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ORIGINAL ARTICLES.

ON THE DIFFERENTIATION, BY MEANS OF THE PITCH OF SOUND, OF PULMONARY SIGNS OBTAINED BY AUSCULTATION AND PERCUSSION.¹

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This paper is intended to be a supplement to an essay "On Variations of Pitch in Percussion and Respiratory Sounds, and their application to Physical Diagnosis," to which was awarded a prize by the American Medical Association in 1852.² The introduction to that essay was as follows: "Very little attention has hitherto been paid to variations in the pitch of the sounds heard in the practice of percussion and pulmonary auscultation. The sibilant and sonorous râles, it is true, are distinguished from each other chiefly by a contrast in pitch, but as respects the remainder of the physical signs pertaining to pulmonary disease, they appear not to have been much studied in this aspect, and even the facts that have arrested notice do not seem to have been applied, save in a very limited degree, to physical diagnosis. By most writers on physical exploration, pitch modifications, except in the sibilant and sonorous râles, are not recognized, no allusion whatever being made to them."³

In the second edition of the able and comprehensive work by Dr. Walshe, of London, recently republished in this country, the subject is noticed more distinctly than by any other author with whose writings I am acquainted. Dr. Walshe enumerates among the elements involved in the different modifications of respiratory sounds in health and disease, variations in pitch; he also mentions several important facts with respect to these variations. But he apparently loses sight of their practical applications, making no reference to them in connection with the diagnosis of individual thoracic diseases. Barth and Roger state, as briefly as possible, that the bronchial respiration is higher in pitch than the cavernous. But, in general, as just remarked, nothing is to be found relating to

this subject in standard treatises on auscultation and percussion.¹

A single additional remark by way of introduction: The pitch modifications of sound, as before intimated, opening a field of study in physical exploration as yet but little cultivated, and to which, so far as relates especially to auscultation, my attention has been but recently directed, propriety and prudence dictate, not only caution in drawing deductions from a number of data somewhat limited, but a certain amount of distrust in a kind of observation in which the liability to error cannot be at once fully estimated. In view of these considerations, the conclusions which I shall present, are advanced as propositions to be confirmed by further researches, the object of this paper being, in a great measure, to invite the investigations of others in the same direction." The essay from which these extracts are taken, embraced the results of clinical studies in relation to the variations in pitch of the sounds obtained by percussion and auscultation. In these studies, the analytical method was pursued, that is, observations in healthy subjects and in cases of disease were recorded, and the records analysed. The diseases studied with reference to the pitch of sound, were pneumonia, pleurisy, pulmonary gangrene, pneumo-thorax, and phthisis in the different degrees and stages of this affection. Abridged histories of the cases of disease which were recorded and analysed, are contained in an appendix to the essay.

My interest in the clinical study of variations in the pitch of sound did not end with the publication thirty-three years ago, of the prize essay. The conclusions at that time presented with diffidence were confirmed by further study, and, together with additional conclusions, were submitted to the profession in my work on "Physical Exploration and the Diagnosis of Diseases affecting the Respiratory System," published in 1856, (1st Edition) and in subsequent publications. My object in this supplementary paper, is to give a statement of the differential characters derived from the pitch of sound, in the signs obtained by auscultation and percussion, as applied to the respiratory system, especially in so far as knowledge of these characters has originated in my own

¹In connection with this statement, it is proper to give the bibliography to which it applies. The works consulted are as follows: "Laennec," edited by Forbes; "Walshe on the Heart and Lungs;" Hughes's "Physical Diagnosis of the Lungs and Heart;" Barth & Roger's "Practical Treatise on Auscultation;" Gerhard on "Diseases of the Chest;" "Prize Dissertations on Physical Explorations of the Chest," by Dr. Holmes, Bell & Haxall; Blakiston on "Diseases of the Chest;" Latham on "Auscultation and Semeiology;" Swett on "Diseases of the Chest;" Bowditch's "Young Stethoscopist;" Lawson's lectures in the Western Lancet.

¹Read in the Section of Practical Medicine, Materia Medica and Physiology, at the Thirty-Sixth Annual Meeting of the American Medical Association.

²Vide the Transactions of the American Medical Association for 1852, Vol. V.

³The vocal sign ægophony should perhaps be excepted.

studies, and to inquire how far the results of my studies are, at the present time, accepted by clinical observers.

ON THE DIFFERENTIATION, BY MEANS OF THE PITCH OF SOUND, OF SIGNS OBTAINED BY PERCUSSION.

A conclusion deduced from observations in different diseases was that the sign known as diminish resonance or dulness is invariably higher in pitch than the normal vesicular resonance of the patient examined. This character of the sign is of practical use in determining a slight degree of dulness. Another conclusion deduced from the examinations of healthy persons with symmetrical chests, was that the normal resonance is higher, as a rule, at the summit on the right, than on the left side of the chest. The higher pitch on the right side, accompanies a normal relatively diminished resonance or dulness on that side. These conclusions have been generally accepted in this country, and to some extent by writers in other countries.

My observations subsequent to the publication of my prize essay led me to conclude that a tympanitic resonance or percussion is higher in pitch than the normal vesicular resonance. Statements by some writers are opposed to this conclusion; that is, it is stated that a tympanitic resonance may be lower in pitch than the vesicular resonance. Here, as in other instances in which there is a difference of opinion in relation to the relative pitch of sound, the question, of course, is to be settled purely by observation and discussion is therefore useless. I am quite sure, that in my own experience a tympanitic resonance has been always higher than the normal resonance of the person examined. The difference of opinion in regard to this point perhaps, arises from the lack of a sharp determination between pitch and quality of sound. In testing the judgment of a class of medical students as to the pitch of tympanitic resonance, I have found that a certain number pronounced the pitch of the sound to be lower when to my ear it is clearly enough raised. To disconnect pitch from quality requires in some persons practice.

The characters, aside from pitch, which distinguish the sign called tympanitic resonance, are by many not sharply defined. Precision requires as an essential characteristic of the sign, entire absence of the vesicular quality of sound. Intensity is not a character; the sound may be more or less intensified, and it may be weaker than the normal resonance. Quality and pitch are the sources of the distinctive characters of the sign. Every clinical observer who has given attention to the physical exploration of the chest, must know that there is an abnormal resonance which is more or less increased in intensity, as compared with the normal resonance, but which is not purely tympanitic. This kind of resonance accompanies pulmonary emphysema. It is the sign obtained over healthy lung above the level of liquid within the pleura, and over the sound lobe of a lung with a lobe solidified by pneumonia. An abnormal intensity is an essential characteristic of this sign. The other distinctive characters, are a combination

of the tympanitic with the vesicular quality, and an elevation of pitch. Hence a descriptive name for this sign, is a vesiculo-tympanitic resonance. This name I proposed in 1856. The name has been generally adopted in this country and by some British writers.

We may formularize the facts relating to the pitch of sound in the pulmonary signs obtained by percussion, by saying, that (excluding flatness which is absence of resonance and therefore has no pitch) all the abnormal signs are higher in pitch than the normal vesicular resonance. This normal vesicular resonance varies considerably in pitch in different healthy persons. The variations will be found to correspond with those of the vesicular quality. In proportion as the vesicular quality of the normal resonance is marked, the pitch of sound is low, and *vice versa*. This correspondence is observed in the variations observed in healthy persons as well as in cases of disease.

ON THE DIFFERENTIATION, BY MEANS OF THE PITCH OF SOUND, OF RESPIRATORY SIGNS.

There are considerable variations in the intensity, the quality and the pitch of respiratory sounds in healthy persons. Hence, there cannot be an ideal standard of the normal respiratory or vesicular murmur. The intensity varies within pretty wide limits; the quality is in a greater or less degree, vesicular, and the pitch is not uniform. This statement applies alike to the sound of inspiration and expiration. Moreover, the length of the expiratory sound is variable.

The normal respiratory murmur varies also in different parts of the chest. The characters of the respiratory sound in the infraclavicular region differ considerably from those of the respiratory sound in the mammary, the axillary or the infra-scapular regions. Situated in either of these latter regions, the characters of the respiratory sound which are normal at the upper part of the chest would denote disease. And again the infraclavicular region does not furnish characters of respiratory sound which are alike on the two sides. A practical acquaintance with these normal variations is an important requirement as preliminary to the study of morbid respiratory signs. The importance of observing and recording the characters of the respiratory sound in a considerable number of healthy persons, and subjecting the observations to analytical study, seems not to have been fully appreciated heretofore, and is perhaps not sufficiently so by many of the present time. The conclusions obtained by this method of study, are embraced in my prize essay and in my "Treatise on Physical Exploration, etc.," the latter published in 1857. Without going into details, I will simply state that these conclusions have not only been confirmed by continued observations, but I am not aware that anyone has claimed to have disproved them.

Taking up first an important respiratory morbid sign, namely, the bronchial or tubular respiration, it is a correct comparison to say that the sound is like that produced by blowing through a tube. But how much more precise is a description embracing its characters pertaining to quality and pitch! These

characters are tubularity and raised pitch. The absence of any vesicular quality, and the high pitch are the essential characteristics. Intensity is of no importance. The pitch and quality, together with other characters relating to relative length, and the higher pitch of the expiratory sound, were stated in my prize essay as determined by observations in a series of cases of pneumonia in the second stage. With these characters, the sign always represents solidification of lung. I may add that the characters of the bronchial respiration, as determined by analytical study, prove this sign to be, not bronchial in its origin, but transmitted from the larynx and trachea. The proof consists in the fact, that the characters of the bronchial respiration are identical with those of the trachea and laryngeal respiratory sound.

Bronchial respiration represents complete or considerable solidification of lung. Now, in different diseases the lung is but slightly or moderately solidified. The bronchial respiration does not represent the latter physical conditions. These give rise to abnormal modifications of the respiratory sound not included in bronchial respiration. How are these modifications to be described and named? The names *rude*, *rough* or *harsh* respiration were heretofore used by English and American writers. These names express not merely an indefinite but a false analogy. As a result of clinical observations and analytical study, I proposed in 1856 the name *bruncho-vesicular* respiration. The pertinency of this name consists in the fact that the characters consist of the normal vesicular and the bronchial in combination. These characters are combined in variable proportions corresponding to the degree of solidification. The name has been generally adopted in this country, although some writers prefer the name *vesiculo-bronchial* or *versiculo-tubular* respiration. Some English writers have adopted the name. But it has made as yet little progress in France or Germany. In France the name *rude* continues to be used, and in Germany the name introduced by Skoda, "indeterminate respiration," is still retained. It is difficult to understand why such an unsatisfactory adjective as "indeterminate" should be used to denote a definite physical sign, except that Skoda's authority in auscultation seems in Germany to be considered somewhat higher than that of Laennec.

It must be admitted that Laennec's description of a respiratory sign representing a pulmonary cavity (exclusive of amphoric respiration) was imperfect. Skoda denied the existence of such a sign. Of English writers, Walshe came nearest to a correct description. But there is a cavernous respiration, and that its characters, as derived from pitch and quality of sound, are sufficiently distinctive, was proved by facts contained in my prize essay. These facts consisted of recorded clinical and autopsical observations. The characters are a low pitch of the inspiratory sound, together with a quality which is neither vesicular nor tubular (a quality which I distinguish as simply blowing), and an expiratory sound still lower in pitch than the inspiratory. Elsewhere than in America, the present status of this sign is about the same as it was 35 years ago. Its non-existence is

still the doctrine in Germany, and the description of it by English and French writers has not materially changed. As an illustration, at a meeting at Copenhagen last summer of members of a committee appointed by the International Congress in 1881 to establish uniformity of the nomenclature of physical signs obtained by auscultation and percussion, there were present a representative from England, from France, from Germany, from Denmark, and from America. The cavernous respiratory sign was one of the topics discussed, and so doubtful were the members of the committee present, other than the one from America, as regards the distinctive characters of this sign, that the member from England proposed to drop the sign from the list.

I do not hesitate to make the assertion that the characters of cavernous respiration are not less distinctive and reliable than those of any other auscultatory sign. Not only is its validity established on the sure basis of observations during life and after death, but the sign can be readily reproduced by inflating lungs containing cavities with flaccid wall, after their removal from the body. Moreover, it may be perfectly illustrated by a simple mechanical contrivance which represents the physical conditions giving rise to it.¹ Its distinctive characters will certainly be accepted anywhere as soon as the evidence of their correctness is brought to the notice and verification of clinical observers in other countries.

To the abnormal modifications of the expiratory sound which, remarkable as it seems, escaped the notice of Laennec and those who immediately followed him, attention was first directed by an American observer, James Jackson, the younger, in 1833. He pointed out the significance of a prolonged expiratory sound as a phthisical sign. He did not direct his attention to the pitch of a prolonged expiratory sound, nor have variations of this sound in this regard up to the present time received consideration elsewhere than in America. In this remark I refer especially to a prolonged expiration when it is either the sole respiratory sign, or not associated with pronounced abnormal characters pertaining to the inspiratory sound. The importance of observing the pitch of this sound was pointed out by me in 1856.² A prolonged, high pitched, tubular expiratory sound is as invariably proof of solidification of lung, when it exists alone or when it follows a normal inspiratory sound, as when associated with a high pitched tubular inspiration in the so-called bronchial respiration. If this prolonged expiratory sound be due to a prolongation of the act of expiration, as in cases of emphysema, or of some obstruction which occasions increased force of this act, the pitch is low and non-tubular as it is in health provided there be no solidification. The mere prolongation, therefore, of this sound, irrespective of pitch and quality, is not a sign of phthisis or any other affection which involves solidification. If not tubular and raised in pitch, a prolonged expiratory sound denotes either that the parenchyma of the lung is not solidified, or that the sound proceeds from a pulmonary cavity.

¹Vide Lectures on the Physical Exploration of the Lungs, published in the Philadelphia Medical News, 1882.

²Vide Work on Physical Exploration.

In respect to the application of pitch to pulmonary râles (embracing under this term all purely adventitious sounds) one point only calls for remark in this paper. Of course, every auscultator knows the import of high and low pitched dry bronchial râles as regards their production in tubes of small or large calibre. The significance, however, of the pitch of moist bronchial or bubbling râles, inclusive of the so-called sub-crepitant râle, is perhaps not generally appreciated. A high pitch denotes that these râles are produced in tubes which are situated either within or proximate to solidified lung, and a low pitch excludes solidification at or near the site of their production. The significance of pitch in this connection was pointed out by Skoda. The correctness of his conclusions has been fully confirmed by my observations. This is a practical point in auscultation to which most writers make no reference.

ON THE DIFFERENTIATION, BY MEANS OF THE PITCH OF SOUND, OF VOCAL SIGNS.

To those who have given no attention to the subject, it may seem that the differential characters of vocal signs offer little room for variations in the pitch of sound. The fact is otherwise; the variations in pitch are of much importance. An abnormal increase of the intensity of vocal resonance without any notable elevation of pitch, as compared with the normal resonance, denotes either a moderate degree of solidification of lung or a pulmonary cavity. The resonance of the voice transmitted through a cavity may be greatly intensified, so much so as to be painful to the ear, especially if the bin-aural stethoscope be used, whereas the pitch is not much, if at all, raised. Taken in connection with other signs, a notable increase of resonance, without elevation of pitch, within a circumscribed area is highly significant of a cavity. If the pitch be high, either with or without increase of intensity, the resonance denotes complete or considerable solidification of lung. This elevation of pitch is in fact an essential characteristic of bronchophony. The voice of the patient seems to be near the ear. Doubtless this was meant by Laennec when he described the voice as being conducted up the stethoscope. A high pitched vocal resonance near the ear is always evidence of complete or considerable solidification, whether the vocal sound be intense or weak. Increased vocal resonance and bronchophony are, therefore, two distinct signs differentiated especially by pitch, the significance of the former being either moderate solidification or a cavity, and that of the latter being complete or considerable solidification.

The sign denoted by Laennec ægophony, and to which he devoted so much consideration in his treatise, has the pitch of bronchophony. It denotes considerable or complete solidification. In this respect it is neither more nor less than bronchophony. It differs from the latter in an apparent distance, as well as in its tremulous or bleating character. In pectoriloquy, as is now well known, in opposition to the teaching of Laennec, the speech may be conveyed either by solidified lung or through a cavity. Can it be determined whether or not pectoriloquy denotes a

cavity or solidified lung in particular cases? I answer this question in the affirmative. The discrimination is made by attention to the pitch of sound. If the vocal resonance associated with the transmission of speech has the characteristics of bronchophony, that is, the pitch raised and the voice near the ear, the medium of transmission is solidified lung; if, on the other hand, the characteristics of bronchophony be wanting, the transmission is through a cavity. This method of differentiation I have practised and taught for many years. Its reliability is yet to be accepted by others.

It is noteworthy that the auscultatory signs, respiratory and vocal, together with those obtained by percussion, are either single or compound. Percussion furnishes a combination of vesicular and tympanic resonance in the sign called vesiculo-tympanic resonance. The respiratory signs called vesicular and bronchial are united in the broncho-vesicular respiration. Pectoriloquy may be associated with either bronchophony or cavernous resonance. Other combinations not considered in this paper are broncho-cavernous and vesiculo-cavernous respiration.

DIFFERENTIATION, BY MEANS OF THE PITCH OF SOUND, OF SIGNS PRODUCED BY THE WHISPERED VOICE.

In 1856 I described certain signs produced by the whispered voice, and proposed names for their designation. Subsequent observations led me to form a group of these signs corresponding to those produced by the loud voice, and corresponding names were applied to them. An enumeration of the morbid signs, designating the normal sound the bronchial whisper, is as follows:

1. Increased bronchial whisper.
2. Bronchophonic whisper or whispering bronchophony.
3. Cavernous whisper.
4. Amphoric whisper.
5. Whispering pectoriloquy.

Variations in the pitch of sound constitute an essential element in the differential characters of these signs.

1. A simple increase of the normal bronchial whisper is but little raised in pitch, the chief characteristic being an abnormal intensity. This sign corresponds to increased vocal resonance.

2. Bronchophonic whisper corresponds to bronchophony with the loud voice, and a high pitch is its chief characteristic.

3. A cavernous whisper is low in pitch. Its analogue, as a vocal sign, is an intensified resonance without elevation of pitch.

4. An amphoric whisper is characterized by a musical intonation.

5. Whispering pectoriloquy may denote either a cavity or solidified lung. If the latter, the pitch of sound accompanying the transmitted speech is high; if the former, the pitch is low.

As a whisper is an expiratory sound, the characters of these several signs correspond of course to those produced by the act of expiration in the respiratory signs which have the same significance, namely, the broncho-vesicular, the bronchial, the cavernous

ous and the amphoric respiration. Whispering pectoriloquy, alone in the group of whispering signs, has no analogue in the respiratory signs. An experience of many years has led me to consider the group of signs produced by the whispered voice as an useful extension of auscultation.

AN ATTEMPT AT THE RADICAL TREATMENT OF TUBERCULOSIS.¹

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Pathologists recognize the frequency of recovery from attacks of tuberculosis of the lungs. When patients once thus affected die of other or intercurrent disease, characteristic cicatrices or calcareous condensations are found in the lungs, along with adhesion of the opposed pleura.

It would therefore seem rational to endeavor to induce or hasten such processes during the course of the disease, with the hope of destroying its cause (perhaps by preventing the nutrition of it), or at least to oppose a bar to its further progress. The possibility of such a procedure would seem all the more justifiable for the reason that the disease is and remains, in most cases, for a long time quite strictly circumscribed. It may be taken for granted that every one now believes the disease to be a mycosis. With the double purpose of directly addressing the cause of this disease with an antimycotic agent, and of producing the irritation which might result in proliferation of the connective tissue of the lungs, I have made a number of parenchymatous injections into the lungs with solutions of the mercuric bichloride of varying strength. A number of experiments of similar character were made by Hiller, of Berlin, with negative results, but I have been stimulated to repeat these experiments with the modification in the solution suggested by Stern, in the hope that by rendering the remedy less irritating to the lungs, I might be able to use a larger dose.

I took the precaution, in making these experiments, to select only such patients (with one exception), in whom the disease existed in what is commonly called its first stage, with at most apical consolidation of the upper lobe. I did not venture upon the use of this remedy where undoubted evidence of softening existed, or where cavities could be appreciated in the lungs. Seven years ago I had the misfortune to lose, upon the operating table before the class, a case in which I had aspirated the contents of a large cavity in the left upper lobe.²

The experiments of Wilhelm Koch upon cats and dogs, which consisted in making into the lungs parenchymatous injections of potassium iodide, with the effect of producing proliferations of the connective tissue to any desired extent, relieved me of the

necessity of making any preliminary operations of this kind myself, and the impunity with which large doses of the bichloride are introduced subcutaneously in man, relieved me of any anxiety of danger in this respect.

[The essayist here related his observations upon five patients carefully selected, where accurate thermometric records were kept and all points of history noted with regard to cough, night-sweats, appetite, condition of bowels and weight. The bichloride was injected daily at a depth of four to six inches, in quantities varying from 1-32 to $\frac{1}{8}$ grain. At the same time all the patients inhaled from an atomiser a solution of the bichloride with common salt three times daily for five weeks. There was, as a result of this treatment, no change whatever in the course of the disease. What fluctuations were observed were of the same character precisely as before. The essayist next spoke of the value of the bichloride as an antimycotic agent, and sought to be able to account for its failure in tuberculosis.]

It is the testimony of all competent mycologists, without exception, that the bichloride of mercury is the most potent antimycotic which we possess. In comparison with this agent, observes Küster in his paper on the treatment of wounds (*Real-Encyclopädie*, xv, 290), "all others must stand in the background, and it is incomprehensible," he continues, "why the search for new antiseptics continues with the risk they imply of unknown dangers to the patient." Schede, of Hamburg, concluded his discourse at the surgical section of the International Congress at Copenhagen, in August last year (vide, published in *Volkmann's Sammlung*, Feb. 12, 1885), with the statement: "Whoever will use sublimate after the manner mentioned, with regard to the cautions described, will find it by far the most reliable and effective means of disinfection, and not only this, but also the agent which will favor the quickest healing of wounds. Moreover, it is the most free of all agents of any disturbing or dangerous accessory effects." Bruns (*Berlin klin. Wochenschr.*, xx, p. 295, 1883) says that with sublimate antiseptics "cases of so-called aseptic surgical fever almost never occurred." The obstetricians and gynecologists at once adopted the bichloride with such degree of enthusiasm as to have led to its abuse and to reactionary protest in the latest times. Fuhrman, of Breslau, shows by statistics (*Schmidt's Jahrbücher*, June 24, 1884), the superiority of sublimate over carbolic acid in the effect on the temperature curves of puerperal fever. In Kezmarsky's clinic at Buda Pesth a comparison between the results of treatment with carbolic acid and sublimate showed "decidedly better results for sublimate," as parametric exudations, ulcerations, etc., etc., occurred much more rarely. It is useless to multiply statements here as to the supreme value of the bichloride in antiseptics. Thorn, in his paper, "A View against the Present Method of using Sublimate" (*Volkmann's Sammlung*, Feb'y 12, 1885), quotes from no less than twelve authorities, who have expressed themselves for the most part emphatically in its favor, though this author himself is decidedly opposed to its use in obstetrics.

¹Read in the Section of Practical Medicine, *Materia Medica and Physiology*, of American Medical Association, May, 1885.

²I may state, parenthetically, that I had upon this occasion to appear before a coroner and fortify my position with the citation of an array of cases in which this operation was successfully performed, though, as was later ascertained, with no permanent benefit in any case.