cause is some undiscovered atmospheric or telluric poison, and that influenza may be held to typify the pure non-infectious, *de novo* or *miasm*, family of epidemics.

1735. This poison seems specially to exercise its influence on parts supplied by the pneumogastric nerve; and it is worthy of remark that hooping-cough, an affection in which that trunk is indubitably concerned, has often been noticed to prevail concurrently with influenza.² The local disorders in simple cases seem scarcely to reach the inflammation-point; in the graver class, as where plastic casts form in the bronchi, the actuality of inflammation cannot be questioned.

1736. *Treatment*.—There is no antidotal treatment for influenza known, nor any convincing evidence extant that the disease may be arrested by art at the outset. As is sufficiently known, there is scarcely a disease under the sun which our forefathers were not in the habit of thus readily arresting by an emetic—influenza, of course, one of the number. At the present day, unfortunately, emetics have lost their ancient efficacy. I have known obstinate vomiting of three days' duration follow an emetic dose of antimony at the outset, and, where some immediate relief of chest-obstruction has ensued, this has commonly been dearly paid for by increased general depression. But I record this unfavorable estimate with the qualification that it is not quite in accordance with that of Sir H. Holland (*loc. cit.* p. 348).

1737. The experience of centuries has established, beyond question, the impropriety of depletory measures, as a general rule, in the treatment of influenza. The Czar of Russia might at least plead in justification of his ukase against bloodletting, the mortality clearly traceable to the practice, not only in his own dominions, but in various countries of Europe—England, France, Spain, Italy. I doubt if the occurrence of consolidation-signs even warrants the use of the lancet. Such signs are observed chiefly in aged persons and in those exhausted either by previous disease, debauchery, or destitu-

¹ I am not aware whether inoculation of the blood or secreted fluids of patients with influenza has ever been essayed.

² *e. g.*, H. Holland, *loc. cit.* p. 342.

tion; and I know, from experience, that dry-cupping and sesquicarbonate of ammonia will remove these signs in cases of the stamp; whereas I have never seen any unquestionable benefit derived from abstraction of blood, either by leeches or scarification. Such consolidation is very positively *passively congestive* in the aged and infirm, and is increased by depressing measures. Should well-marked signs of sthenic pneumonia occur in a young or middle-aged person, leeching or cupping may be advisable;—but even then caution is requisite; a dozen leeches have, within my experience, produced successive fainting fits in a previously healthy and robust individual. I have never seen a case in London where venesection seemed advisable; perhaps such may occasionally be met with among the more vigorous inhabitants of rural districts. Neither should tartar emetic, active purgatives, nor (I think, in spite of the encomiums of Dr. J. Davies) mercury, with a view to its constitutional action, be employed.

1738. The treatment I have found most successful, is as follows:—Keep the patient in bed; open the bowels by some gentle laxative; give diaphoretics in combination, especially if there be rheumatic pains, with colchicum and an alkali; procure sleep by extract of lettuce, or of hyoscyamus; and allow diluents freely. After the first three or four days, if bronchitic rhonchi exist, a blister should be applied between the shoulder-blades or to the sternum, and an expectorant mixture prescribed. This mixture may with advantage be somewhat stimulant;—let the vehicle, for example, be partly ammoniacum, serpentaria, or decoction of senega; lobelia inflata, in small doses, and paregoric should enter into its composition. Tonics, iron, and quinine may be given daily during convalescence, unless the stomach have been implicated to any amount. If there be much exhaustion from the first, sesquicarbonate of ammonia and strong beef-tea should be given without hesitation; and the free use of wine or brandy may eventually become imperative.

1739. It follows from what has been said in a previous paragraph, that segregation of patients is not necessary, as a means of preventing the spread of the disease.

III.—HOOPING-COUGH, OR PERTUSSIS.

1740. Hooping-cough, or pertussis, seems, practically speaking, composed of special bronchitic irritation—the speciality of character being sufficiently indicated by the qualities of the secreted product—and of reflex spasm of the air tubes, more especially declaring itself in laryngismus.

1741. *Course and Symptoms.*—Three stages of the disease may be recognized: the catarrhal; the spasmodic; the terminal.

1742. (I.) The *catarrhal* stage is marked by coryza, general irritation of the air-passages, dry or almost dry cough and feverish disturbance: the pyrexia may be severe, and is, in rare instances, attended with marked nervous excitability and even slight noctur-

nal delirium. If there be expectoration, it is in no wise specific in character. The cough sometimes has a tendency to recur paroxysmally, but there is nothing peculiar in its actual character.

1743. From ten days to a fortnight appears to be the mean period of duration of this stage; the extremes three or four days and three weeks.¹ It may be wanting altogether—a deficiency noted in about one of fifteen or twenty cases.

1744. (II.) The commencement of the *spasmodic* stage is announced by the distinctive paroxysms of cough occurring at irregular intervals by day and night. Each fit may be abrupt in its occurrence, or preceded by tickling in the trachea and uneasy sensations in the chest and throat,² of sufficient duration to give full warning of its approach.

1745. During the fit of cough expiration and inspiration are in their several ways laborious. Expiration consists of a variable number of forcible puffs (there may be as many as twelve or fifteen), rapidly succeeding each other, without obvious intervening inspiration, and performed with almost conclusive energy. These successive expiratory efforts seem to force all the supplementary and some of the residual volumes of air from the lungs [122], and it is often not until some of the minor phenomena of asphyxia become apparent, that the patient obtains relief by a prolonged cooing, so-called hooping, inspiration. The labor of inspiration comes of the difficulty of overcoming the temporary lung-collapse produced by the excessive expirations, and the more or less marked laryngismus. The louder the hoop the more complete, probably, the relaxation of the glottis: an imperfect hoop is consequently of unfavorable significance. Expiration is the bane, inspiration the antidote.

1746. A single fit rarely lasts more than half to three-quarters of a minute: relief then comes, at least for a moment. But a complete paroxysm, consisting of a variable number of these fits, may hold on for a quarter of an hour or upwards. When thus prolonged, not only do the face and eyes become painfully turgid and livid, but blood may issue from the mouth, ears, and nose;³ the conjunctivæ become ecchymosed; copious cold perspiration breaks out; slight convulsions occur; hernia may form; violent vomiting and involuntary discharge of the feces and urine may take place,—the latter rather of expulsive than paralytic mechanism. The pulse is frequent, greatly out of proportion to the number of inspirations; but it becomes natural, unless some complication exist, after the close of the paroxysm.

1747. The paroxysm terminates commonly by expectoration (during the early part of this stage, thin, scanty, and pituitous: during its more advanced part, rosy, semi-transparent, albumen-

¹ In an epidemic at Geneva, Lombard found it sometimes protracted to the sixth week.

² Fancifully looked upon by Romberg as "the aura of the vagus."

³ Epistaxis, dangerous *per se*, has sometimes been observed.

like); or by vomiting;—or by pure exhaustion, without discharge of any kind. And in a few minutes, sometimes a few seconds, the patient feels as in health, except from some slight sensation of fatigue, and, if a child, resumes his play, as though nothing had happened. But in bad cases considerable pain in the region of the diaphragm, with disturbed breathing, may hold on for several minutes; fainting may occur; or there may be various indications of venous congestion within the head.

1748. The frequency of recurrence of the paroxysms varies greatly; there may be but two in a day, or two or three per hour. Sometimes ensuing without any immediate excitation, they are more frequently traceable to such influences as irritate the excitomotory system,—the act of swallowing sudden draughts of cold air, a fit of anger, abrupt movements of the body; like spasms of reflex mechanism generally, they sometimes come on by night; and it has been remarked, the severer the disease, the more frequent and violent the nocturnal seizures.¹

1749. The mean duration of the convulsive stage seems to fall between thirty and fifty days: but it may terminate by the third week (not an earlier period, as far as I have seen), or be protracted for three months or even upwards.

1750. If the disease be simple, and of moderate duration, the general health scarcely suffers. The nutritive functions are naturally performed; the strength keeps up; the spirits of the child do not flag. But when the cough lasts long, failure of strength and wasting take place; and though, as far as I know, death does not occur by mere asthenia of this sort, it evidently helps to a fatal issue.

1751. The urine may become saccharine, the quantity of sugar being generally insignificant; sometimes, it is alleged however, the specific gravity rises seriously, and a diabetic state of clinical importance is established.²

1752. (III.) During the *terminal* stage, the cough, becoming less frequent, loses the convulsive and hooping characters; the expectoration ceases to wear the albumen-like, ropy appearance, and becomes simply catarrhal. Eventually all symptoms disappear in the course of from one to three weeks.

1753. The *physical signs* are, in the mass of cases, only negatively important; they exclude diseases which might erroneously be supposed to be present. During prolonged paroxysms, and especially towards their close, the percussion-sound temporarily loses in resonance, and rises somewhat in pitch: I state this from positive observation; but it is no more than might be expected from the

¹ A fit is occasionally excited in a child, already affected, by imitation (even hearing the cough is sufficient to set this mixed physical and reflex mechanism in action); but that the disease has ever been thus produced *ab initio* seems a fancy wholly unsupported by facts.

² Gibb, "Lancet," January, 1858.

forced evacuation of the air-cells that occurs. During the brief efforts at inspiration between the successive expiratory puffs of the cough, inspiratory sound may sometimes be caught; but during the noisy and hooping inspiration, very little true breathing-sound reaches the surface; probably spasm of the bronchial tubes prevents the air from advancing to the vesicles. Sonorous and sibilant rhonchi, and, if there be much fluid in the tubes, the varieties of the moist bronchial rhonchi, are heard.

1754. The movements of respiration in the paroxysms are perverted, as already described [54], through the influence of tendency to collapse at the bases of the lungs. If collapse, either lobular or diffuse, become a persistent state, a fresh series of signs may be detected. The respiration-movements grow more and more shallow; the percussion-note loses resonance posteriorly, and at the mid-front especially. True respiration-sound is inaudible, and not replaced by bronchial breathing, but partly covered by moist rhonchus. Though the respiration may rise to 60, 80, or even 100 in the minute (whence, though the pulse is absolutely very frequent, complete perversion of the pulse-respiration ratio), there is little of the subjective dyspnoea of capillary bronchitis or of the pyrexial heat of skin of pneumonia—the surface is, indeed, more commonly cool.

1755. *Relapse* of hooping cough is far from uncommon; genuine *recurrence* extremely rare—as rare probably as of any of those diseases of which one attack confers immunity from a second.

1756. *Morbid appearances*.—Hooping-cough is a disease without any true anatomical character; nevertheless in fatal cases numerous textural changes are found.

1757. Of these by far the most frequent, as originally shown by Dr. Alderson,¹ and recently insisted on by Dr. G. Hewitt,² is lobular collapse of the lungs [951]; absence of this state (which more nearly than any other holds the relationship of an anatomical character to the disease) seems to be the exception. Coupled with, and within the area of, this collapse, is occasionally found distension of the air-cells and terminal portions of the tubes with air and pus—so called bronchial abscesses. The bronchial tubes are more or less uniformly inflamed; the larynx and trachea not obviously implicated; the lung-substance, in a moderate proportion of cases, lobularly or diffusely inflamed. Pleuritic changes are very rare. Emphysema, the result of the disease, and therefore of acute form, is pretty commonly seen adjoining collapsed tissue; dilatation of the bronchi has so seldom been actually found after death, that the reality of its dependence on the disease has been questioned.³

1758. Autenrieth's notion that the vagus is inflamed has been satisfactorily disproved; nor does Romberg's hypothesis, that the

¹ Med. Chir. Trans., vol. xvi. 1830.

² Pathol. of Hooping-Cough, 1855.

³ Yet Dr. Stokes says that "in young children affected with hooping-cough a period of two or three months is sufficient to produce the fullest development of bronchial dilatation."—Dis. of the Chest, p. 155.

nerve is irritated in whooping-cough by an inflammatory process in the adjoining bronchial glands, stand the test of observation—though the spasmodic influence of such a process, when it exists, cannot be questioned (*vide* BRONCHIAL PHTHISIS).

1759. The *Complications* of pertussis are bronchitis, pneumonia, collapse of the lung, croup, continued vomiting (not explicable by the cough), diarrhoea, tympanitic distension of the abdomen, convulsions purely neurotic, or dependent on cerebral congestion, with drowsiness and coma, tubercular meningitis, bronchial phthisis, and the exanthemata. The latter modify or arrest the cough during their periods of invasion and status.¹ The cough has been observed to cease during the ague-fit (Romberg).

1760. I have seen cases where pigeon-breast has ensued on prolonged whooping-cough [54].

1761. *Causes.*—Whooping-cough occurs epidemically and is transmissible by infection. These propositions involve the necessity of our admitting a special animal virus as the cause of the disease. This virus is supposed to exist in the expired air. Whether the disease be transmissible by inoculation of the blood or bronchial secretions, remains, as likewise the duration of the incubation-period, undetermined.

1762. The infectious agent is portable in fomites. Of this fact Dr. Neil Arnott has related to me the following remarkable illustration: A lady left a port in the East for England with two children in the whooping-cough; the vessel put in at St. Helena, where the linen of the children was sent ashore to be washed: the children of the laundress were seized with the disease, and from them it spread generally through the island—no case of the complaint having previously occurred there for a lengthened period.

1763. The female sex predisposes to whooping-cough: at least female children are in this country destroyed more extensively by it than males; to 1,000,000 living of each sex in England and Wales, 546 males and 665 females (the mean being 605) perished by the disease in 1838.² It is most common before the fourth, becomes less frequent after the fifth, and excessively rare after the tenth year of existence.

1764. Whooping-cough is an affection common to all varieties of climate. Epidemic seizures are most mortal, as a rule, in the cold quarter of the year: thus in 1837–38, in London, from October to March, inclusive, there were 1522 deaths against 842 from April to September.

1765. Whooping-cough is a disease of extreme but undetermined frequency. In some cases an affection so mild, and its special characters so feebly developed, that doubts may be entertained as to its having existed at all, in others it is so severe as to jeopardize or actually destroy life.

¹ Wall, on Chin-Cough, 1813.

² Registrar's Second Report, 1843.

1766. The annual mortality in this country from pertussis is, in truth, most serious: thus, in 1838, the deaths from this cause were 9107—a mortality giving it actually the seventh place in amount of destructiveness in the Registrar's list of diseases.

1767. Death has occurred from asphyxia, from rupture of the air-cells, and effusion of air into the mediastinum and common cellular membrane, or from rupture of the pleura and pneumothorax, or from the mere exhaustion of the protracted disease. But its complications, capillary bronchitis, pulmonary collapse, pneumonia, croup, convulsions during a paroxysm, tuberculous meningitis, and cerebral congestion, are the most active agents in destroying life.

1768. *Prognosis*.—The proportion of those dying to those seized being unknown, we want this fundamental element of prognosis: besides, the ratio varies materially in different epidemics. The younger the child, it is generally taught, the greater the danger. Females die in larger proportion to those attacked than males. The disease is generally more severe when epidemic than sporadic. No trust is to be placed in the mildness or severity of the catarrhal stage as a guide. Antecedent feebleness, the existence of pyrexia between the fits, and the various complications, are of evil import. The signs of well-marked collapse are commonly of fatal augury.

1769. *Diagnosis*.—There is no character as yet established, whereby the catarrhal stage can with surety be distinguished from common bronchial irritation: prevalence of the disease, or known exposure to infection are the only aids.

1770. The diagnosis of the confirmed disease from bronchial phthisis has already been considered [746].

1771. *Nature*.—Pertussis appears to be a virus-disease, in which the poison has a special attraction for the pneumogastric nerve, and probably the connected portions of nervous centres: the convulsive character of the cough, the frequent vomiting independently of this, and the occasional saccharine state of the urine seems to point to such localization. Still, all such ideas are for the present merely speculative. The seeming relationship of the disease to epidemic catarrh has already been referred to.

1772. In a certain number of cases small round superficial ulcerations form at the root of the tongue; hence the disease has been fancifully assimilated to hydrophobia, an affection reflex-spasmodic in character, and attended with vesicle-formation in that locality.¹

1773. *Prophylaxis*.—Satisfactory evidence of the alleged prophylactic efficacy either of vaccination or of belladonna is altogether defective.

1774. *Treatment*.—(a) In mild cases of hooping-cough little is required in the way of treatment. Attention to the state of the bowels, the use of gently soothing expectorants, limitation in eating, warm clothing, and avoidance of all the *ledantia*, more especially

¹ Lersch, in Journ. für Kinderkrankheiten, 1844.

of sudden excitement, emotional and physical, with, if possible, immediate remove to a warmer and drier atmosphere,¹ than that in which the disease has been contracted, comprise all the precautions needed.

1775. (b) When the disease is of grave character *per se*, is it possible to modify its course by treatment, or is the dictum of Romberg correct? "We know of no method by which we can arrest the progress of the disease or shorten its duration—we have not even the negative advantage of finding that certain methods of treatment increase the symptoms." But, conceding the fact of our incapacity in this aspect, a great deal remains for the physician to accomplish in the relief of suffering and the management of complications.

1776. (1.) During the catarrhal stage (assuming the symptoms are from circumstances known to be precursory of pertussis), if the irritation be severe, antimony, or ipecacuanha, in doses measured by the patient's age, are desirable. Unless the symptoms are sharply inflammatory, blood-letting in any of its forms should be avoided: the disease must run a certain course, and the patient's strength requires husbanding.

1777. Various means of lessening the severity of the paroxysms may be had recourse to. Nauseants, given also occasionally in emetic doses, are among the best of these—antimony, ipecacuanha, and lobelia inflata, especially the two latter, in combination. Antispasmodics, such as assafoetida (if unbearable by the stomach, rubbed over the epigastrium and spine), musk, valerian, and camphor, answer well in some cases. Of narcotics, hyoscyamus, lettuce, and conium are the safest; opium should not be given unless in combination with ipecacuanha. Tincture of Cannabis Indica, in the dose of a drop for each year, and mixed with sugar, has been strongly recommended. Belladonna, pushed to the verge of poisonous effects, is sometimes a justifiable remedy, where the paroxysms are dangerous *per se*; I have used it with the unquestionable effect of mitigating their severity and frequency, but I have no evidence that it shortens the disease. Hydrocyanic acid, as a rule, is a fitter agent; and may be trusted to throughout as the most direct sedative of the spinal cord: could generalization be allowed from a small number of cases, it would appear to bring the duration of the complaint sensibly within the mean.² Chloroform, in doses of from three to ten minims according to age, lessens the severity of the fits. Coffee, as strong as it can be made by Loy-sell's apparatus, in doses of half a drachm to one or two ounces, acts similarly, and with singular efficacy, in some individuals.

1778. Counter-irritation of the chest by tartar emetic, croton oil, or acetic acid and turpentine, is decidedly useful: such applications

¹ I have known mere change of the kind, without any superiority of atmospheric conditions, favorably modify the complaint.

² A. B. Granville, "Treatise on Hydrocyanic Acid;" London, 1820.

should be used of low strength. A blister kept on for two or three hours, and followed by a linseed poultice, sometimes greatly lessens irritation for several days. Belladonna frictions to the spine, or a broad strip of belladonna plaster, extended from the nape of the neck to the loins, are distinctly serviceable in many cases. Morphia, applied endermically to the throat, is favorably spoken of; and there is much theoretical argument in favor of the frequent repetition of small blisters at the nape of the neck.¹

1779. A fit may sometimes be shortened by a draught of cold water, or by the cold-water-dash to the face. The shower-bath, in the case of children, generally does more harm than good. And we are not likely at the present day to revert to our ancestral system of "curing" the disease by exciting sudden and violent fright.

1780. Chloroform-inhalation may be had recourse to in bad cases: of its influence in shortening the paroxysm, and weakening the force of the spasm, there can be no doubt. The quantity inhaled should be just sufficient to produce slight cutaneous insensibility, never to bring on narcotism.

Touching the orifice of the glottis with a strong solution of nitrate of silver sometimes lessens the irritability of that part: the process will, it is alleged, remove the disease, if employed for eight or ten days. *Per contra* I have known it very sensibly increase the severity of the paroxysms [1833].

1781. Of various alleged specifics, such as vaccination, sulphuret of potassium, cochineal, nux vomica, arsenic, and cantharides, nothing satisfactory can be said. Alum, in small and repeated doses, extensively tried by Mr. W. B. Hutchinson at the Foundling Hospital, appears to him, though wanting in the specific virtues announced, to shorten somewhat the average duration of the disease, and render the paroxysms less violent. The disease never, according to Dr. Arnoldi, resists longer than three weeks the influence of nitric acid, diluted to the acidity of lemon juice, freely used: a child, aged two years, took in this form one and a half drachms of concentrated nitric acid in the day with the best effects.

1782. During the first and second dentition, the teeth should be carefully looked after. Flannel should be worn next the skin, a uniform temperature maintained about the patient as far as possible; and, if the complaint set in towards winter, and removal to a warm locality be impossible, he should be confined to the house absolutely.

1783. Towards the close of the disease change of air, as in the somewhat analogous case of laryngismus stridulus, proves of signal benefit: and now it is that the utility of iron,² and nervine tonics,

¹ Holl, "Med. Times," April 1859.

² Sesquioxide of iron has, on insufficient grounds, been put forward as capable of cutting short the disease.

such as oxide, sulphate or valerianate of zinc and nitrate of silver, cannot be questioned.

1784. The disease being infectious, segregation is required. How long the virus retains its specific qualities, and when it attains its maximum activity, are queries to which it rests with the future to reply.

1785. (2) *Complications*.—Inflammatory conditions arising during the convulsive stage should be less antiphlogistically treated, than if pertussis were absent. I cannot resist the evidence of my own experience on this point; though I find a different notion held by some commendable writers.

1786. Pulmonary collapse, on a scale sufficient for diagnosis, is the signal for actively supporting and stimulant measures.

SECTION VIII.—DISEASES OF THE MEDIASTINA.

I.—MEDIASTINAL TUMOR.

1787. I have seen in the mediastina tumors, composed of simple exudation-matter, scirrhus-encephaloid, encephaloid, fibrous, and fibro-fatty substance: masses of steatoma and hair have been described by others. The local symptoms and the physical signs (inasmuch as both are mainly of mechanical origin) are almost identical, whatever be the constitution of the tumor.

1788. *Physical Signs*.—When a tumor occupies the mediastina, and encroaches, as it commonly does, mainly in front, bulging of the sternum and costal cartilages, in a variable spot and to a variable superficial extent, may exist; the intercostal spaces, widened and flattened, are then unaffected by respiration: but, on the other hand, no shadow of bulging may exist, and yet from other signs the presence of tumor be indisputable. Wherever a tumor, of any thickness, reaches the surface, vocal fremitus is annulled. Fluctuation, simple or peripheric, is not to be detected; and a double impulse is sometimes transmitted from the heart, and may be felt both by observer and patient as a sort of inward succession.

1789. If the tumor encroach pretty equally on both sides of the chest, there may be no alteration in their relative semi-circular measurement, though both, absolutely speaking, are dilated. Measurement in motion shows that the respiration-play is impaired, and the impairment may fall rather on expiratory retraction than inspiratory expansion. If by chance either main bronchus (and it is much more frequently the right that suffers) be seriously obstructed, the respiration-play will be relatively deficient on that side, independently of the influence of any general excess of solid mass within the right thorax. Should the tumor encroach notably on one side or the other, and be at the same time adherent to the wall of the chest, the space between the middle line and nipple will be lengthened on the same side.

1790. The results of percussion vary with four main conditions:

the thickness of the mass, the sonorousness or the reverse of its own proper substance, its adhesion or not to the chest-wall, its relationship to the trachea and large bronchi. The note may be fairly pulmonary; excessively dull, and toneless [Type I. 195]; high-pitched and hard with sharp resistance [Type III. 199]; or either tubular or amphoric.¹ There is commonly highly-marked parietal resistance. The superficial dimensions of the growth may thus be traced in the front or in the spinal regions behind. The resistance and resonance of the heart and liver commonly differ from those of tumors; and hence, if the natural and morbid structures are in juxtaposition, their neighboring edges may be defined by simple or by auscultatory percussion.

1791. The auscultatory signs vary widely. The respiration may be weak, almost to suppression, over the morbid mass, or (from pressure on the main bronchus) over the side generally; or it may be of diffused or even tubular or hollow blowing type: these differences will depend on the precise relationships of the growth to the bronchial tubes and parietes; as will the absence or presence of bronchophony or pectoriloquy of the loud form. The heart's sounds are conveyed through the solid mass with undue intensity; and if this press on the aorta or pulmonary artery, there may be systolic murmur, simulating intra-cardiac murmur, at the base. Bronchial dry and moist rhonchi may be heard.

1792. The position of the heart and of the wings, or of either wing, of the diaphragm, will depend wholly on the direction in which the tumor grows: they may be considerably displaced, or retain their natural positions, even where a large mass occupies the mediastinum.

1793. But the most distinctive and striking symptoms of mediastinal tumors arise mechanically from their *compressive* and *perforative* influences; both kinds of action may be centrifugal or centripetal.

1794. A special section (Part I. Section VIII.) has already been devoted to pressure-signs; it is only necessary here to observe, that they may be variously and as it were capriciously combined according to the bulk and direction of growth of the mass. Pressure also acts irritatively, producing pleurisy, active hydrothorax, bronchitis, local pneumonia, and laryngo-tracheitis.

1795. *Centrifugal perforation* of the chest-wall or spinal column, not unfrequent from aneurism, is rare from tumor: I have never known of an example, except where the growth was cancerous.

1796. *Centripetal perforation* has in rare instances been observed in the lung, pulmonary artery, and œsophagus.

1797. *Symptoms (a) Local.*—The symptoms of mediastinal tumor

¹ Near the trachea, or more generally in front, or even in the back, the percussion-note may be tubular, or even amphoric: I have known it amphoric over the lower half of the right back.

are pain, very variable in amount; dyspnoea; cough, with or without sanguineous expectoration, of the jelly-like kinds [1625], or catarrhal; actual hæmoptysis: inability to lie with the head low, and eventually complete orthopnoea, the sufferer sometimes, for weeks before death, never daring to go to bed, and never enjoying more than fitful dozes. Or the patient may, when in bed, habitually lean forwards or sideways, with the head supported on the hand, the elbow bent, so as to throw the tumor off the trachea or main bronchus. I have known this awkward posture assumed during sleep, the patient being unconscious of the change: an instance of consensual action.

1798. (*b*) *General*.—The constitution may long bear up against the local disease; but the dyspnoea and insomnia at length affect the appetite, and emaciation sets in. The patient dies gradually, anasarctous and exhausted, or he may perish suddenly from obstruction or perforation of the pulmonary artery.

1799. *Diagnosis*.—An intra-thoracic tumor may, according to its seat, be confounded with extensive chronic pneumonia and chronic pleuritic effusion, with chronic pericardial effusion, great enlargement of the heart, or aneurism of the thoracic aorta. The distinctive marks of the cardiac and arterial affections will be found in the descriptions of these.

1800. Tumor will be distinguished from chronic pneumonia by the tendency to increase, instead of diminution, of bulk of the affected side, by the implication of the mediastinum, by the more serious change in the results of percussion, the failure or the disappearance of vocal fremitus, which remains in chronic pneumonia, and the different characters of the respiration in the two diseases. Hæmoptysis and red jelly-like expectoration never occur in chronic pneumonia; whereas the emaciation is of earlier appearance, and more marked than in cases of tumor.

1801. From empyema, tumor will be distinguished by the following negative or positive evidences: by the absence of intercostal fluctuation, simple or peripheric; by the greater tendency to tubular forms of percussion-resonance over the seat of disease; by the limits of the morbid resonance being either not at all, or very slightly, changed by altering the patient's position;² by the interspaces not being convex; occasionally by the intensity of blowing respiration; by the loud transmission of the heart's sounds; by the comparative irregularity of outline of the side, some spots being more prominent than others; by the fact, that in cases of tumor, careful percussion will almost surely detect some spot giving a comparatively normal, pulmonary, sound, where, according to the laws of physics, liquid, had this been the cause of the general dulness, must have made its way, and hence caused dulness there

¹ Holmes, U. C. H., *Females*, vol. vii. p. 120.

² Caution is, however, requisite in using this test [224].

as well as elsewhere; by the whole class of centripetal pressure-signs; and, if they have occurred, by hæmoptysis, or by the jelly-like expectoration.

A patient having mediastinal tumor may also have empyema on the side most encroached on, generally the right. If the patient be seen for the first time, when the two diseases are present, and if precise medical information as to the previous course of the complaint be wanting, this combination may be very difficult of diagnosis. But empyema does not produce centripetal pressure-signs,¹ nor give rise to hæmoptysis or jelly-like expectoration; if these symptoms be present, there must be, in addition to empyema, either tumor or aneurism. Besides, the test of movableness of dull sound may, with due caution, be appealed to.

1802. The distinctive marks between mediastinal tumor, pericardial effusion, and aneurism of the aorta, are defined in the volume on the Heart.

1803. Given an intra-thoracic tumor, how may its *nature* be determined? If the signs of infiltration of the lung coexist, the tumor, as far as I have seen, is either composed of simple exudation-matter (of these I have examined three microscopically) or cancer. If the tumor present externally, it is cancer; if tumors exist elsewhere, either secondary to, or independent of, that in the chest, supposing even *their* nature cannot be established directly, the chances are strong, that the thoracic growth is cancerous. Violent hæmoptysis is more common with cancerous than other growths; expectoration of cancer can, of course, only occur with the former. The constitutional characters of cancerous disease may be wanting.

1804. Intra-thoracic tumor is, of course, beyond the permanent influence of *treatment*. But it is astonishing what marked temporary improvement of all the direct symptoms may be effected by cautious cupping, dry-cupping, flying blisters, profuse inunction with an ioduretted liniment, gentle purgation, and diuretics. I have twice known the diagnosis of intra-thoracic tumor contested, on the grounds of the relief produced by such measures; yet, *post-mortem* examinations, in one instance in three, in the other, in seven weeks, proved the existence of massy growths. Unfortunately all therapeutical means soon cease to avail us; and I know no more truly painful spectacle than that of the closing sufferings inflicted by mediastinal tumors.

¹ In a case of combined small tumor and effusion on the left side, recently seen with Dr. Scurrah (November, 1859), the diagnosis was made through the notable extension of infra-clavicular tubular note across the sternum (for horizontal conduction could scarcely have carried it so far, had the note depended on partial condensation of the upper lobe through the pleuritic fluid below)—by aphonia, explicable only by traction of the recurrent nerve—and by the presence of a small independent nodule above the clavicle.

II.—MEDIASTINAL ABSCESS.

ANTERIOR MEDIASTINUM.

1805. Abscess in the anterior mediastinum, a rare malady, is almost always of tuberculous nature—and associated generally with strumous softening and abscess of the cervical glands.

1806. The physical signs are, in nature, the same as those of tumor: but in degree they differ. Inasmuch as fluids press equally in all directions, there will be proportionally less of the effects of centripetal pressure in the case of abscess than of tumor; the trachea, veins and œsophagus will longer escape. The percussion-note, too, will not be so absolutely dull: thus in the case of a man with suppurating cervical glands, and all the physical signs of non-aneurismal, solid, tumor behind the first bone of the sternum, the amount of dulness very perceptibly decreased during three months' observation previous to death.¹ Inexplicable during life, this change was accounted for by the purulent liquefaction of a portion of a tuberculous mass in the mediastinum; fluid would, of course, make its way from the sternal surface, backwards and sideways, in the direction of gravity, and permit the lung to come more forwards. It would, however, be a bold proceeding to diagnosticate liquefaction of a tumor on such evidence alone.

1807. Suppurative action is generally very painful in this situation; irritation of the pleura and intercostal terminal twigs combines with the pain of the cellular or glandular inflammation to wear out the patient.

1808. Generous diet, cod-liver oil, moderate local depletion and counter-irritation are the therapeutical means indicated.

POSTERIOR MEDIASTINUM.

1809. Abscess in the posterior mediastinum occurs sometimes from suppurative softening of bronchial glands; sometimes from tuberculous caries of the dorsal spine. The signs of the former will be found in Section III.; of the latter I know nothing by experience.

¹ Buckley, U. C. H., Males, vol. ix. pp. 248—310.

APPENDIX.

CHANGE OF CLIMATE.

1810. ALTHOUGH we cannot at the present day subscribe unconditionally to the apophthegm "*pessimum ægro cælum est, quod ægrum fecit,*" experience justifies us in placing among the most important agencies, for modifying the course of various chronic diseases, migration from one climate to another, and further, experience likewise proves that among chronic maladies so remediable, those of the lungs hold the highest rank.

1811. In changing climate, that is the sum-total of the extrinsic physical conditions amidst which we breathe, we expose ourselves to new atmospheric, celestial, and telluric influences, varying in all conceivable varieties and modes of association from those to which we have been accustomed.

As far as concerns the atmosphere, we change temperature, absolute, as well as relative, from day to night, from day to day, and from month to month; habitual moisture; dews; weight; mean quantity of rain, and mean period within which it falls; electrical states; amount of ozone; mean amount of horizontal movement of the air; temporary violence of winds, or habitual windiness; specific quality in prevalent winds; amount of ordinary addition to the local air in the shape of mechanically irritant particles, such as smoke, of chemically irritant gases, or of volatilized poisonous organic matter.¹

In respect of celestial influences we change force and steadiness of insolation, as a calorific and vivifying agency; chemical activity of the sun's rays; lunar influences;² and even those of asteroids.³

As regards telluric influences, we change the geological and

¹ We send consumptive invalids of the most refined ideas and habits to Rome, in order that they shall enjoy its soft and equable winter temperature. But we forget that we condemn them at the same time to the revolting spectacle of, and poisonous exhalations from, human excreta in their daily walks through the best and most frequented parts of the town. I remember well, after visiting one of the spots, which, if correctly named, should rank among the most hallowed in the Eternal City by its associations—the house of Rienzi, "last of Romans"—being forced to return home at once from the violent sickness brought on by the intolerable odors. Can health be found in an atmosphere so mephitic?

² The coarse superstitions, long prevalent concerning the influence of the moon on health and disease, seem to have produced a distaste for the serious investigation of the subject. Without referring to any special morbid effect, how can it be questioned that a different influence must be produced on animals exposed to lunar rays in London and at the Havana, for example, where moonlight is literally often brighter than sunlight in London?

³ Laycock, "Med. Gazette," Dec. 1846.

mineral conditions of the soil; porosity and faculty of absorbing rain; the qualities of the potable water; the presence or absence of ponds, marshes, trees;¹ the neighborhood of the sea or of fresh water in the condition of lake, of tranquil stream, or foaming rapid; the amount of elevation above the sea-level; and the physical formation of the district, plane or undulating, open or confined, wide or narrow and gorge-like.

1812. Now, as all these conditions may be associated in endless variety of amount, activity, and manner of combination, it follows that little information of a kind practically applicable in the management of diseases can be expected from the examination of individual climates in regard of any one, or of any small number of the more prominent, of these characters.² The more so, as there are influences of climate wholly beyond the range of meteorological investigation—climates, in truth, of closely the same atmospheric characters produce effects very dissimilar on the animal economy. We cannot, in other terms, announce *à priori* the influence which any one climate will exercise upon the inhabitant of another, though the meteorology of both regions be perfectly worked out according to the standard of existing physics. The physiological influence of all varieties of change of climate must be observed to be understood; and *à fortiori* the influence of such changes in morbid states of the frame.³ Now a series of precise observations on invalids is yet wanting; and until this want be supplied, attempts at fixing the climate fittest for any particular form or degree of disease must, it appears to me, continue to result in frequent disappointment.

1813. Still some few general truths, capable of being practically utilized, may be derived from an unbiassed scrutiny of the statements made and testimonies given—contradictory and conflicting though these often prove—by writers and by travellers, healthy or invalid, medical or non-medical. Of these truths the more important may, I think, be set down as follows:—

(1.) Absolute temperature is of much less consequence than the relationship the temperature of the new spot bears to that of the old. The same place will on the one hand produce or accelerate, or on the other hand cure or stay the progress of, consumption in individuals born in climates of opposite characters. I have known sojourn at Constantinople materially benefit English consumptive

¹ The difference in the present and ancient climatic conditions of Provence, and the existing virulence of the Mistral, are to a large extent plausibly referred to the cutting away of dense forests, that tempered the desolating blast of that wind.

² In respect of temperature and numerous other atmospheric qualities, the subject of change of climate is amply and variously illustrated in the classical volume of Sir James Clark—a work which, as Isensee observes, “creates an epoch” in medical geography and therapeutics. (*Geschichte der Medicin*, p. 1585; Berlin, 1844.)

³ The degree to which the *à priori* system of argumentation has been pushed, in regard of the influence of climate, verges occasionally on the ludicrous. As an illustration of this, I may refer the reader to the disquisition on the relative merits of marine and inland residence in Richelmi’s work on the Climate of Nice (p. 180.) In his ingenious applications of meteorology—too ingenious by half—everything is remembered, *except the patient*.

patients ; it proves confessedly destructive to Egyptians.¹ (2.) It is a grave mistake to suppose that a given climate cannot effect beneficial change in the condition of consumptive sufferers from other regions, because those born within it themselves more or less frequently fall victims to phthisis. Probably the earth offers no more favorable spot to the tuberculized British patient than Nubia. Yet the native Nubians are extensively destroyed by phthisis. Again, the climates of Australia almost invariably prove serviceable to delicate Europeans, natives of northern latitudes ; yet pectoral disease is far from being unknown among the natives of Australia of British stock.² And hence, profoundly interesting though this be, the study of the geographical distribution of disease and of the isopathic zones marked out by nature on the earth's surface,³ does not lend the aid, that might possibly have been expected, in the selection of fitting climates for invalids of various kinds. (3.) Extreme climates, as a rule, are injurious ; tropical heat exerts an unfavorable influence. Mere change of climate is *per se* beneficial, provided there be no absolutely noxious quality in the meteorology of the new region sought. (4.) *A fortiori* moderately frequent change from place to place is more efficacious therapeutically than prolonged sojourn at any one spot, although the climatic characters of this be markedly salubrious. (5.) Theoretically speaking, steadiness of temperature from day to day, with but slight nocturnal fall of the thermometer, ranks as a very important condition : but practically it turns out to be comparatively insignificant. For those climes, Egypt and Australia, which furnish from time to time the most striking examples of arrest of phthisis in individuals of the Saxon and Celtic races of North Europe, are glaringly deficient in this element of theoretical success. (6.) The emotional influence of climate contributes to its successful or baneful results on the physical state of the system more actively than is imagined. But the nature of that influence cannot be predicted in any individual case. I have known natives of the Canary Isles, and English people long domiciled in the East or West Indies charmed with the sunless gloom of London.⁴ How long such deficiency of light would continue to prove exhilarating, would probably depend in each individual on the amount of temperament that finds joy in variety. (7.) Next in importance to genial warmth

¹ Hottentot soldiers at the Cape suffer more from pulmonary disorders than white soldiers ; so, too, at Sierra Leone, blacks furnish a larger quota of chest-disease than white soldiers—in the ratio of 6.3 : 4.9 per 1000.—Vide Boudin, "Annales d'Hygiène," t. xlii.

² Phthisis is, however rare. It is stated by Dr. J. Beddoe ("On Mortality in Australia and in England," p. 5) that "the mortality in the colony of Victoria, from all kinds of tubercular disease taken together, is less than that from phthisis alone in any county in England."

³ For an interesting survey of the state of knowledge on this subject, vide Aitken, "Handbook of Medicine," p. 727.

⁴ Sir J. Herschel found by the actinometer that the force of sunshine equalled 48°.75 at the Cape of Good Hope, while ordinary good sunshine in England marks no higher than 25° to 30°.—Athenæum, April, 1835.

stands, as matter of experience, the dry and bracing, or *per contra* the moist and relaxing quality of climate. (8.) In the selection of a locality, dominantly of one or other of these qualities, the anatomical conditions, state of progress, and presumed intimate nature of the existing affection are less faithful guides than the excess of the *strictum* or the *laxum* in the organism generally, and the natural partiality of the individual in one or the other direction. (9.) Places subject to wind—whether this declare itself in excessive habitual windiness, as in New Zealand¹—or in violent occasional wind without specific properties—or in wind having specific properties, as the mistral, the bise, the gregale, the simoom, the sirocco, or the harmattan—are either altogether unfit for the residence of pulmonary invalids, or can only be resorted to at seasons when those winds do not prevail, or in limited districts where natural or artificial protection is obtainable. (10.) Whatever be the difference of opinion as to the influence of high or low barometric pressure as an enduring state, there can be no doubt that regions characterized by rapid alternations in the weight of the atmosphere, are unfit for pulmonary sufferers. (11.) But the difference of opinion referred to is at the present day scarcely justifiable. For, on the one hand, evidence seems to have been collected, as already shown [1479*], calculated to prove that the sum-total of conditions, existing in the atmosphere of elevated regions, antagonizes the deposition of pulmonary tubercle. And, on the other hand, where spots on, or scarcely more elevated than, the sea-level, exhibit any particular immunity, specific superadded conditions, themselves antagonistic to tuberculization, may be traced in the climate. One of these antagonizing conditions seems to be either actual malaria, or the physico-chemical states conducive to malaria [1461]. (12.) The quality of the food obtainable in any proposed place of abode is a matter of essential importance. Defect in this point of view will, especially in some persons, more than counterbalance any advantage derived from superiority of climate. (13.) The peptic qualities of an atmosphere—those that stimulate appetite and promote primary digestion—are a matter of grave consideration. The climate which will, in any given case, prove most effectual in this aspect cannot be announced *à priori*; I have known the appetite more stimulated by the atmosphere of Pau and Torquay than by that of Nice and Malaga. (14.) Climates vary in their influence on the temper, both indirectly through the improvement or the reverse they produce on the existing disease, and directly by some mysterious working in the system, appreciable but unintelligible. Physical mischief will not be repaired in a climate that renders the temper morose and irritable.

1814. There are few pulmonary affections which may not be either cured, or relieved, by the influence of judiciously selected climate. Those ill-defined conditions included under the vague title of

¹ Dieffenbach reports that in New Zealand there are scarcely more than twelve calm days in the year.—Travels in New Zealand; Lond. 1843.

"delicacy of chest" may thus be completely removed, and for a permanency—as likewise the tendency to winter-attacks of bronchitis. Chronic bronchitis in all its varieties, asthma, emphysema, hay-fever, and chronic pneumonia are always to be relieved, occasionally to be cured—and the disposition to recurring hæmoptysis effectually controlled.

But, of all diseases, incipient consumption is that in which the efficacy of change of climate appears least questionable in the mass of cases. If in individual instances the experiment of change often egregiously fails, the failure depends either on inappropriateness of the spot selected—or, more commonly, on the very advanced condition of the local and general suffering, when the change is effected. The nearer the time of the first outbreak of the disease the new climate is sought, and the less serious the constitutional impairment, the stronger the likelihood of benefit. But there is no condition, be it ever so grave, in which at least temporary benefit may not ensue. A singular fact is, that the systemic suffering may greatly decrease, and the strength and flesh improve, though the local disease be actively increasing. I have under such circumstances known reparative chances take place in one lung, while softening and excavation advanced in the other.¹

1815. *Winter-residences.*—In order to facilitate the selection of a winter-place of abode for pulmonary invalids, the following classification of climates is offered—with the proviso, however, that it is only in point of general character the different spots brought together can be held to agree. The qualities ascribed to each group are supposed to be most marked in the order the various places are mentioned.

1816. GROUP I. *Climates distinguished by soft and relaxing character, combined with moderately high thermometric range.*—The Azores;² Pisa; Rome; Pau; Cove; Torquay;³ Penzance.⁴ These climates, as a general rule, agree with pulmonary and cardiac affections, attended with dry bronchitis and a dry irritable state of skin, especially if the invalid be constitutionally but little disposed to suffer from general languor.

1817. GROUP II. *Climates less moist and relaxing, of somewhat higher thermometric range, and slightly more stimulant than those of Group I.*—Madeira; Teneriffe;⁵ Palermo; Lisbon. Either of the two islands, of which the former is more relaxing than the latter, will be appropriate for persons in whom there is no prominent demand for a relaxing or bracing, but simply for a steadily warm and genial, air: Funchal, from its superiority in the comforts and appliances of civilized life, will probably long be preferred to Santa Cruz. Palermo⁶ and Lisbon supply places of transition to the next group.

¹ *e. g.*, Mr. —, seen with Mr. Daubeny, of York Place.

² Bullar, "A Winter in the Azores."

³ Radelyffe Hall, "Torquay, in its Medical Aspect, 1857."

⁴ Sir John Forbes, "Med. Topography of the Land's End."

⁵ Pinkerton, "Climate of Teneriffe;" Monthly Journal, 1854.

⁶ Palermo is one of the many continental spots, admirably suited by climate for certain consumptive invalids, rendered almost wholly useless to Englishmen by the wretchedness of its accommodations.

1818. GROUP III. *Climates essentially dry and hot, with keen stimulant quality more or less predominant.*—Malaga; Nice;¹ Cannes; Malta; Algiers; Cadiz; and San Lucar. This group of climates is well adapted for cases in which relaxation is at once a notable character of the existing disease, and of the constitution at large. Cases of chronic bronchitis, with copious discharge; of phthisis, similarly characterized; of feeble dilated heart; of humid asthma and allied affections, benefit strikingly by the air of these places. A dry, irritable state of mucous membrane, and chronic laryngopharyngitis of whatever type, are made worse by them all. These spots, too, especially Nice, Cannes, and Malta, exercise a peculiarly exciting effect on the nervous system of some persons.

1819. GROUP IV. *Climates possessing in a less degree the essential attributes of Group III.*—Corfu; San Remo; Mentone; Villafranca; Cimiez (Nice); Hyères.

1819*. GROUP V. *Climates distinguished by warmth, dryness, and purity of atmosphere, without notably stimulant or relaxing quality.*—The Nile;² Rhodes. The most remarkable effects I have observed in regard of the apparent suspension of phthisis, through the influence of climate, have been the results of life in a Nile-boat: yet even to Egypt, the land of stilly enchantment, intellectual, emotional and corporeal, the invalid must not repair without knowing that his courage may be rudely tested from time to time by unusual conditions of atmosphere;³ an observation which will, however, more strongly apply to every other spot mentioned.

1820. GROUP VI. *Places, of which the favorable influence is mainly dependent on their altitude above the sea-level.*—The effect of rarefied, and at the same time warm air, has scarcely been tried as yet on European consumptive sufferers. But it is very certain that the Peruvian practitioners habitually send patients who become phthisical at Lima and other places, on or about the sea-level, to Arequipa, Rondos, or Huanuco. These and other spots, varying in altitude from four to ten thousand feet above the sea-level, seem unquestionably to exercise a favorable influence, not only on the local disease, but on the attending diathetic state [1540]. That enlargement of the capacity of the chest follows the habitation of these elevated districts, by persons removing from the sea-level, seems as certain as that the natives possess a thoracic development

¹ "Nice and its Climate," by Edwin Lee, M. D.

² "Egypt and Nubia," by J. Dickinson, M. D., 1858.

³ Thus on the occasional violence of the winds, and severity of the cold, hear the testimony of an American traveller, not the less trustworthy, because its terms are florid. "Still? why the wild winds pace up and down the Valley of the Nile, like his mad hounds howling for Actæon; like all the ghosts of all the three hundred dynasties anterior to history, demanding to live again. . . . Warm? why, the Howadji sat more voluminously swathed in coats, cloaks, and shawls, than mummies in their spiced bandages. They began, bravely, with sitting in front of the cabin; warmly wrapped in winter-clothes, and only a little chilly, played that it was summer, and conversed in a feeble, poetic way of the Egyptian climate. Gradually they retreated to the divans in the cabin, and cursed the cold."—*Nile-Notes of a Howadji*, by Curtis.

ranging considerably above the average of those exposed to high barometric pressure [1031].

1821. GROUP VII. *Districts where, in combination with moist warmth, Malaria prevails.*—The claims of Pozzuoli as a winter residence for phthical invalids have of late been strongly urged by MM. Renzi and Carrière.¹ The latter marvels that Pozzuoli, “assuredly possessed of a milder winter than any other station in Italy,” has so long been neglected by medical art. Not only does the climate favorably modify the symptoms of phthisis, according to these observers, especially when accompanied with an irritable state of the mucous surfaces; it actually removes those symptoms altogether.

The efficacy of the air of Pozzuoli seems so remarkable to M. Renzi that its soft warmth cannot alone explain the influence; and he suggests that the mingled sulphur vapor may play the part of “balsamic remedies” in regard of the pulmonary apparatus. M. Carrière justly objects that volcanic emanations, such as pervade the local atmosphere, must be of complex nature, and that a single form of them cannot logically be selected as the probable cause of the observed effects.

May not the paludal emanations of the soil have much to do with the antagonizing influence exhibited in regard of phthisis? At all events the ordinary effects of malaria do not exhibit themselves in phthical persons sent to this district, though the inhabitants are malariously poisoned to the highest degree. It is remarkable enough that another climate, that of Venice, which M. Carrière affirms to be “one of the best climates during the first stage” (loc. cit. p. 465), is distinctly malarious. Considered independently of their miasmatic attributes, both Pozzuoli and Venice would rank with Group I. Of the amount of accommodation obtainable at Pozzuoli no great hopes can be entertained.

1822. GROUP VIII. *Places in the British Isles protected, more or less completely, from northerly and easterly winds, and therefore superior as winter residences to spots of about the same temperature but more exposed.*—Undercliff; Hastings; Hotwells (Clifton); Dover; Bournemouth; Grange. Grange, a spot on the shores of Morecombe Bay, but little known, appears to offer a striking example of the singular modifying effects which local influences may exercise on the regional characters of climate. Myrtles thrive well in the open air here till after Christmas; the quality of the air is soft and soothing; and the thermometer often marks ten degrees and upwards higher here than at Kendal and the surrounding spots. I entertain no doubt Grange offers a favorable place for winter residence to invalids from the northern districts.

1823. Havana, the capital of Cuba, unfortunately offers such bad accommodation that the advantages of its genial winter climate are, practically speaking, lost. Harbor Island, Nassau (New Providence), and some other spots among the Bahamas, afford available

¹ Le Climat de l'Italie, pp. 221—224; Paris, 1849.

winter residences for persons who, on other grounds, might find the western hemisphere desirable. There are certain parts of Florida in which, if I can credit the statements made by some patients, the qualities of the climate surpass those of any part of the globe. Buenos Ayres, too, is highly lauded.

1824. *Summer Residences*.—If the patient have wintered in the south-west of France, beautiful summer excursions are afforded in the valleys of the neighboring Pyrenees—Eaux Bonnes, Bagnères de Bigorre et de Luchon, Cauterets, St. Sauveur, &c. In some of these places, especially Eaux Bonnes and Cauterets, are mineral waters of undoubted utility in bronchitic disorders.¹

1825. The Baths of Lucca are of easy access to the invalid who has wintered at Rome or Pisa; Castellamare or Sorrento to those returning from Palermo, Malta, or Egypt.

1826. The air of Switzerland agrees well with many consumptive patients during the milder portions of the year; the pretty village of Montreux, completely sheltered from the north-east wind, is an available spot even in the spring and autumn.

1827. *Spring Residences*.—Many places, more or less excellently adapted for the invalid in the winter, become detrimental in the earlier part of the spring, from the prevalence of active winds: Malaga, Malta, Nice, Ventnor, are instances in point. Egypt and Algiers are less open to this objection than most foreign places of resort; Bournemouth and Clifton perhaps suffer less in our own country from vernal east wind than most other spots frequented by pectoral sufferers.

TREATMENT BY THE COMPRESSED-AIR BATH.

1828. Upwards of sixty years ago the Royal Society of Sciences at Haarlem proposed, as a subject for competition, the influence of condensed air on animal and vegetable life. The queries put by the Society appear to have met with no response. At a later period Sir John Sinclair suggested, on the ground of experiments made by certain persons on the lower animals, that individuals in given states of disease, might be made to breathe with advantage compressed air. But to M. Junod we are indebted for the first authentic experiments on the human subject in the state of health.² These experiments seem, however, to have been rudely conceived and executed—whence, probably, the decisively unfavorable Report of Magendie on the subject, declaring that the treatment by compressed air was inapplicable to the human subject.³

1829. Meanwhile M. Tabarié appears to have been conducting a series of most careful trials; and to have had the merit of establishing the feasibility of the system. Under his direction M. Ber-

¹ *Vide*, for a very complete medical account of the Pyrenean district, Taylor on "The Climate of Pau," 2d edition.

² Séances de l'Acad. des Sciences, Août, 1835.

³ Bertin, "Du Bain d'Air Comprimé," p. 7—a logically and conscientiously written volume.

tin, at Montpellier, as also MM. Pravaz,¹ Milliet, and others of Lyons, have largely applied condensed air in the treatment of a variety of affections.

1830. The apparatuses invented by M. Tabarié, are hollow spheroids of wrought iron, of various sizes, to hold one, two, or ten or a dozen persons at once. The air is pumped in by steam-engines—and a contrivance adapted by which that vitiated by respiration is removed. The least pressure employed medically is about half an atmosphere, the greatest two-thirds of an atmosphere. Each sitting lasts two hours; the first half hour is occupied in increasing, the last in lowering, the pressure; an hour is consequently passed under the full excess of pressure. The mean number of baths required for various chronic diseases is said to vary from thirty to forty.

1831. Physiologically these baths slacken the pulse and respiration as a rule; drive the blood from the surface; excite the appetite; and throw into the system an excess of oxygen. The venous circulation is said to be rendered more active, and secretion and absorption promoted.

Singularly enough, some of the effects are precisely the same as those produced by diminished atmospheric pressure—difficulty of utterance, febleness of voice, inability to whistle, without the least disposition to cough; sense of pressure on the membrana tympani; and much thirst, without notable excitement of the urinary organs.

1832. The pulmonary affections said to be benefited by this treatment are, especially, acute and chronic bronchitis, asthma both humid and dry, and emphysema. That a sense of comfort is experienced, while in the bath, by asthmatic sufferers, seems indubitable: and I have certainly received strong disinterested testimony to the fact, that permanent relief may be obtained in the latter affection; but, on the other hand, it has not occurred to me to meet with any case in which actual cure even of spasmodic asthma has clearly followed the very fullest employment of the system. M. Pravaz records some few cases where amelioration appears to have been effected in the first, and even in the second stage of phthisis. But a much more extensive, and a more cautiously interpreted, experience, than any hitherto obtained, is required on the entire subject.

INJECTIONS INTO THE BRONCHIAL TUBES.

1833. That considerable relief of laryngeal irritation, improvement of the voice, diminution of dysphagia, and an easier condition of breathing may be obtained in the laryngeal affections attending phthisis, by sponging the back of the pharynx, the epiglottis, and the confines of the upper orifice of the larynx with a strong solution of the nitrate of silver, cannot be doubted. The fact is exem-

¹ *Emploi Médical de l'Air Comprimé*, 1850. See, also, "Compressed Air as a Therapeutic Agent," by A. Simpson, M. D., 1857.

plified in every-day practice. But how stands the evidence as to the alleged utility and practicability of sponging the interior of the larynx itself, and of injecting the bronchial tubes, and the interior of pulmonary excavations? The following are the inferences which I feel justified in drawing from my own observation, fortified by the extended experience of others.

(a.) No proof exists that the interior of the larynx, at and below the true vocal cords, has ever been reached with the sponge and probang in the living subject. The feat is of most difficult accomplishment in the dead body—an amount of force being required, which would be utterly unjustifiable in the case of the living person. (b.) The utter fallacy of supposing that, because a hollow tube, passed beyond the root of the tongue, influences the flame of a candle held before its external orifice, therefore the internal end of that tube has reached the trachea, has been fully proved. It has been shown that if a hollow tube be purposely pushed into the cesophagus, almost to the cardiac orifice of the stomach, the flame of a candle will be drawn to or blown from the orifice with inspiration and with expiration.¹ (c.) I have made numerous attempts with a curved silver catheter, provided with a gutta-percha hollow bell at the external end,² to reach the trachea. But I have never felt satisfied I had succeeded. (d.) There can be little doubt that the failure to reach the interior of the windpipe is matter for congratulation to both patient and operator. For occasionally an unusually large quantity of the fluid injected from the catheter, accumulates about the upper part of the larynx, and not being instantly sputtered away by the convulsively energetic cough that ensues, a few drops make their way into the larynx. The terrible suffering that follows and holds on in a more or less aggravated form for some while, shows that disastrous results must follow, were any quantity of the caustic fluid really thrown into the tubes. (e.) In a word, it appears to me, the alleged injection has never been demonstrably executed; and were a process invented by which it might be effected, I believe its execution would be unjustifiable.

OSTEOID OF THE LUNGS.

1834. A remarkable example of this rare form of disease occurred some time since in Mr. Quain's practice at University College Hospital. The specimen may be seen in the Museum (No. 4181).

¹ Results of New York Commission confirmed by Erichsen, "Science and Art of Surgery," 2d edition, p. 751. The experiments of Professor Griesinger, of Tübingen, on this point, are peculiarly interesting and conclusive; for he started on his inquiries with the conviction, subsequently most fully and candidly relinquished, that the introduction of a catheter below the vocal cords was easily to be effected. (Deutsche Klinik, April 17, and July 17, 1858.)

² Made by Coxeter, Grafton-street, East.

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