On the relation of the chest-movements to prognosis in lung-disease : and on the application of stethometry to examinations for life assurance / by Arthur Ransome.

ON THE RELATION OF THE CHEST-MOVEMENTS TO PROGNOSIS IN LUNG DISEASE

RANSOME

ON THE
RELATION OF THE CHEST-MOVEMENTS
TO
PROGNOSIS IN LUNG-DISEASE.

ON THE

RELATION OF THE CHEST-MOVEMENTS

TO

PROGNOSIS IN LUNG-DISEASE

AND ON THE APPLICATION OF STETHOMETRY TO EXAMINATIONS FOR LIFE ASSURANCE.

BY

ARTHUR RANSOME, M.D., M.A. (CANTAB.),

PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION AND DISEASES OF THE THROAT, MANCHESTER;
LECTURER ON PUBLIC HEALTH IN THE OWENS COLLEGE, MANCHESTER.

WITH ILLUSTRATIONS.

"*The which observed, a man may prophecy,*
With a near aim, of the main chance of things
As yet not come to light, which in their seeds
And weak beginnings lie intreasurèd."

HENRY VI. Pt. II.

London:
MACMILLAN AND CO.
1882.

LONDON:
R. CLAY, SONS, AND TAYLOR,
BREAD STREET HILL, E.C.

PREFACE.

In January, 1881, I communicated to the Royal Medical and Chirurgical Society a paper, entitled, "Further Observations on the Value of Stethometry in the Prognosis of Chest Disease," which was afterwards published in vol. lxiv. of the *Transactions*. In this paper were condensed the results of my observations on this subject made during the previous twelve years.

In consequence of the favourable opinion at that time expressed, in reference to this method of examination of cases, it was thought desirable that the results should be made known to the general medical public.

In the present work, accordingly, along with my more recent experience, I have incorporated the observations then made—together with those contained in my treatise on stethometry, so far at least as these relate to the subject of *prognosis*.

I have arranged these materials in such a manner as to give a general view of the mode in which chest measurements may be employed to the greatest advantage

in prognosis, together with a sufficient array of evidence in support of the claims of stethometry in this regard.

These observations are now submitted to medical criticism in the hope that the conclusions, which I have myself formed, may meet with general acceptance, and that a new and trustworthy physical sign may thus be added to those that we have already.

If this should prove to be the case, a method that will assist us in forming a judgment upon some of the most difficult questions in medical practice, will certainly be welcome, and accurate mensuration of the chest movements, by means of a stethometer, will soon be considered a necessary part of the duty of a practical physician.

Whatever may be the outcome of this attempt to introduce exact measurements into general practice, I desire to express my warmest thanks to my friend, Dr. William Ogle, of Derby, both for his constant kindness in criticising and amending my MS., and also for revising the proofs for the printer.

CONTENTS.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

CHAPTER X.

CHAPTER XI.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

CHAPTER XVII.

LIST OF PLATES.

ON PROGNOSIS IN LUNG-DISEASE.

CHAPTER I.

INTRODUCTORY.

AMONGST the many questions that medical men are called upon to solve, there are few that are at times so difficult, and yet so important, to answer as those connected with the prognosis of disease.

The caution of medical men in expressing an opinion as to the probable issue of a case is indeed proverbial, and it is justified by the fact that, in general practice, more discredit often attaches to a failure in prognosis than even to non-success in treatment. We are expected to possess both gifts of healing and gifts of prophecy, and the power to make a correct forecast of the course of a disease is often taken as a measure of our knowledge of its nature. Whatever may be our course, however, with regard to expressing an opinion it is certainly most important that we should ourselves form a correct judgment.

In some forms of chest disease prognosis is truly a comparatively simple matter, and at least no more difficult than in many other forms of illness. In acute inflammations of the lungs or pleuræ we may be guided to a correct

view by the ordinary signs, such as the extent of the disease, the degree of fever, and the general condition of the patient; and even in some chronic affections of these parts, such as simple uncomplicated chronic bronchitis or asthma, we can often prophecy with safety, for instance, that life will not be materially shortened by the ailment. On the other hand, there are cases, such as cases of acute tuberculosis, that will assuredly speedily end in death.

In some instances again we may have light thrown upon the probable future by certain co-existent circumstances, such as heart disease in emphysema, or chronic bronchitis, and, even in such a complaint as phthisis, by the aid of long experience or of a series of collected observations, we may consciously or unconsciously apply the method of probabilities. Thus there may be assigned a certain value, as Dr. Pollock has shown, to the concurrence of signs such as clubbed fingers, emphysema, bronchitis, certain forms of heart disease, or some "other agent converting the disease from its usual course." On the bad side of the account also we might note the baleful presence of gastric disorder, of albuminuria, or diabetes. But there will always remain a large class of cases, probably far the largest that we meet with, in which prognosis is extremely difficult, and in which, at the present time, all attempt at prophecy is practically abandoned. Any aid to our judgment therefore in this behalf will assuredly be welcome.

Now there are three chief points upon which, in almost every case, some degree of foreknowledge would be desired by both patient and medical attendant:—(1) as to the final issue of the disease; (2) as to its rate of progress at any one time; and (3) its probable duration under certain circumstances that may arise in its course.

In order to decide any one of these points we need undoubtedly an accurate knowledge of the disease itself, of

its antecedents, and of the physical condition of the patient at the time. No one method of inquiry can possibly do away with the need of a thorough medical examination on all the circumstances of the case. But it is quite possible that certain of the signs we observe may have a higher significance than others; and this is the more likely if we can see that they have a bearing upon several of the conditions of the problem.

In this position of prominence, in cases of chest disease, we may place the records of the movements of the walls of the thorax obtained by means of the stethometer.

During the past thirteen years I have taken careful measurements of these movements in most of the forms of lung affection that have come under my care, and in many of them I have been able to note the duration of the case and its ultimate issue. I have thus been gradually led to ascribe considerable importance to chest measurement as an aid to prognosis in lung disease, and I now venture to place before medical men, in a separate form, my observations on this subject.

I have elsewhere [1] shown the importance of stethometry in some physiological problems, and in the study of certain pathological conditions, its help in diagnosis, and the indications which it may afford even for treatment; but in the present treatise I propose to confine myself strictly to its bearing upon the subject of *prognosis*.

[1] *On Stethometry*, Macmillan, 1876.

CHAPTER II.

ON THE USE OF THE STETHOMETER.

In the first place, it will be necessary briefly to describe the instruments which I use and the mode of their application.

But first it should be noted that the movement of any point on the chest-wall is complex in its nature. It is, mathematically speaking, in three different *dimensions* or directions, viz., upwards, forwards, and outwards.

In order to give an accurate representation of the movements of any point, therefore, it is essential to record, these "dimensions of the motion." In other words, the extent of the movement measured in each of the planes in which the point moves, must be recorded. As we proceed it will become more and more evident how important it is to observe not merely the gross movements of the chest-wall, but also the relative extent of the *upward* and *forward* movements, and in some instances the lateral or *outward* movements have also to be carefully measured.

For each of these dimensions of the motion has its own significance. The *upward* dimension means simply the extent to which the clavicle or the rib can be raised or lowered. Thus it declares chiefly the degree of muscular power that can be exerted upon these bones; or else, as in cases where these levers have been abnormally raised, it

measures the limit to which this elevation has already extended.

A diminution of the *forward* movement of a rib, on the other hand, may show either a loss of muscular power, or the presence of adhesions preventing the natural expansion of the chest; or again, it may point to a want of elasticity in the underlying lung, and lastly (for we are dealing with a vital machine), it may arise from an increased sensitiveness in the inflamed lung, which imposes automatically a certain amount of restraint on the muscular apparatus.

Similar remarks will apply to variations in the *outward* motion, when the button of the stethometer is applied sufficiently low down, or on points on the lateral regions of the thorax.

It is further needful to make all these measurements simultaneously in order to avoid errors arising from variations in the mode of breathing. The stethometer is an instrument that I have had made in order to fulfil these conditions, and to measure separately and simultaneously each dimension of the motion.

In the front of the upper part of the chest the movements of the sternum, of the clavicles, and of the anterior end of the third rib, are chiefly upward and forward; the lateral or outward movements of these parts are so small that they may usually be neglected. To observe the upward and forward motions at these points a very simple apparatus—the two-plane stethometer—may be employed, and I will proceed now to describe it.

The *two-plane stethometer* (Fig. 1) consists essentially of a lever (L), with a button (B) at one end, shaped so as to adapt it to the anterior rounded surface of a rib, and at the other end, a mechanism connecting its motions with the fingers of two dials.

In the instrument here figured the length of the lever

(L) is eight inches (20·3 centimetres). It is attached to the dial-plate (P) by a rivet (*r*) which, acting as a pivot, permits it to swing upwards and downwards to the extent of rather more than two inches, but which allows of no lateral motion. The lever (L) is then continued onwards nearly two inches (5 centimetres), and expands vertically into a segment of a circle, racked at its circumference so as to turn a small pinion (*a*), marked by a dotted circle which is fixed to the base of the index finger. The

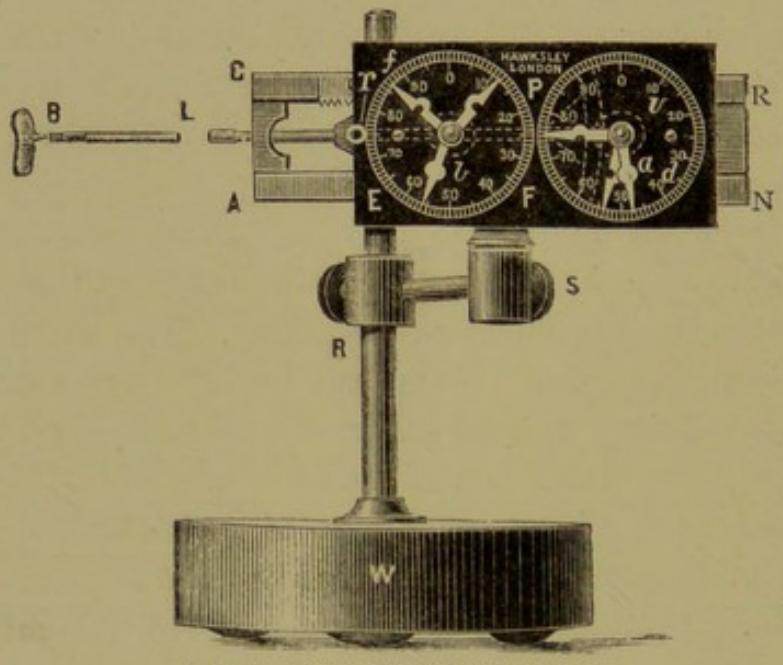


FIG. 1.—Two-Plane Stethometer.

size of this pinion (*a*) is calculated so as to turn the index-finger once round the dial (UD), with two inches of movement of the button end of the lever (B).

The dial-plate, and the lever thus attached to it are now mounted upon a carrying framework (C A R N), upon which the plate is allowed to ride on rails in the backward and forward directions only. In the course of this movement a horizontal rackwork, attached to the frame, works upon another small pinion (*b*) fixed to the dial-plate, at the

base of the index-finger on the dial (EF). Horizontal movement of the dial-plate to the extent of two inches is thus made to turn the index-finger once round the dial (EF).

The dials are divided into 100ths of an inch, and to each index-finger is attached a pair of recording fingers, that remain on the dial at the extreme points to which the motion of the index-finger has been carried.

The whole apparatus is swung by means of a pivot in an upright slot (S) so arranged as to permit only of lateral motion, and in this instrument this lateral motion is left unrecorded. When in use the apparatus is mounted upon a brass rod (R), to the base of which a heavy weight (W) is attached, and its height can be adjusted by means of a screw.

The *three-plane stethometer*,[1] a somewhat more complex instrument than the preceding one, has been designed for the measurement of points lower down on the chest-wall, or on its lateral regions, but it will, of course, serve for the less extensive objects of the two-plane instrument.

The examination of these lower parts of the chest is quite necessary in cases of pleurisy, pneumonia, or pneumothorax, where the determination of the proportionate dimension of the outward motion is of especial importance.

The instrument need not now be described, as its construction is fully given in my previous work[2] and the accompanying diagrams will sufficiently display its nature.

It will probably suffice now to state that on the dials belonging to these two instruments is recorded each

[1] Both these instruments are made by Mr. Hawksley, 300, Oxford Street, London.

[2] *On Stethometry*, p. 44.

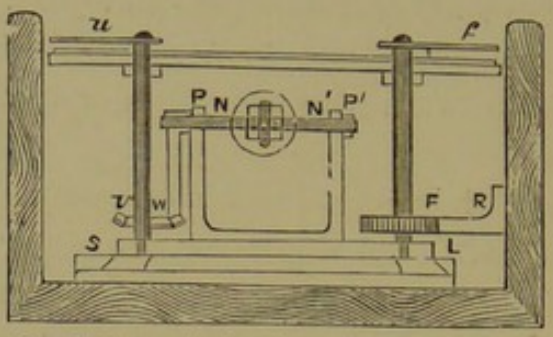


FIG. 2.—Sectional plan and elevation of the three-plane instrument.

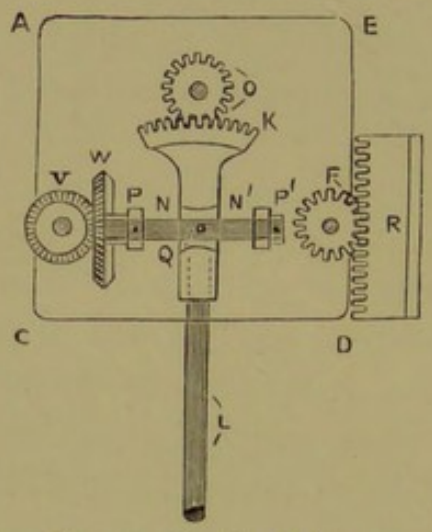


FIG. 3.—Sectional plan.

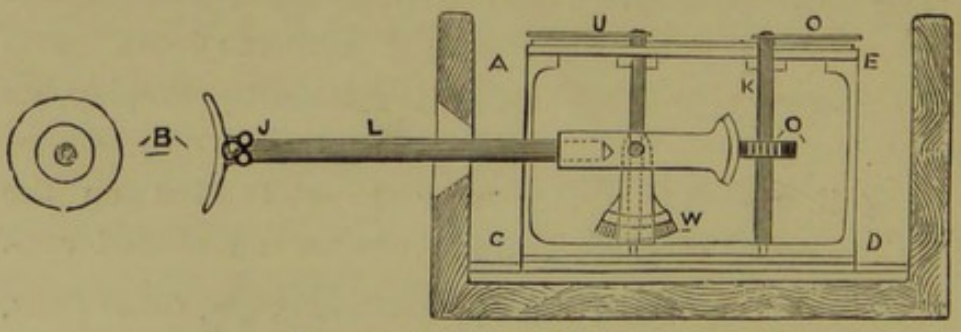


FIG. 4.—Sectional side elevation.

dimension of chest-movement—forwards and upwards in the two-plane stethometer, and forwards, upwards, and laterally outwards in the three-plane machine; and that they are simultaneously recorded.

The mode of application is the same for both, and is as follows :—

The patient, with the chest exposed and devoid of any ligature, &c., is seated upon a straight-backed chair, which fixes the back and especially the upper part of the spine, by means of a pad, as shown in the annexed woodcut,

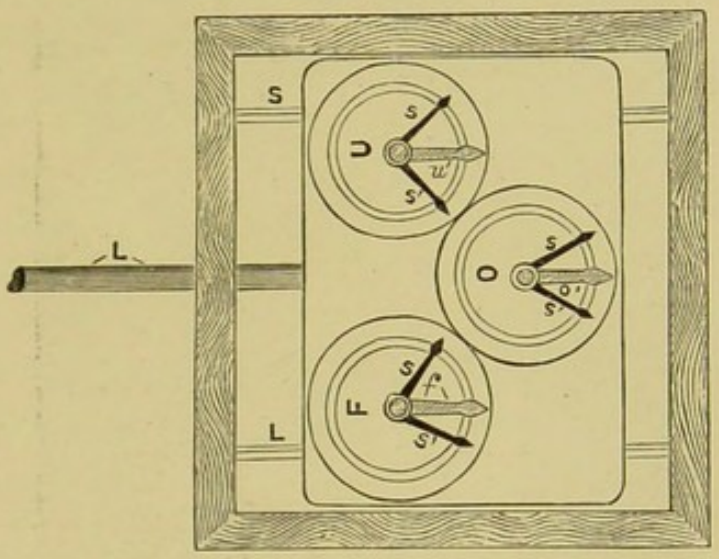


FIG. 5.—Plan. U, upwards; F, forwards; O, outwards.

Fig. 6, and sometimes his head also is allowed to rest against a support.[1] In this manner the probability of any side movement and any bending of the spine not due to respiration is reduced to a minimum. The button-end of the rod is then brought against any point of the chest, in such a manner that the direction of the rod is perpendicular to the plane of the shoulders, and also

[1] A small but thick book may often be made to do duty for a pad, if it be placed between the upper part of the spine and a high-backed chair, opposite to the spinal articulations of the ribs whose movements are to be measured.

perpendicular to the front of the box containing the apparatus.

The distance of the patient from the apparatus is so arranged that in ordinary breathing the carriage containing the machinery rests about half way upon the slides. The registering fingers are then applied to each side of the indices, and when it is required to know the extent of forced breathing, the patient is directed to

FIG. 6.—Mode of application.

take a deep inspiration and then to make as complete an expiration as possible. The rod is then held so as to prevent further motion, and the extent of the movements in the three directions read off upon the dials.

It is usually desirable to take the extreme extent of several respirations, and this is done by allowing the patient to go on breathing forcibly several times before the instrument is stopped.

There are certain sources of fallacy to be regarded in applying the instrument, and corresponding precautions to be taken. In the first place, the mode of breathing, especially when it is forced, may be unnatural and irregular from nervousness, officiousness, or anxiety; the ribs may be even kept entirely fixed, and the breathing abdominal.

It is necessary, therefore, to urge the patient to breathe easily and naturally, and, when a deep inspiration is needed, to ask him to breathe quietly and deeply; and sometimes a little time has to be given, and the attention has to be drawn away from the instrument.

Those observations in which the breathing has not been natural must of course be rejected as worthless.

It is also desirable that the muscles of the arms should not be allowed to take part in the process of breathing, as they generally introduce some irregularity in the movements. In all cases, therefore, the patient is directed to rest the tips only of the fingers upon the edge of the table; this arrangement also steadies the body of the patient.

With these instruments I have now made a large number of measurements in different forms of chest disease, and have compared them with similar records from healthy subjects.

They have thus been fully tried, and have proved the trustworthy character of their indications. Moreover, although it is needful that the measurements should be made in a uniform fashion, so that the records may be comparable from one time to another, it may be as well to add that the method of application of the instruments is one not difficult to learn.

I may state that the three-plane stethometer has already been extensively used in Denmark. I shall presently

TABLE I.—*Chest Movements in Healthy Males and Females at different Ages* (*in* 100*ths of an inch*).

Sex.	Age.	Sternum.				Clavicles.				3rd ribs.				5th ribs.			
		Upper.		Middle.		Right.		Left.		Right.		Left.		Right.		Left.	
		F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.
M.	11	98	110	98	96	64	117	64	120	110	75	102	100	110	100	102	100
	28	—	—	98	111	56	99	59	90	124	150	127	165	112	180	102	180
	35	90	111	96	120	90	108	80	105	80	129	85	135	102	135	102	135
	42	25	50	55	110	55	100	50	90	85	130	78	115	100	130	100	110
	66	10	50	25	30	15	45	15	35	30	50	35	70	30	55	30	60
	82	10	30	15	30	7	24	7	25	20	40	30	40	35	70	30	60
F.	12	50	70	70	80	35	100	40	100	55	95	55	100				
	22	51	54	85	51	54	60	60	75	65	96	75	96				
	29	75	75	102	90	60	90	65	90	115	105	105	105				
	34	30	50	35	60	50	70	55	75	75	110	90	120				
	36	37	70	40	75	42	75	38	75	51	90	51	105				
	68	35	50	55	40	25	35	30	45	55	50	58	60				

make use of the observations of a distinguished physician, Prof. Drachmann, of Copenhagen, in confirmation of some of my own conclusions.

Table I. gives a few examples of the dimensions of the chest-movements in healthy persons, of both sexes, at different ages. They will serve as a basis for comparison with the succeeding tables of measurements taken in cases of disease.

It may be stated as a general rule, in healthy persons, and the same rule applies also to a great extent to cases of chest-disease, that the forward dimensions of the movements diminish with advancing years. In females, also, the forward dimensions of the motions of the ribs are often greater in proportion to the upward dimensions than in males,—and this observation seems to hold good, even in advanced life. In other words, the bony fabric retains its elasticity for a longer time in females. In many women the chest-movements on the left side slightly exceed those on the right; in males the contrary seems to be the usual rule.

CHAPTER III.

ON THE NATURE OF THE ASSISTANCE TO BE OBTAINED FROM STETHOMETRY.

I MAY now turn to the immediate subject of this work, namely, the assistance to be rendered by chest measurement in the *prognosis* of chest disease.

In the course of my observations with the instruments of measurement that have been mentioned, it soon became evident that there are often peculiarities in the various dimensions of the chest-movements—peculiarities that could be assigned with some precision to the rapidly fatal and to the more chronic classes of cases respectively.

Further consideration showed also that it was not improbable that these peculiarities might be turned to account as an aid to the prognosis of many of the forms of lung disease.

In these disorders, apart from general symptoms, and from the concurrence of certain complications, we need for prognosis, first of all, a clear diagnosis of the nature of the case before us; secondly, an accurate knowledge of the disease when recognised; and its effects upon the movements of the walls of the chest form no unimportant part of this knowledge. Thirdly, we need some means of estimating the rapidity of advance of the disease, or of its recedence; and it is most important that this information should be

capable of being expressed in definite language, numerically if possible, so as to permit of a clear comparison of the data obtained from time to time. Fourthly, it is desirable that we should know to what extent the complaint has made inroads upon the constitution of the patient—in other words, how far it has affected his vital power.

Now, on all these points, the stethometer is likely to be useful to the physician.

1. In my work on Stethometry, I have been able to show that, for purposes of diagnosis, stethometry is an important adjunct to other means; (*a*) that it assists in the detection of incipient pulmonary disease, its indications sometimes preceding all other signs (p. 137); (*b*) that it will sometimes show the effects of previous disease long after other physical signs have disappeared (p. 139); and (*c*) that in some doubtful cases its evidence is all-important; on the one hand in proving the existence of serious progressive mischief, on the other in dispelling suspicions aroused by other symptoms (p. 141).[1]

2. Our knowledge of the effects of different diseases upon the mobility of the several parts of the chest-wall is still very imperfect. But already some progress has been made in this direction, and the mode in which the ribs act in dyspnœa (p. 111), and in the various spasmodic acts of sneezing and coughing (pp. 112-116), has been to some extent investigated.

3. The successive numerical records of the stethometer are often of great assistance in determining the rapidity of the advance of the disease, and the extent to which it has already affected the movements of respiration.

[1] The lady whose case is recorded at p. 141 of the above work is still living, and is now in good health.

4. The vigour remaining in the muscles of inspiration is frequently shown by the experiment, and is often a very ready gauge of the vital power of the patient.

All these points have already been worked out with the three-plane stethometer, and in the course of the following pages I propose to carry the investigation a step further, and to show that both with this instrument, and with the simpler two-plane apparatus, we may obtain information that is of the greatest importance for purposes of *prognosis.*

In the acute forms of pneumonia and pleurisy, apart from the difficulty that there would be in applying the instruments of measurement, without doing injury to the patient, there are usually no degrees of difference in the mobility of the parts over the seat of inflammation ; they are kept both voluntarily and involuntarily as motionless as possible. The general symptoms must necessarily be our guides in such cases.

My observations are, therefore, confined to those forms of disease into which the element of time enters, and permits of the adaptation of the respiratory mechanism to its altered conditions. Such affections as chronic bronchitis and asthma—with or without emphysema ; cases of pleurisy in which effusion has taken place, and has been absorbed, or in which adhesions have formed ; and lastly, many of the forms of phthisis. It is, indeed, in such cases as these that we most need assistance in prognosis.

In acute diseases the patient and his friends will often bear the brief suspense without complaining, but when the time of suffering wears on to months and years, and when the hope of recovery is again and again deferred, then an opinion as to the probable duration of the case is eagerly sought for, and the assistance to be derived from observa-

tions on the chest-movements will be highly appreciated.

I will first adduce a few cases of the non-phthisical class of diseases—the results of which are known, The relations of the chest-movements to the prognosis of phthisis will require a somewhat closer examination.

CHAPTER IV.

ON PROGNOSIS FROM STETHOMETRY IN EMPHYSEMA.

In some affections of the lungs the degree of diminution of the motions of the chest-wall is a direct measure of the extent to which the disease has advanced.

In emphysema, and in complaints complicated by emphysema, such as some forms of asthma and chronic bronchitis, this is especially the case. It may readily be perceived also why this should be so. The position of the emphysematous chest in its advanced forms is that of full inspiration, or even an exaggeration of this position. The chest-walls are pushed out to their extremest limits, the more advanced the disease the greater is this distension, and the more immovable do the ribs become; in extreme cases they are so raised and pushed forwards and outwards that no lowering or indrawing in expiration is possible. Hence we are quite prepared to find that not only is the total amount of movement reduced in these cases, to a very small fraction of the healthy standard: but the motions in each plane are equally affected, equally diminished, and their proportions to one another are unaltered. Owing to the urgency of dyspnœa the lower ribs are not unfrequently drawn inwards, in advanced cases, by the action of the diaphragm in the efforts at inspiration. And in consequence of the loss of elasticity of the lung-tissues

the act of expiration is slowly and most imperfectly performed.

It is not difficult, therefore, to see the value of stethometry in the prognosis of these diseases.

A single measurement will often furnish data which, when compared with the records of healthy movements, and taken along with the age, history, and general character of the case and its complications, will enable a very correct estimate to be made of the degree to which the disease has advanced, and a series of such examinations made at regular intervals will give the rate of its progress, and will

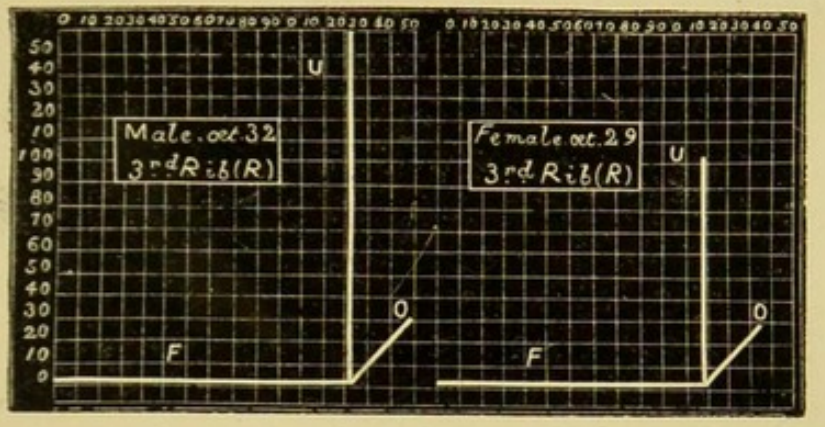


FIG. 7.—Average dimensions of movements in healthy males and females.

enable the physician to give a better approximation to the probable duration of life than could be attained by any other means.

The accompanying figures (7 and 8), representing the dimensions of motion in healthy males and females, and those found in a case of emphysema, will serve to show the great differences in the magnitude of these movements and their diminution in some cases of this disease.

Tables II. and III. contain respectively cases of emphysema, chronic bronchitis, and asthma. The several instances are arranged simply in the order of their degree

of chest movement, those with the smallest motion being placed the first.

Even with this simple numerical guide only in the construction of the table there is very distinct evidence in the appended remarks, that the position of the case in the register accords closely with its degree of severity as judged by its subsequent history. But I would again warn the reader that there are many points to be taken into consideration besides the extent of chest movement.

In Table II., Case 1 must be regarded as displaying the worst symptoms of emphysema, not only on account of the very small degree of movement enjoyed by the thorax, and

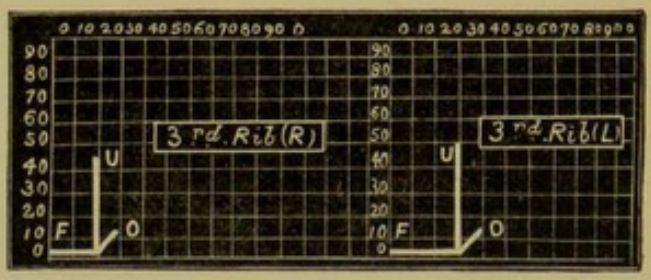


FIG. 8.—Diagram of movements, in Case 1, of emphysema.

from the signs of distress given by the inspiratory indrawing of the chest-wall so high up as the fifth rib (indicated by the minus sign —), but also because the illness had lasted a comparatively short time, and because at the age of thirty years a man of his stature ought to have displayed a much greater freedom of motion.

The movements of the chest in Case 2 were still smaller but the distress was less, and there was no indrawing of the ribs.

In Case 3, there were no signs of immediate danger, and he lived for two years after the examination.

The aged Case 4 comes next; and although No. 5 actually died of congestion of the lungs only two years

TABLE II.—*Chest Movements in cases of Emphysema (in 100ths of an inch).*

No. of Case.	Sex.	Age.	Sternum.				Clavicles.				3rd ribs.				5th ribs.				Remarks.
			Upper.		Mid.		Right.		Left.		Right.		Left.		Right.		Left.		
			F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	
1	M.	30	17	36	19	45	17	45	17	36	20	45	34	45	−3	21	20	30	Advanced emphysema. Died 1 month after examination.
2	M.	60	15	20	10	20	5	30	10	20	15	40	15	40	...	...	...	...	Bronchitis 30 years. Died 18 months after.
3	M.	60	18	50	30	60	10	25	12	25	30	58	35	58	35	63	35	60	Asthma and chronic bronchitis about 20 years. Died of heart complication 2 years after.
4	M.	82	10	30	35	30	13	25	12	25	30	50	20	50	...	...	..	...	Duration 2½ years.
5	M.	59	28	51	27	51	...	...	...	...	42	60	34	45	...	...	...	...	Died of congestion of the lungs in 2 years.
6	M.	58	...	...	...	...	39	57	34	36	42	57	41	54	...	...	...	...	Complictd. with chron. bronchitis and heart disease. Died 4 years after.
7	M.	81	25	50	...	...	25	40	20	40	30	25	60	50	50	60	50	60	10 years' chronic bronchitis, with emphysema. Died 2 years after.
8	F.	65	40	30	35	35	20	40	25	50	50	55	55	50	...	...	...	...	Chron. bronch. 20 years. Emphysema 15 years, especially in right upper lobe. Living.
9	F.	51	32	50	...	...	30	40	26	45	50	68	60	62	...	...	...	...	Chronic bronchitis since childhood, latterly asthma and emphysema. Living.
10	M.	26	50	60	20	70	40	70	45	80	50	110	35	120	55	110	23	110	15 years' chronic bronchitis; incipient emphysema. Living.
11	M.	45	...	...	...	...	...	...	...	...	80	115	80	120	...	...	...	...	Chronic bronchitis since childhood; incipient emphysema. Living 3 years after.
12	M.	40	90	120	...	...	65	100	75	120	90	120	90	120	115	80	95	105	Asthma 13 years. Lower ribs slightly indrawn. Living.

after the examination, yet his expectation of life was really greater on account of his age, and at the time of noting there was no heart or kidney mischief.

In Case 6, both mitral and aortic valves were already seriously diseased, and hence the prognosis was necessarily hazardous; but so far as the lungs were concerned it was evident from the degree of chest movement enjoyed, that he had still a large reserve of respiratory power to fall back upon.

Case 7 was also far advanced in life, but the comparative freedom of the chest movements showed that his disease had not as yet seriously affected him. He lived in fact two years after the examination.

Cases 8, 9, 10, 11, and 12 are all still living, and having already spent so many years in coughing, with so little impairment of chest movement, they are obviously the most hopeful of the group.

It may be objected, that these cases are too few in number to justifiy the erection upon them of a theory of prognosis. I believe, however, that they are fairly representative in their character,[1] and when we consider the mode in which emphysema is known to advance and to affect the movable parts of the thorax, we may venture to take the chest record provisionally, if not absolutely, as a very useful guide to our opinion respecting the degree to which the disease has advanced, and consequently as to its rate of progress towards a fatal termination.

[1] In order to avoid any suspicion of bias on my own part in their selection, I simply took the first dozen cases of which I had complete notes, and of which I knew the termination or the result.

CHAPTER V.

ON THE RELATIONS OF THE CHEST-MOVEMENTS TO PROGNOSIS IN CHRONIC BRONCHITIS AND ASTHMA.

FROM our knowledge of the usual longevity of uncomplicated cases of asthma, and of chronic bronchitis, we might anticipate that the register of chest measurements would give less distinct indications of the degree of severity of the complaint; and this view is to a great extent borne out by my experience. Still a careful scrutiny of cases shows that even in these disorders, a large amount of power of movement must be taken as a favourable sign, and the opposite condition as a sign both of lessened vitality and of severity of the disease.

It may further be remarked, that when a series of such measurements are taken, an increase of power usually means also an improvement in the patient's condition, and a marked rapid diminution of chest-movement often foretells the approach of a fatal result. This last observation also is the more easily made, because bronchitic patients habitually resort to forced efforts at breathing. And thus their ordinary chest movements differ very little from those recorded when they are told to breathe as deeply as they possibly can.

In the accompanying Table (III.) are ranged the movement-registers in some fairly typical cases of chronic bronchitis and asthma. They were selected solely on this ground, and without any reference to the subject now before

us. They are arranged like the cases in Table I., in the order of extent of general motion of the chest-wall, preference being given rather to the extent of the forward than to that of the upward movement.

It will be seen in this Table, as in Table I., that, although we have only been guided by this simple fact, yet the more serious forms of these diseases are to be found in the early part of the Table, and those low down in the series are either of less severity, or have been affected for a shorter period.

It will not escape notice that the first four cases in the table are all now dead, and that the length of time which they existed after the measurements were taken was very nearly in the order of their position in the Table. The fact that the woman, æt. 57, with smaller movements than the male, æt. 60, yet lived one year longer, is hardly an exception to our remarks, seeing that in all cases it is necessary to take into account not only age and sex, but many other concurrent circumstances. On this point I would refer to the remarks on Table I. at p. 12.

There is naturally more difficulty in estimating the prognostic value attaching to the movement records of the eight patients who are still living; but I think that the appended remarks show with sufficient clearness that the more serious cases are those of Nos. 5, 6, and 7, and that the remaining cases are either of less severity, or that they have been affected for a shorter period.

As diagnosis is one very important element in prognosis, it may be interesting at this point to call attention to the remarkable equality of the extent of motion on the two sides of the chest—an equality that extends to nearly all the cases of both chronic bronchitis and asthma, and also in great measure to the cases of emphysema. The significance of this remark will be more clearly seen when we

TABLE III.—*Chest Movements in Chronic Bronchitis and Asthma (in 100ths of an inch).*

No. of Case.	Sex.	Age.	Sternum.				Clavicles.				3rd ribs.				5th ribs.				Remarks.
			Upper.		Mid.		Right.		Left.		Right.		Left.		Right.		Left.		
			F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	F.	U.	
1	M.	50	25	20	25	40	...	...	...	...	25	40	25	38	20	30	20	35	Chronic bronchitis and asthma, with heart mischief 1 year. Died in 3 months.
2	M.	67	35	49	35	40	...	...	...	...	30	50	25	50	25	35	45	50	Bronchitis 40 years, severe 8 years. Died 2 years after.
3	F.	57	30	40	30	30	15	20	20	30	27	23	25	30	...	...	...	...	Winter cough 16 years, occasional asthma. Died 4 years after.
4	M.	60	18	50	30	60	10	25	12	25	30	58	35	58	35	63	35	60	Chronic bronchitis and asthma 20 years. Severe hæmoptysis 10 years ago. Died 3 years after examination.
5	F.	61	25	40	35	50	20	45	20	43	35	60	38	55	...	...	...	...	Winter cough 35 years. Living 5 years after.
6	F.	50	35	50	40	45	25	50	30	50	40	70	40	70	...		...	...	Winter cough and asthma 13 years. Living 5 years after.
7	M.	42	15	75	30	95	25	55	20	60	50	85	50	95	60	70	50	85	Winter cough since childhood. Severe bronchitis with asthma 4 years. Living.
8	F.	25	30	50	45	60	25	50	20	50	55	80	55	80	...	...	...	...	Winter cough 18 years. Living 3 years after.
9	F.	45	28	70	38	85	35	75	35	80	50	105	55	115	...	...	...	...	Asthma 6 months. Living 9 years after.
10	F.	47	56	39	...	...	46	45	39	45	59	48	59	36	...	...	...	...	Chronic bronchitis 12 years. Living 12 years after.
11	M.	30	50	115	50	100	50	100	45	100	70	90	60	100	85	90	70	90	Winter cough 10 years, asthma 6 years, old pleurisy on left side. Living 9 years after.
12	M.	36	21	70	75	120	43	80	43	80	85	110	90	115	125	180	115	180	Winter cough 20 years. Living 9 years after.

come to see the contrast between the two sides in cases of pleurisy and phthisis.

Several of the cases of bronchitis were sent to me with the suspicion of incipient phthisis, notably, cases 1, 4, 8, and 9, and it was at least satisfactory to find that the indications given by the regularity and equality of the stethometric measurements were borne out by the physical signs.

In the Table before us the only instances that depart materially from this general rule of nearly equal forward movements on the two sides are those of No. 2 (third and fifth ribs), and No. 10 (clavicles). In both these cases there were probably old pleuritic adhesions that accounted for the greater immobility of the bones on one side than on the other.

It is further noteworthy, that in all the advanced cases, both of bronchitis and emphysema, in which readings of the fifth ribs had been taken (as in No. 1, Table I., and No. 1 and 2, Table II.), there were signs of especial lessening of motion in the lower bones of the thorax. This fact is strictly in accordance with our experience in these cases unassisted by the stethometer.

On the whole, therefore, we may conclude that stethometry will prove of service in deciding respecting bronchitis and asthma, as well as in emphysema.

CHAPTER VI.

ON THE PROGNOSTIC INDICATIONS AFFORDED BY STETHOMETRY AFTER ATTACKS OF PLEURISY.

COMMON observation shows that in acute pleurisy the ribs on the affected side are kept as rigidly immovable as possible. It is only when the violence of the attack has passed off that an attempt at the ordinary movements of respiration are made, and then it is that the stethometer shows very clearly the efforts which nature is making to compensate for the loss of breathing space, and the progress towards the restoration of the elasticity of the lung.

It might at first sight appear that, as the abnormal movements of the ribs are dependent upon the formation of adhesions and upon the presence of unabsorbed fluid in the chest, the other physical signs of these conditions ought to prove just as useful as stethometry in affording a basis for prognosis. I admit frankly that up to a certain period in the disease this remark is probably quite correct but this period extends only to the first few weeks after the acute stage has passed by, and even at this time the signs of muscular vigour presented by the extent of the upward indications, often give important evidence as to the general condition of the patient, and hence are by no means to be despised.

But if, as the effusion gradually becomes absorbed, and

TABLE IV.—*Extent of Movement of the Chest-wall in recent cases of Pleurisy (in 100ths of an inch).*

Case.	Direction.	Sternum.			Clavicles.		3rd ribs.		5th ribs.		Remarks.
		Upper.	Middle.	Lower.	Right.	Left.	Right.	Left.	Right.	Left.	
1. Male, æt. 39	F.	20	—	—	5	3	35	5	50	15	3 months, pleurisy left side; still fluid to fifth rib in front. 2 years after weak, unfit for work.
	U.	30	—	—	20	30	40	50	40	60	
2. Male, æt. 31	F.	15	—	—	30	12	50	12	30	20	4 weeks, left pleurisy, effusion nearly absorbed. 2 years after tubercular disease of left lung.
	U.	30	—	—	40	55	90	80	70	100	
3. Male, æt. 54	F.	—	—	—	15	50	—	—	—	—	Died 18 months after; pleurisy on right side.
	U.	—	—	—	40	50	—	—	—	—	
4. Female, æt. 30	F.	—	20	23	—	—	40	15	50	16	5 weeks, left pleurisy, fluid absorbed. Sickly for 2 years. 3 years after, still not strong.
	U.	—	20	30	—	—	70	40	65	50	
5. Female, æt. 31	F.	—	15	15	20	15	35	10	30	15	3 months after left pleurisy. Living 8 years after, but in bad health.
	U.	—	35	20	50	20	70	45	50	50	
6. Male, æt. 19	F.	39	—	—	68	29	54	39	51	25	4 weeks, absorption of pleuritic effusion on left side. Died 3 years after of phthisis. See diagram, p. 32.
	U.	75	—	—	80	66	99	84	135	60	
7. Female, æt. 34	F.	20	20	—	20	25	23	45	20	40	7 weeks after right pleurisy. Effusion still present. Sickly for 1 year, then recovered.
	U.	40	40	—	35	50	30	35	30	40	
	O.	—	—	—	—	—	—	—	4	30	
8. Male, æt. 13	F.	35	55	—	50	95	50	67	20	75	3 months after pleurisy with effusion on right side. Remained delicate for about 2 years, then recovered completely.
	U.	45	50	—	40	100	40	70	40	100	
9. Female, æt. 32	F.	25	35	35	25	40	33	40	35	55	7 weeks before right pleuritic effusion. Made a good recovery.
	U.	50	65	60	40	60	80	90	80	70	
10. Female, æt. 29	F.	35	40	55	33	40	33	60	75	85	4 months, effusion on right side lasting 1 month. 9 months after completely recovered; strong, healthy.
	U.	40	65	50	40	55	70	80	80	90	
	O.	—	—	—	—	—	—	—	15	35	
11. Male, æt. 28	F.	32	50	55	25	55	55	78	50	93	2½ months after right pleurisy with effusion. Recovered.
	U.	80	80	75	30	60	70	110	100	100	
12. Male, æt. 27	F.	60	100	70	55	65	95	105	95	95	2½ months after right pleurisy with effusion. Recovered.
	U.	70	65	60	45	70	75	65	70	60	

TABLE V.—*Chest Movements in Pleurisy, measured some time after the Attack (in 100ths of an inch).*

Case.	Direction.	Sternum.			Clavicles.		3rd ribs.		5th ribs.		Remarks.
		Upper.	Middle.	Lower	Right.	Left.	Right.	Left.	Right.	Left.	
1. Male, æt. 19	F.	15	—	—	35	45	10	50	5	50	1 year ago right pleurisy with effusion. Became tuberculous 6 months after.
	U.	15	—	—	40	50	10	50	—	40	
2. Female, æt. 34	F.	50	33	—	18	30	50	65	—	—	5½ years ago had pleurisy on right side. Now incipient consolidation to 2 inches.
	U.	50	50	—	50	63	70	95	—	—	
	O.	—	—	—	—	—	7	15	—	—	
3. Male, æt. 34	F.	—	25	—	—	—	50	25	45	30	2 years ago effusion on left side, rapidly absorbed. Now tuberculosis commencing on the same side.
	U.	—	100	—	—	—	120	00	120	110	
4. Male, æt. 21	F.	30	40	20	30	45	85	50	80	40	13 years ago had pleuritic effusion on left side. Now tall, thin, pale, weak; but no physical signs of tubercle.
	U.	70	70	70	75	90	90	100	120	100	
	O.	—	—	—	—	—	25	15	25	10	
5. Female, æt. 34	F.	30	45	—	—	—	40	70	65	70	15 months since effusion on right side, slow to retire. Now at work, but weak and delicate.
	U.	60	75	—	—	—	95	80	70	100	
	O.	—	—	—	—	—	—	—	15	12	
6. Female, æt. 30	F.	—	40	40	—	—	55	50	55	40	3 years since effusion on left side, absorbed slowly; sickly for two years. Still delicate 7 years after.
	U.	—	70	70	—	—	90	95	70	60	
7. Male, æt. 24	F.	15	10	10	25	25	55	43	65	45	8 years since lingering effusion on left side, and remains thin, stunted, delicate. Living 8 years after.
	U.	95	90	90	70	70	100	105	115	130	
8. Male, æt. 30	F.	50	50	50	50	45	70	60	85	70	20 years ago severe pleurisy, with effusion on left side. Has been asthmatic 6 years; is otherwise healthy.
	U.	115	100	90	100	100	90	100	90	90	
	O.	—	—	—	—	—	18	18	20	25	
9. Male, æt. 17	F.	40	60	—	50	30	50	70	80	75	4½ years ago pleuro-pneumonia on right side; delicate for two years. Now stout, strong, healthy.
	U.	60	60	—	60	70	60	100	100	100	
10. Female, æt. 29	F.	35	45	70	37	40	50	55	80	80	18 months since effusion on right side lasting 1 month. Now completely recovered; strong, healthy.
	U.	60	75	90	70	75	90	90	115	100	
	O.	—	—	—	—	—	—	—	25	25	
11. Female, æt. 24	F.	—	—	—	50	40	75	55	100	75	8 years ago pleurisy on left side. Now well and strong, but slightly short of breath.
	U.	—	—	—	100	95	110	110	100	100	
	O.	—	—	—	—	—	—	—	30	20	

The dimensions on the diseased side are, in each case, printed in heavier type, to assist the comparison between the two sides.

again after its complete absorption, successive examinations are made, and there is a steady return towards a healthy standard, then the greater or less rapidity with which this is accomplished will afford a basis for our forecasts of the future, such as can never be attained by reliance upon general symptoms.

The illustrative cases of pleurisy are arranged in two series.

1st. Those in whom the measurements were taken shortly after the attack ; and

2nd. Those recorded upwards of a year after the illness.

In both tables the order of arrangement has simply been determined by the extreme differences in the forward movements of the two sides of the chest, those with the greatest degree of impairment of this motion on the diseased side being placed first.

It is apparent from Table IV. that even the earlier records of measurement foretell to some extent the degree of injury done to the system—those in whom there is least forward movement on the injured side continue to display weakness of constitution long after the attack, or even, as in Cases 2 and 6, succumb to tubercular disease, whilst those whose chests recover their action more speedily are also quick in regaining their normal vigour.

Case 3 died 18 months after the record was taken. Cases 4 and 5 remained weak and sickly for a long period ; and Case 6 died, 3 years after examination, of phthisis, although he had no hereditary tendency to this disease. Case 7 is placed after No. 6, because although she shows less vigorous movement, the difference between the readings on the two sides is less than in No. 6. She and the boy, No. 8, both showed weakness for some time afterwards, but eventually recovered completely ; and the remaining four cases, with considerable freedom of

movement after the attack, all made good and fairly rapid recoveries.

From the data afforded by Table V., there is still more reason to watch with anxiety those patients in whom the thoracic walls remain persistently retracted, and comparatively immovable after pleurisy. There is usually a less complete return to health and bodily vigour when this is the case than when the adhesions are less numerous and less tenacious in their hold.

The contrast between the remarks relating to the first four and the last four cases is sufficient to justify this warning.

The first three cases in the table died eventually of phthisis. The next four remained sickly and delicate for long periods of time; and it is only the last three cases, each possessing considerable respiratory powers, who show signs of complete recovery of vigour and health.

Case 6, Table IV., is a good instance of excessive upward readings in a case of pleurisy. From this patient two other series of measurements were recorded—the first soon after the attack of the left side had taken place; the second about two months afterwards, another attack of pleurisy with effusion on the right side having intervened. Fig. 5 shows the proportion of the upward and forward dimensions in this case.

It is very interesting to note the great increase in the upward readings in the last series of observations, due, no doubt, to an increased use of the respiratory muscles, which seem to have become stronger by use; at the same time, it may be remarked that in the lower regions of the chest the forward motion is reduced to the smallest dimension compatible with the degree of upward motion recorded.[1]

[1] If the initial angle of the rib be taken to have been about 65°, and the chord-length of the rib about 6·5 in., both average dimensions in a man nearly

It may be remarked, on reference to the Tables IV. and V., that this peculiarity in the mode of breathing —namely, a diminished forward push with an increased

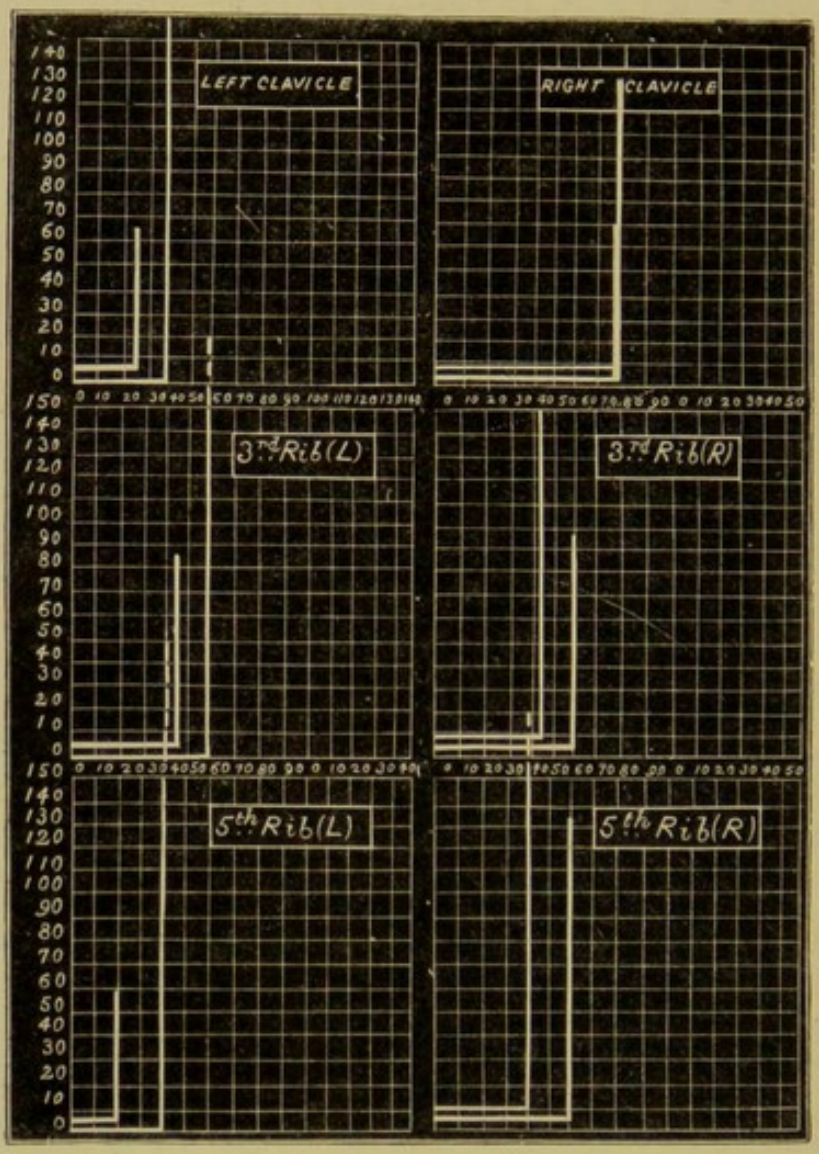


FIG. 9.—By an oversight, the latest measurements in the case of the right 3rd and 5th ribs are placed above instead of below the earlier record.

upward rise of the ribs—is common to most of the more severe forms of pleurisy—both in males and females; and

6 ft. in height, then it will be found, on calculation, that the forward push must have been at least 0·5 in., to permit of an upward rise of 1·70 in. See *On Stethometry*, p. 81.

in many cases the severity of the attack is declared by the degree to which the forward motion is impaired, whilst the upward movement is unaffected or increased.

This exaggeration of upward movement seems to extend in some cases even to the bones on the sound half of the thorax.

Take the following movements as an example of this :—

Case.	Direction of motion.	Mid-sternum.	3rd ribs.		5th ribs.	
			Right.	Left.	Right.	Left.
Male, æt. 34. Two years ago had pleurisy in left side. Effusion rapidly absorbed.	Forw.	25	50	25	45	30
	Upw.	100	120	100	120	110

The great alteration in the proportions of the forward and upward readings in this case will be evident enough on comparing them with the following measurements taken from a healthy man, of the same age and stature.

Healthy case.	Direction of motion.	Mid-sternum	3rd ribs.		5th ribs.	
			Right.	Left.	Right.	Left.
Male, æt. 35	Forw.	96	80	85	102	102
	Upw.	120	129	135	135	135

This increase of certain movements, which has now been noted in cases of pleurisy, seems to be only a part of a more general law common to several diseases.

There seems to be a tendency in different parts of the chest-wall to compensate for loss of movement in some parts, or in some direction, by an exaggerated movement in those parts that are free to move.

We shall presently find that in phthisis numerous

instances of this compensatory increase of motion are to be found, and in this disease it is sometimes the forward thrust that is exaggerated, sometimes the upward rise.

The same peculiarity is also to be noted in non-phthisical cases, in which the action of individual ribs is interfered with; *e.g.* the following measurements were made on a case in which there was no disease of the lungs whatever, but in which a chronic abscess under the left clavicle had caused immobility of that bone. It is interesting to notice also in this case the compensatory increase of movement of the left third rib.

Direction of movement.	Sternum.		Clavicles.		3rd ribs.	
	Upper.	Middle.	Right.	Left.	Right.	Left.
Forward	30	50	23	7	45	55
Upward	50	45	30	14	50	60

In one rare case of idiopathic pneumo-thorax, on the right side, which I had an opportunity of examining, twelve years after the patient's recovery, it was somewhat remarkable to find that the movements on the affected side were greater than on the other. The difference may perhaps be ascribed to the greater muscular power, usual amongst men, on the right side of the body, and the case may simply show the complete recovery of healthy power on that side. The following were the measurements obtained :—

	Sternum.		Clavicles.		3rd ribs.		5th ribs.	
	Upper.	Middle.	Right.	Left.	Right.	Left.	Right.	Left.
Forward ...	45	80	75	75	125	95	145	125
Upward	75	125	120	125	145	135	155	130
Outward	—	—	—	—	28	38	30	38

We shall have to inquire more closely into this subject later on, in speaking of the prognosis in cases of phthisis. It will be sufficient in this place to call attention to the fact, and to observe that in pleurisy the power o raising the ribs is no sign of mildness of the attack. There is rather reason to believe that in young and muscular subjects the extent of movement upwards is in direct proportion to the resistance to the forward and lateral thrust, and thus that it must be taken as a sign of serious adhesions having formed within the chest.

Moreover we shall see on turning to the Tables that freedom of upward motion is not of happy augury when it concurs with serious impediment to the other motions of the ribs.

Thus Cases 2 and 6, Table IV., both of which eventually became phthisical, had very high upward readings on the affected side; and in Table V., Cases 3, 4, and 5, all of them amongst the more sickly of the group, had also all of them a large amount of upward movement, together with small forward and lateral motions of the ribs.

It is quite possible that the first three cases, which finally became phthisical, were from the outset tuberculous in their nature; but this fact would not in any way detract from the importance of the indications given by the stethometer. If confirmed by subsequent experience, it would plainly show that tubercular pleurisy affects the movements of the thorax more decidedly than the simple disease, and would thus assist not only the prognosis, but also the diagnosis, of the case.

The consideration of these facts has lead me therefore to conclude—(1) that in the prognosis of pleurisy we cannot regard the upward readings of the stethometer as of much

significance, so far as regards the prognosis of the case ;[1] (2) that the degree to which the disease has interfered with the forward and lateral motions is a fair indication of the severity of the attack ; and (3) that the extreme differences n the extent of movement on the two sides of the chest are probably our best guides to a successful prognosis in this disease.

[1] Except that it probably augurs badly, seeing that it shows that the adhesions are of a firm unyielding character, and that they are thus likely to be permanent.

CHAPTER VII.

GENERAL OBSERVATIONS ON CERTAIN CIRCUMSTANCES WHICH INFLUENCE PROGNOSIS IN CASES OF PHTHISIS.

PROGNOSIS in phthisis is well known to be extremely difficult, especially as to the probable duration of life under the various states of the disease. After a certain amount of disorganisation has been produced in the lung, it may be easy to pronounce the sentence of incurable upon it, although, as I have ample evidence to show, the disease may at times be arrested even in its third stage; or the general condition of the patient may lead us to a still more unerring conclusion on this point—symptoms of acute tuberculosis, or certain complications, may present themselves that will compel us to predict a rapid course and a speedy ending. Yet there remain many cases in which prognosis is most difficult.

It has been well remarked that in phthisis there are usually traces of several independent forms of chest disorder associated in each case. Inflammations of various kinds; acute, chronic, scrofulous, or perhaps syphilitic, congestions; pleurisies; abscesses; hydro- or pneumo-thorax; fibroid, cirrhotic, or melanotic disease.

It may well happen therefore that prognosis in such a disease should be correspondingly difficult, and certainly in no disorder is it more needful to take into account all the circumstances of the case.

But even in this complex disorder, whilst the difficulties of the task must not be understated, yet we can happily obtain, in many cases, very valuable assistance from stethometry.

Much more study will, however, be needful in order to attain this aid than in the case of the more simple lesions produced by other disorders.

The influences affecting the movements of the chest-wall are necessarily too varied, for the discovery of any simple relation between them and the gravity of the disease, such as we have found in pleurisy or emphysema.

Thus in most cases, there is not only diminution of motion from simple loss of elasticity of the underlying lung, but there are often tough fibrous bands limiting the action of the ribs; and associated with these impediments there is usually loss of muscular power, both local and general, and a weakening of the whole respiratory energy.

Even uncomplicated phthisis, running its course of localised asthenic inflammation and consolidation, with subsequent softening and excavation, may produce diverse effects upon the motions of the chest-wall—different degrees of diminution of the general movement, out of all relation to the extent of the disease; altered proportions in the degree of upward or forward motion, the upward rise being sometimes increased sometimes lessened, and the forward thrust showing equal variations in its extent.

But with all this variation in the results of chest measurement, it can hardly be doubted that the records obtained bear some relation to the circumstances of the case, and the very fact that the movement registers cannot be directly connected with the condition of the lungs, as revealed by auscultation, justifies the anticipation that they indicate something of the constitutional vigour of the patient, and something perhaps of his power of resisting the inroads of the disease.

Many more cases will need to be measured by the stethometer before we can arrive at thoroughly trustworthy conclusions respecting the meaning of all the variations of the movements which may be found in phthisis, but already there are signs that these variations may become aids to us in our judgment upon individual cases.

There is, however, one precaution that must be taken in acquiring the needful records from which our conclusions are to be drawn, and that is that the mensuration must in all the cases be performed at a time when the disease is not in an active state, *i.e.*, when irritative fever and other signs of acute inflammation and irritation are present. It must have occurred to most practitioners to have attended cases in which abscess forming in the lung as a result of scrofulous consolidation has simulated rapid softening and disorganisation of the part, and the accompanying fever and emaciation may have caused grave apprehension of a speedy termination by death, and yet in certain of these instances after a more or less protracted discharge of purulent matter the abscess has either healed or dried up, the patient has recovered, and sometimes for years has enjoyed a very considerable degree of health, and has returned to his ordinary avocations.

In these difficult and doubtful cases stethometry can at first afford little, if any, aid to prognosis, but afterwards, in judging of the progress towards recovery, it is quite possible that the movement registers may give more distinct guidance than any other symptom.

In less urgent forms of the disease also it is not desirable to run the risk of fallacy, if, from high temperature or from other indications, there is reason to suspect that the case is in an active period of its course.

Even chronic cases, when they are for a time in this

stage, necessarily give greatly diminished movements, and thus the presence of active inflammation accompanied by fever has always been a bar to the use of the stethometer with a view to prognosis. I now always apply the thermometer at the time of examination, and if I find evidence, either in its indication or in other symptoms, that there is active mischief going on, I wait for a remission in the complaint before giving an opinion as to its probable course.

Since the lulls in the course of the disorder are less frequent and shorter, in the more acute forms of phthisis, the measurements in this class of the disease cannot so often be utilized for this purpose ; and it is usually necessary to exclude most cases of acute tuberculosis altogether from this method of calculation.

In order to show the bearing of stethometry upon the prognosis of cases of phthisis it will be well to show that there is a distinct difference between the chest measurements of acute and chronic cases during periods of quiescence, and that there are certain peculiarities in the respiratory movements that can be recognized as usually belonging to the one or the other type of this disease.

In order to do this with sufficient cogency of evidence I propose to adopt two distinct methods of inquiry, each of which has its advantages, and the united force of both of them may perhaps bring conviction on the subject to the minds of those who might resist conclusions drawn from one source only.

1. The first method is the one that primarily called my own attention to the subject, and made me think that there might be some connection between freedom of respiratory action and chronicity of disease.

It consists in comparing together the records of the movements of the chest of those who have already lived a

long time, and of those who have speedily succumbed to the disease; the measurements being made at epochs in the complaint when the apparent mischief in the lungs, in the two classes of cases, was about the same, or else when it was less developed in the acute than in the chronic class of case.

2. The second method is more distinctly statistical in its nature, and consists essentially in the arrangement of the records of cases in two groups—the first of those who have been the subjects of acute forms of phthisis, or in whom at any rate the duration of life has been comparatively short, and the second of distinctly chronic forms of the disease. In this method no attempt is made to secure similarity of extent of disease in the acute and chronic groups.

The results of each of these methods of inquiry will now be laid before the reader.

CHAPTER VIII.

A CLINICAL STUDY, CONDUCTED WITH THE AID OF THE STETHOMETER, OF A FEW ACUTE AND CHRONIC CASES OF PHTHISIS.

In the first, or clinical, method it will be necessary to give extracts from the notes of the cases, as brief as possible, but yet sufficiently full to enable the reader to judge whether they are strictly comparable—in other words, whether they may be placed approximately on the same level as regards the degree of disorganisation of the lung.

The results of chest measurements will then be given, and it will be seen at once whether there is any definite difference between the registers.

The cases thus go in pairs, of one chronic and one acute case, and with the one exception of the rate of progress they have been selected so as to present as many points of similarity as possible.

CASE A.

Female, æt. 20, young lady. Dark complexioned; hereditary phthisis.

Physical signs on Dec. 10th, 1872.

Right side.—Slight diminution of resonance, on percussion, over and under clavicle to 4 in. Over this region, harsh breathing, prolonged expiratory murmur, heart sounds conveyed, bronchophony, no moist sounds or crackle.

Left side.—Dulness, on percussion, to 2½ in. in front; absence of respiratory murmur, no moist sounds. At back, amphoric resonance to 6 in.; cavernous breathing all over this region, strong pectoriloquy, slight gurgling rhonchus.

CASE B.

Female, æt. 25, nurse, formerly factory hand. Phthisis hereditary. Dark complexion.

Physical signs on June 20th, 1872.

Right side.—*Front*, slight dulness in supra-clavicular region, clear—almost tympanitic—resonance to 4 in., amphoric breathing, and pectriloquy, and variable bubbling rhonchus; *behind*, similar evidences of cavity.

Left side.—Slight dulness to 3 in., bronchial breathing, fine crackle above the clavicle, tolerably healthy breathing below 3 in.

Stethometric Measurements in 100*ths of an inch.*

Case A.		Regions.	Case B.	
F.	U.		F.	U.
30	20	Upper sternum	15	50
35	30	Mid- ,,	10	40
—		Lower ,,		—
30	30	Right clavicle	10	24
40	38	Left ,,	15	50
70	70	Right 3rd rib	16	55
55	60	Left ,,	22	55

The physical signs in these two cases indicate a very close resemblance in the extent of the lung disease, and in the degree of disorganisation it had produced. The cases were also comparable in their ages, height, and muscular power, but it will be seen that the movements registered by the stethometer differ very considerably, Case A enjoying a much larger amount of general movement than Case B, especially over the clavicles and ribs. Can this difference be accounted for by the differing rate of progress in the two cases?

CASE A was pronounced phthisical, by the late Dr. Symonds of Clifton, in 1864, and since then has coughed more or less constantly. She did not, however, lose much flesh until three years ago, and she is still moderately well nourished. She spat blood once slightly, in Oct. 1872. Menstruation is regular, but scanty. The expectoration is variable, now scanty and muco-purulent.

She died in the spring of 1874.

CASE B began to ail in April 1870. She ceased to menstruate, and there was consolidation under the right clavicle in the June of that year; she has spat blood several times since then. In January 1872 her digestion was much impaired, and she emaciated rapidly; in June 1872 the stethometric record was taken; in October she began to get worse rapidly, the disease advanced chiefly on the left side; and she died on December 19th 1872.

In the following male cases, I have also endeavoured to approach to some degree of conformity in the extent of the

lung mischief, but it will be found that on the whole there was less disorganisation in the acute Cases D and F, than in the chronic Cases C and E.

CASE C.

Male, æt. 25, gentleman. Slender, dark complexion, pale; height, 5 ft. 9 in. Family history of struma, not of phthisis.

Physical signs, January 20th, 1872.

Right side.—Dulness on percussion to 4 in. below clavicle, occasional fine crackle throughout this region, bronchial breathing and bronchophony. Similar signs at the back, the lower two-thirds healthy.

Left side.—Much contracted below left clavicle and inferiorly; dull all round the base of the lung; clear, tympanitic percussion to 3 in. below clavicle, cavernous breathing, pectoriloquy.

CASE D.

Male, æt. 27, gentleman. Slender, dark complexion, pallid; height, 5 ft 8 in. Of strongly phthisical family.

Physical signs, January 20th, 1873.

Right side dull on percussion above and to 3 in. below clavicle; fine crepitant rhonchus above clavicle; large moist crackle and bubbling at 2 inches below clavicle, pectoriloquy.

Left side.—Slight dulness above and to 1 in. below the clavicle; occasional moist crackle, harsh respiratory murmur, prolonged expiration.

Stethometric Record.

Case C.		Regions.	Case D.	
F.	U.		F.	U.
56	39	Upper sternum	18	38
85	45	Mid- ,,	25	50
85	41	Right clavicle	20	35
54	39	Left ,,	15	30
110	75	Right 3rd rib	30	50
68	39	Left ,,	25	40
110	75	Right 5th rib	—	—
68	39	Left ,,	—	—

The rates of progress of these two cases were as different as are their stethometric registers. The history of Case D, is given in very few words. He was a delicate strumous youth, but had no lung affection until October, 1872, when he first commenced to cough. He then saw an eminent medical man in Manchester, who advised him to go to

Ventnor, and on his return in January the above notes were taken, and although there was then no pyrexia, or evidence of active advance, the physical signs prove that the disease had made very rapid progress in four months. He died fifteen months afterwards.

Case C has a much longer history, and in order to make clear the severity of the case it will be necessary to give somewhat copious extracts from its notes.

He was a delicate, quick-growing lad, subject to strumous swellings in the neck. In February, 1865, whilst still at school, he had acute pleurisy on the left side, with abundant effusion lasting about nine weeks, which illness was followed by flattening of the left subclavian region, and much contraction at the base of the lung. On the right side, harsh and prolonged respiratory murmur was noted. He now remained in fair health for two years, but in March, 1867, he began to lose strength and flesh, had a cough, quick pulse in the evening, night-sweats and chills. Under the left clavicle there was dry crackle, and anteriorly for four inches moist crepitation and dulness on percussion. After a year of varying health he went to Australia, and on his return, excessively weak and emaciated, in the spring of 1869, he was found by an eminent London physician to be in an almost hopeless state. A chest examination gave :—

Left Side.—Contracted below the clavicle and inferiorly dull all round the base—a well-marked gurgling rhonchus at the apex—the respiratory sounds faint but audible posteriorly along the scapula.

Right Side.—Very coarse, almost gurgling rhonchus under the clavicle, same signs in supra spinous fossa—crepitus over half the scapula—the lower two-thirds of this lung were the only portions of the chest where anything like vesicular respiration was audible.

There was general pyrexia—occasional chills and night-

sweats. Notwithstanding these most unfavourable symptoms however he gradually improved under home nursing. The fever left him, the chest signs improved and in a few months' time even the crackle and the gurgling in the large vomica on the left side ceased, and he gained both flesh and strength. He died in the spring of 1875.

Yet another comparison may serve to show the contrast between acute and chronic cases in their power of thoracic movement.

CASE E.

Male, æt. 54. Height, 5 ft. 6 in.; dark complexion, pale. Phthisis not hereditary.

Physical signs, March, 1869.

Right side.—Clear, almost tympanitic, percussion-note to 3 in. below clavicle; below this, dull to 4½. Over the upper part, cavernous breathing and pectoriloquy; below, bronchial breathing and bronchophony. No moist sounds.

Left side.—Dulness on percussion to 1½ in. below the clavicle; harsh murmur and prolonged expiration, heart sounds conveyed, no crackle.

CASE F.

Male, æt. 45. 5 ft. 9 in. in height; dark, pale. Family history doubtful.

Physical signs, January, 1873.

Right side.—Diminished resonance on percussion to 6 in. in front; bronchial breathing and bronchophony, conveyed heart sounds and occasional crackle all over this region. Under the clavicle, gurgling rhonchus, and cavernous breathing, and pectoriloquy.

Left side.—Dulness on percussion to 2½ in.; moist crackle, harsh breathing.

Chest Measurements.

Case E.		Regions.	Case F.	
F.	U.		F.	U.
51	45	Upper sternum	20	18
—	—	Mid- ,,	30	20
—	—	Lower ,,	35	25
48	45	Right clavicle	15	20
51	39	Left ,,	15	10
67	66	Right 3rd rib	28	20
42	51	Left ,,	35	30
—	—	Right 5th rib	20	15
—	—	Left ,,	25	40

Case E was a man of active, energetic temperament, thin, wiry, and fond of hunting. He was a Manchester merchant, and at the outset the case seemed likely to prove a serious one. It commenced in 1866 with laryngeal complications, and went on rapidly to consolidation of the right apex, and to certain premonitory signs of disease on the left side, *e.g.*, harsh inspiratory murmur and prolonged expiration.

In the spring of 1867 he went to Italy, where he was unfortunate enough to contract the Roman fever, and became much reduced in strength. On June 21 it was noted that for two inches below the clavicle and the upper third of the scapula behind on the right side, there was very fluid crepitation, and on the left side there was slight diminution of resonance, dry crackle under the clavicle; there was no fever, but occasional night-sweats.

On October 17, in the same year, a well-defined cavity was found in the right apex, extending to the third rib, almost dry, but with some coarse crepitant sound on coughing, and fine crackle for four or five inches in front. The base of the lung was healthy, and on the left side the disease appeared to be stationary. He now went to Egypt, and returned in May, 1868, greatly improved in general health, and (with the chest signs much lessened in intensity) with apparently no secretion from the vomica. In the spring of 1869 the above measurements were taken, and at the present time (June, 1882) the disease appears to be quite quiescent. He has retired from business, but he hunts and shoots, and performs all the outdoor duties of a country gentleman.[1]

Case F had only suffered from a cough for two years.

[1] Whilst these sheets are passing through the press I learn that during the past summer the disease has again become active, and that this patient is likely soon to succumb.

Before that time he had enjoyed good health, and he only began to get thinner twelve months ago, and spat blood.

Three months ago he had a sharp attack of laryngitis, and he is still hoarse. When the examination was made he was weak and unable to work, but there was no fever, and he did not suffer from night-sweats, and he was able to walk about a mile without difficulty. The case had evidently been of an acute form, but it was not then advancing, and there was nothing to foretell a very rapid decline, but shortly after the chest measurements were taken he took cold, and died after a few days' illness.

A very brief survey of the respective movement registers of these cases will suffice to show that there is a much smaller extent of general motion in the acute than in the chronic forms of the disease. In some respects also the differences are so striking that even this small collection of measurements would be sufficient to justify further inquiry into the relations between the duration of life in phthisis and the degree of mobility of the chest wall.

We may already discover in these illustrative examples certain interesting peculiarities in the details of the chest measurements, peculiarities that will hereafter be found to have an important bearing upon the question of prognosis; but the consideration of these points may with advantage be deferred until a larger body of evidence has been brought forward.

This evidence will come to the front during our examination of the subject by the second method.

CHAPTER IX.

STATISTICAL INQUIRY RESPECTING THE CHEST MOVEMENTS IN ACUTE AND CHRONIC CASES OF PHTHISIS.

We shall now turn our attention to the numerical method of inquiry. It consists, as I have already said, in arranging cases of phthisis, of all grades of progress, in two series, acute and chronic, and in noting any differences in the respective chest movements that might be likely to serve as guides to our judgment in other instances.

Probably to many minds this method will appeal more forcibly than the other, seeing that to a great extent it lessens the probability of any selection of cases according to any particular bias in the observer's mind.

In the following tables any tendency towards selection of examples has been carefully avoided, and this cause of fallacy has been the more easily kept at bay owing to the limited area over which my observation has extended. For the last thirteen years I have kept careful notes of cases of phthisis, and nearly all the instances which I bring forward have occurred either in my own practice or in consultation with other medical men.

The number of observations from which I can obtain my examples is thus somewhat limited, but this limitation has the great advantage of securing impartiality. The tables contain nearly all the completed observations of which I have

a record, all at least that bear upon the subject of prognosis. All the records I now present are drawn indiscriminately from my note-books, the only reference made being to ascertain the duration of life; and thus almost every completed case is here given, in which the disease has pursued either an obviously acute or a distinctly chronic course.

Those cases are omitted that are not remarkable for either extent of movement of the chest wall or for length or shortness of duration. I have necessarily left out the ordinary average cases from which nothing definite could be gathered in the direction in which we are now seeking for information.

The lists, especially those of the acute class, are also limited by the necessity that has already been mentioned of using only those measurements that have been obtained during the absence of fever.

Some forms of phthisis complicated and ushered in by pleurisy have equally been excluded, and this class includes some cases of fibroid disease of the lung. The mechanical effects of extensive adhesions perturb the purely morbid influences, and prevent conclusions from being drawn from the numerical records. With these exceptions, nearly all my other cases that are available for our purpose are to be found in one or another of the tables, and they may therefore be accepted as a fair representation of the dimensions of the chest movements, in cases occurring within the limited area of my practice.

Another important result of the mode in which the information has been acquired is the fact that it has thus been possible to watch the subsequent progress of the cases. The result of the illness has been ascertained in a much larger proportion of cases than could have been accomplished in ordinary out-door hospital practice. I am thus able to give in most instances both the duration of the

malady from its supposed commencement, and the length of life after the taking of the stethometric measurements.

It is indeed essential to the method that we are now considering that it should be possible to obtain the after-life history of the cases whose chest measurements have been recorded. They have to be ranked in one or the other group, according to their actual longevity. It will then be apparent whether any conclusions we might be inclined to draw from peculiarities in the chest-movements are or are not justified by their final issue.

It will be found that a large number of the cases recorded are chronic in their character. This fact is partly due to the social grade from which the examples are chiefly drawn, partly perhaps to the favourable character of the locality in which most of these persons have lived. Many of them have in fact been imported into this place, owing to the reputation that Bowdon enjoys of being favourable to recovery from chest complaints.

In consequence of the social position of the patients, in most of the chronic cases my own diagnosis has been confirmed by other physicians, and in several of the instances of long after-life I have been able to rely for their previous history upon the testimony of eminent medical men whom they had consulted in the early stages of their disorder.

These preliminary remarks may serve to explain the nature of the evidence that is at our disposal, and they will moreover tend to give my readers confidence in the indications of the tables which I propose now to lay before them.

The four tables given on pp. 81-84 are chiefly concerned with two series of chest measurements, belonging respectively to acute and chronic forms of phthisis, and, as in health the chest movements in males and females differ somewhat,

both in their proportions and in extent, the two sexes are separately contrasted.

It has not been found possible to effect any other selection with regard to age, size, build, or muscular strength. All are necessarily grouped together, with the one relation between them of their common disease.

It may be well to remark on this point that the disadvantages entailed by the necessity of thus bringing together such dissimilar subjects does not arise in actual practice. When we are face to face with our patient, all the considerations that I have mentioned may be allowed their due weight, and we may compare the actual movements of the chest with a mental estimate of what would have been their extent in a healthy individual of similar age, stature, &c.

Table VI. refers to twenty-five cases of chronic phthisis amongst males ; Table VIII. to the same number amongst females. Tables VII. and IX. give similar particulars respecting acute cases, of whom twenty of each sex are recorded.

The points on the chest wall, selected for our present observation as to their movements, are the clavicles about their middle, and the anterior ends of the third ribs. In a few cases I am able to give the movements of the third ribs only.

In many instances, especially amongst males, I had noted also the movements of the sternum and of the ends of the fifth ribs, but in the tables these have been omitted in order to secure uniformity.

The better to display to the eye the extent of motion in each group, and thus to facilitate comparison between them, I have projected the figures of the tables into the form of diagrams, giving by means of horizontal bars the proportionate dimensions of each measurement.

The bars, with diagonal shading placed in the median line of each diagram, show the extent of the *forward* movements of the above-mentioned points; the black bars on each side of the diagrams show the corresponding extent of these movements in the *upward* direction; and in each case the upper line of each pair of figures relates to the clavicles, the lower line to the movements of the ribs.

In each case, the measurements on the most diseased side are placed to the left of the middle line of the diagram, and of the tables, and an attempt has been made to arrange the cases in the order of the extent of motion, those with the least dimensions being placed at the top of each series.

By this method it is possible to see at a glance the comparative extent of movement on each side, and to compare the cases with one another. A brief description of the nature of the disease in each patient is placed over the representation of the chest register. An average measurement from healthy persons is appended to Charts III.[1] and IV. to serve as a basis of comparison.

A fifth chart (V.) is also given, showing the chest movements of certain cases, twelve in number, which I regard as exceptional. These are cases possessing much freedom of chest movement, which yet terminated fatally at an early period. They will have to be examined in detail presently.

A glance at the charts of both male and female cases shows at once that there is a striking contrast between the relative extent of chest movement in the two groups of distinctly acute or distinctly chronic nature, and a closer study will reveal peculiarities that occur in one and that are absent in the other.

[1] It must be noted that the numbers of the charts do not correspond to the numbers of the tables, thus, Chart I. is taken from Table VI. and so on.

We must now examine the details of the measurements, and judge as to their bearing upon prognosis; in other words, we must learn whether certain peculiarities are so constant in each group that their occurrence in a given case will enable us to say either that it is likely to advance rapidly to a fatal issue, or that it may become chronic, or even tend towards cure.

Chart 1.

PHTHISIS. CHRONIC CASES. (MALES.)

MOVEMENTS OF CLAVICLES & 3RD RIBS.

	Upwards	Worst Side	*Forwards*	*Forwards.*	Best Side.	*Upwards.*
1.	J.W. Æt. 65. *35 years ago, Vomica at apex (authority Dr C.J.B. Williams) now no physical signs* (c) x			RESULTS *Living 5 years after.*		
2.	E.W. Æt. 48. *Commenced 5 years ago consolidation to 4 in (Right)*			*L. 1 year after (Left) healthy.*		
3.	J.K. Æt. 40. *5 years (Left) large dry Vomica to 4 in.* x			*Result uncertain. Right 2nd stage to 6 in.*		
4.	Mrs S. Æt. 40. *9 years before Dr H. Bennet found Vomica (Right)* (c) x			*Now no physical signs. Living 9 years after.*		
5.	R.H. Æt. 31. *2 years (Left) 1st stage at apex.*			*(Right) healthy. L. 1 year after.*		
6.	J.W. Æt. 17. *8 mos (Left) 1st stage to 1½ in.* (c)		(c)	*Right) healthy. L. 7 years after.*		
7.	J.J. Æt. 35. *2 years (Left) 2nd stage to 5 in.* (c)			*(Right) 1st stage to 1½ in D. 2 years after.*		
8.	N.G. Æt. 26. *6 years (Left) deposit to 5 in.*			*(Right) healthy. D. 2 years after.*		
9.	G.C. Æt. 57. *10 years (Left) 2nd stage to 4 in.* (c)			*(Right) healthy. Living 8 years after.*		
10.	D.L. Æt. 26. *3 years (Right) dry Vomica to 3 in.* x			*(Left) incipt consoln result uncertain.*		
11.	J.D. Æt. 42. *4 years (Right) 1st stage to 2 in.*			*(Left) incipt deposit at apex result uncertain.*		
12.	G.S. Æt. 25. *1 year (Left) 1st stage to 3 in.*			*(Right) healthy. D. 3 years after.*		
13.	A.W.L. Æt. 54. *2 years (Left) incipt deposit to 1½ in.* (c)			*(Right) Consoln to 4½ in. Vomica at apex.* x (c) *Living 11 years after*		
14.	E.G. Æt. 25. *7 years (Right) 1st stage to 2 in.* (c)			*(Left) Consoln to 3 in. Vomica at apex* (c) x *D. 2 years after.*		
15.	J.G. Æt. 62. *34 years before pronounced on left side by Sir T. Waters & Sir J. Clarke.* (c)			*L. 5 years after. no physcical signs.*		
16.	H.W. Æt. 29. *4 years (Hæmopt) (Left) upper lobe 2nd stage.* (c)		(c)	*D. 2 years after. (Right) healthy.*		
17.	T.R. Æt. 36. *3 years (Hæmopt) (Left) 2nd stage to 1½ in.*			*L. 18 mos after. (Right) healthy.*		
18.	F.A. Æt. 27. *5 years before consolidn of left apex (Dr C.J.B. Williams)* (c)			*L. 5 years after (Right) healthy.*		
19.	W.C. Æt. 38. *Dr Walshe found Phthisis on left side 5 years after.*			*L. 7 years after. no physical signs.*		
20.	G.L. Æt. 48. *9 years (Left) consoln to 2 in.* (c)			*L. 8 years after (Right) slight dept of apex.*		
21.	E.S. Æt. 17. *1 year deposit 1st stage at (Right) apex.*			*L. 3 years after (Left) healthy.*		
22.	J.T. Æt. 18. *3 years before (Right) 2nd stage to 3 in.* (c)			*L. 1 year after (Left) incipt dept under clavicle.* (c)		
23.	J.P. Æt. 25. *4 years (Left) deposit to 5 in large. Vomica at apex.* x			*D. 4 years after (Right) upper lobe 2nd stage.*		
24.	T.G. Æt. 61. *1 year (Right) 1st stage 2 in.*			*D. 10 years after (Left) healthy.*		
25.	W.I. Æt. 27. *2 years (Left) 1st stage to 2 in.*			*L. 2 years after (Right) healthy.*		

Chart 2.

PHTHISIS. ACUTE CASES. (MALES)

MOVEMENTS OF CLAVICLES & 3ds RIBS.

Upwards. **Worst Side.** *Forwards* *Forwards.* **Best Side.** *Upwards.*

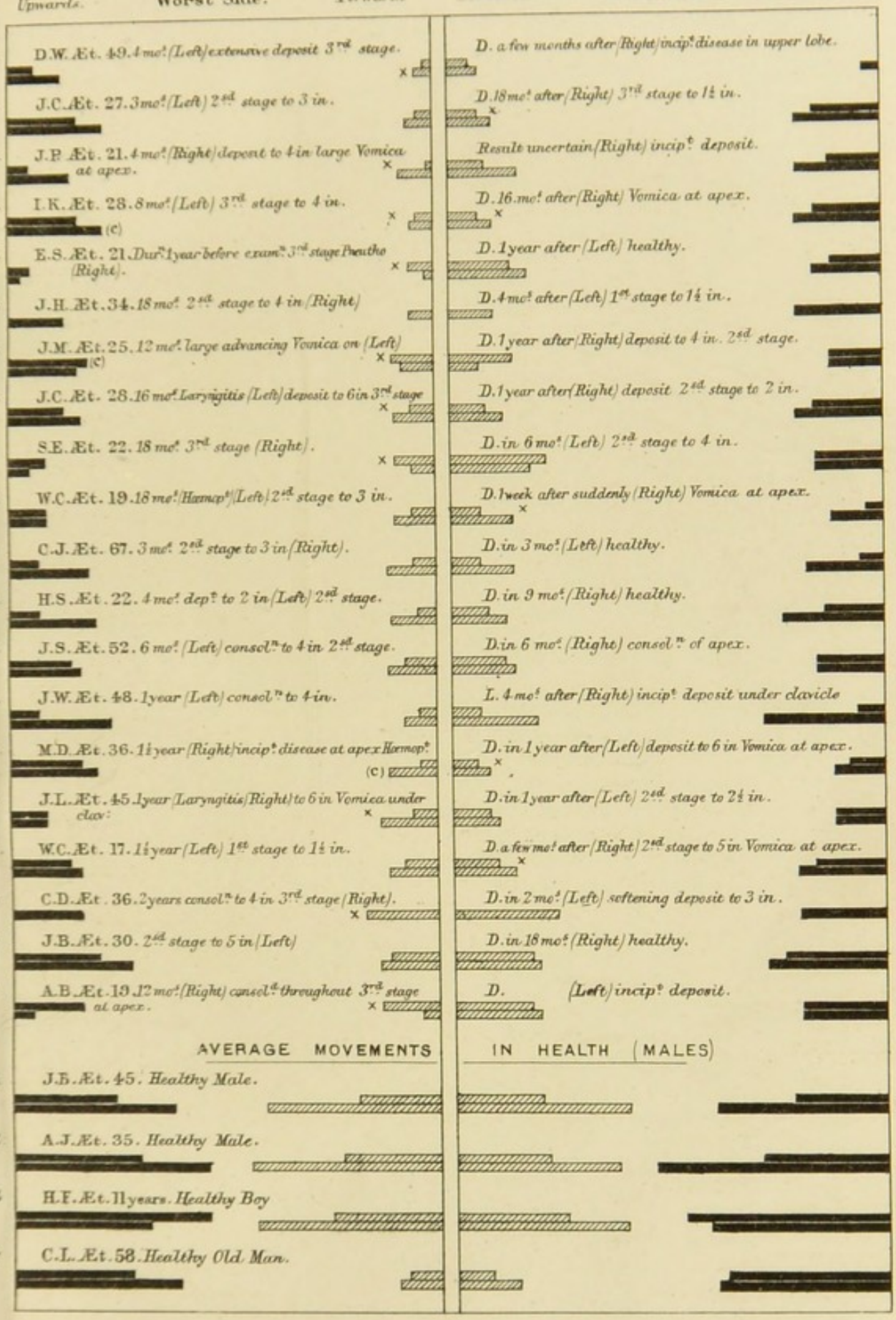


Chart 3.

PHTHISIS. CHRONIC CASES. (FEMALES.)

MOVEMENTS OF CLAVICLES & 3RD RIBS.

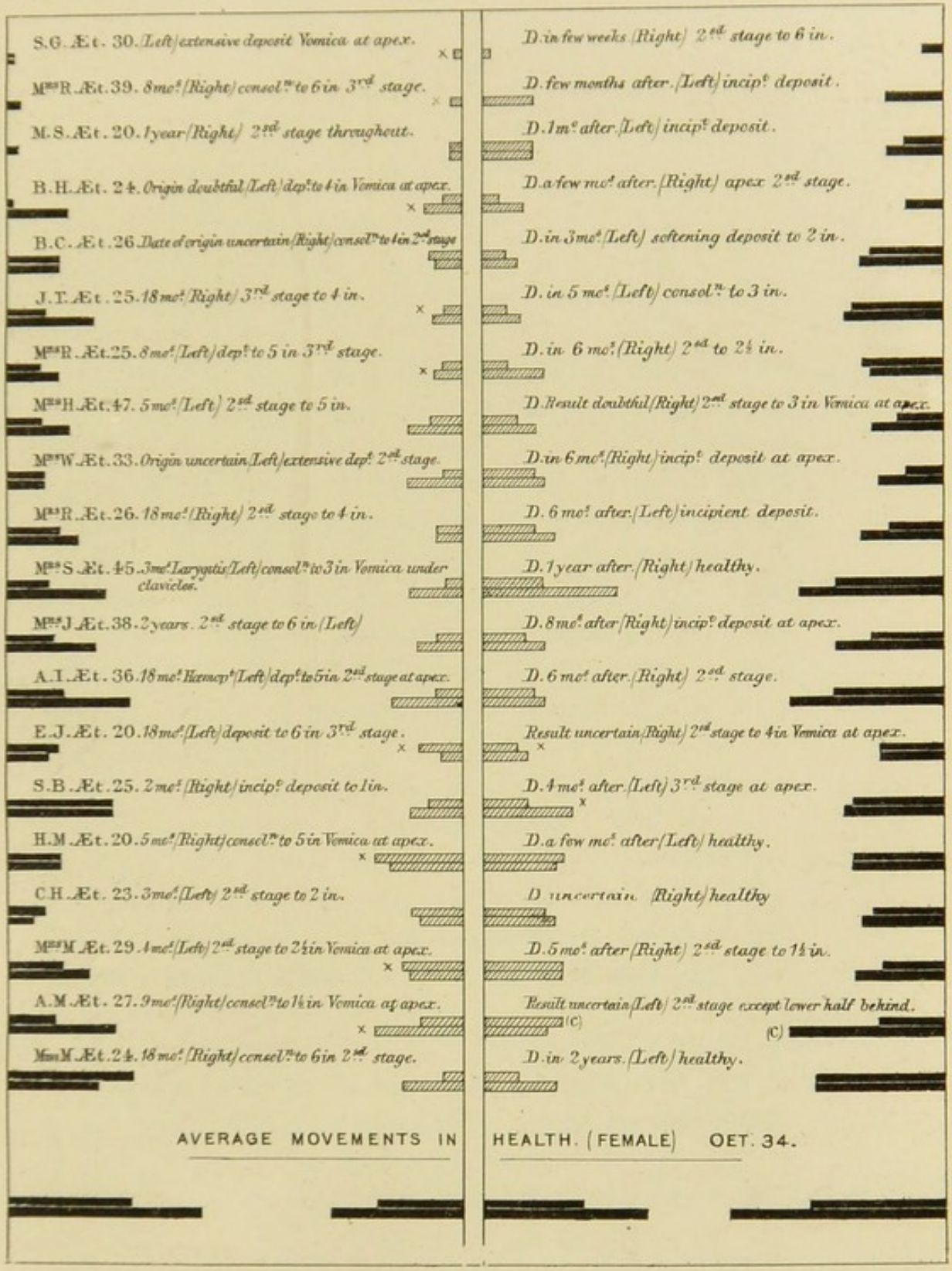
	Upwards	Worst Side. *Forwards*	*Forwards.*	Best Side. *Upwards.*
1	Mrs J. Æt. 30. *4 years (Right) deposit to 4 in 2nd stage.*		*(Left) healthy. D. 1½ year after.*	
2.	Mrs B. Æt. 50. *4 years (Right) 2nd stage to 2 in.* (C)		*(Left) healthy. L. 10 years after.*	
3.	M.W. Æt. 25. *8 years (Haemopt.) Vomica Praesternal Left side.* ×		*(Right) healthy. Living 5 years after.* (C)	
4.	Mrs B. Æt. 32. *3 years dept. to 5 in. Vomica under 3rd rib (Right).* ×		*(Left) incipient dept. D. 2 years after.*	
5.	Mrs S. Æt. 34. *5½ years (Right) softening deposit to 2 in.*		*(Left) healthy. L. 1 year after.*	
6.	E.G. Æt. 27. *2 years (Left) deposit to 4 in 3rd stage.* ×		*(Right) incipt. deposit. D. 2 years after.*	
7.	F.J. Æt. 28. *2½ years (Right) 1st stage to 3 in.*		*(Left) healthy. D. 2 years after of internal hæmorrhage.*	
8.	A.P. Æt. 30. *1 year (Right) incipt. deposit to 4 in.*		*(Left) healthy. L. improved 18 mos after.*	
9	Mrs C. Æt. 35. *2 years Haemopt. (Left) 1st stage to 3 in. softening at apex.* (C)		*(Right) healthy. Living 8 years after no advance.*	
10.	Mrs D. Æt. 30. *18 mos ago Dr C.J.B. Williams found tubercular disease in left side now dept. to 4 in 1st stage.* (C)		*L. 6 years after. Right side healthy.*	
11	Mrs S.W. Æt. 29. *3 years (Left) large dry Vomica* ×		*(Right) incipt. deposit at apex. D. 2 years after.*	
12.	G.S. Æt. 28. *10 years ago Haemopt. consol.n at apex of (Right)*		*L. 5 years after. (Left) healthy.*	
13	Mrs S. Æt. 30. *2 years (Right) 1st stage to 3 in.*		*L. 8 years after. (Left) healthy.* (C)	
14.	F.M. Æt. 23. *18 mos (Right) 1st stage to 2 in.*		*D. 3 years after. (Left) healthy.* (C)	
15.	A.F. Æt. 20. *8 years before Phth. diagnosed by Dr Symonds Left large dry Vomica at back.*		*D. 2 years after. (Right) 1st stage to 3 in.*	
16.	Mrs W. Æt. 27. *P 4 years (Right) softening deposit to 4 in.* (C)		*D. 2 years after. (Left) incipt. deposit to 1½ in.* (C)	
17.	J.C. Æt. 29. *1 year (Left) deposit to 2 in 2nd stage.*		*Living 6 years after (Right) healthy.*	
18	J.F. Æt. 23. *4 years deposit to 2 in (Right) Vomica at apex.* ×		*L. 1 year after improving (Left) healthy.*	
19.	M.R. Æt. 23. *2 years (Left) 1st stage to 2 in.* (C)		*Living 9 years after (Right) healthy.*	
20.	S.J. Æt. 25. *3 years (Left) 2nd stage to 6 in.*		*L. 5 years after. (Right) healthy.*	
21.	S.K. Æt. 35. *1 year (Left) incipt. dept. to 2 in frequent Haemopt.*		*L. 5 years after (Right) healthy.*	
22.	Mrs J. Æt. 33. *3 mos (Right) deposit to 2 in 2nd stage.*		*L. 7 years after (Left) healthy.*	
23.	Mrs S. Æt. 42. *8 years (Right) consol.n of upper lobe behind.*		*L. 1 year after (Left) healthy.* (C)	
24.	R.C. Æt. 20. *2 years (Right) incipt. deposit to 3 in.* (C)		*L. 2 years after (Left) healthy.*	
25.	E.H. Æt. 36. *1 year (Right) apex consol.n*		*L. improved 1 year after (Left) healthy.*	

Chart 4.

PHTHISIS. ACUTE CASES. (FEMALES).

MOVEMENTS OF CLAVICLES & 3RD RIBS.

Upwards **Worst Side.** *Forwards* *Forwards.* **Best Side.** *Upwards.*



CHAPTER X.

GENERAL MOVEMENTS OF THE CHEST WALL IN PHTHISIS.

1. THE extent of chest movement in the upward and forward directions in chronic and acute cases respectively.

In all forms of chest disease in which any degree of dyspnœa has been produced there is an *increased* degree of movement of the chest wall in ordinary breathing. In healthy persons the motion of the ribs in this act may be imperceptibly small, but in many subjects of chest disease the action of the diaphragm requires to be supplemented by that of the thoracic walls, even in what would be considered by the subjects themselves as ordinary tranquil expiration.

This fact does not however prevent the occurrence of a general loss of power of forced breathing. With the onset of disease this power is always lessened to some extent, and phthisis is no exception to the rule. It may be well here to repeat that in all the measurements recorded, it is the full extent of the movements in forced breathing that is given.

It is impossible to survey the four diagrams representing the chest registers of the two series of acute and chronic cases, without being at once struck by the smaller extent of motion enjoyed by the former group.

This fact is evident firstly in the minimum movements

recorded in the tables. In the acute series there is in several cases no appreciable motion in one or other direction over the seat of the disease. Amongst females, in two cases (Table IX., Chart IV., Cases 1 and 2) complete absence of movement is noted in the third ribs, and there is no forward motion of the clavicle on the worst side. In two cases also there is no upward movement—in No. 3 of the third rib, and in No. 4 of the clavicle.

Amongst males also (Table VII.), no upward movement of the right clavicle was noted in Case 1, and the forward motion of this part was hardly perceptible in Case 3.

No such complete immobility of any part of the chest wall is to be found amongst the chronic cases.

When there is movement to be observed in the parts of the chest over the seat of disease, it is always much less in the acute cases than amongst the chronic series, and the lessening of motion is to be observed in both the upward and forward dimensions of the movement.

For the details of these measurements I will refer to the tables themselves. A complete analysis of them is given at pp. 7—9, of my paper "On the Value of Stethometry in the Prognosis of Chest Disease" (*Medico-Chirurgical Trans.*, Vol. LXIV.).

It may suffice here to recognise the fact that whilst in acute cases the minimum forward reading on the diseased side comparatively seldom exceeds 0·20 inch, amongst chronic cases such low readings are not often found, and in this group it is always over the less movable bone, the clavicle, that the minimum reading is reached.

The average dimensions of the forward movement of the clavicle on the worse side is 0·15 inch in acute cases, and 0·29, or nearly double that amount, in chronic cases. Over the third rib also in chronic cases this movement

only once sinks below 0·20 inch, and the average forward push of this bone in this series is 0·51 inch, whilst in the acute series it is only 0·24 inch.

A similar contrast is also to be remarked in the extent of the *upward* movements in chronic and acute cases respectively.

In the chronic male cases (Table VI.), the average upward movement of the clavicles on one side is 0·50 inch, and on the other 0·54 inch ; and amongst females (Table VIII.), the mean readings are 0·54 on the worse, and 0·63 on the better side.

The corresponding measurements in the male acute cases are 0·25 on the worse, and 0·31 on the better side ; and amongst females they are respectively 0·26 and 0·38.

The third ribs also move upwards much less freely in the acute cases. Amongst males on the worst side the mean upward rise is 0·36, and amongst females it is 0·38.

On the least diseased side the readings are for males, 0·45 ; for females, 0·51.

In the chronic group the corresponding readings are for males, 0·72 and 0·78 ; and for females, 0·78 and 0·86.

We may thus say broadly that the chronic cases have double the amount of movement that the acute cases have, both in the forward and in the upward directions of motion of the bones in question, and that in most instances patients may be provisionally grouped accordingly.

It is interesting to notice that in both series of patients the average reading is the greatest amongst females in both the forward and upward movements, and this remark applies not only to the clavicle, which might be supposed to be the more movable bone in females, but also to the third ribs on both sides of the chest.

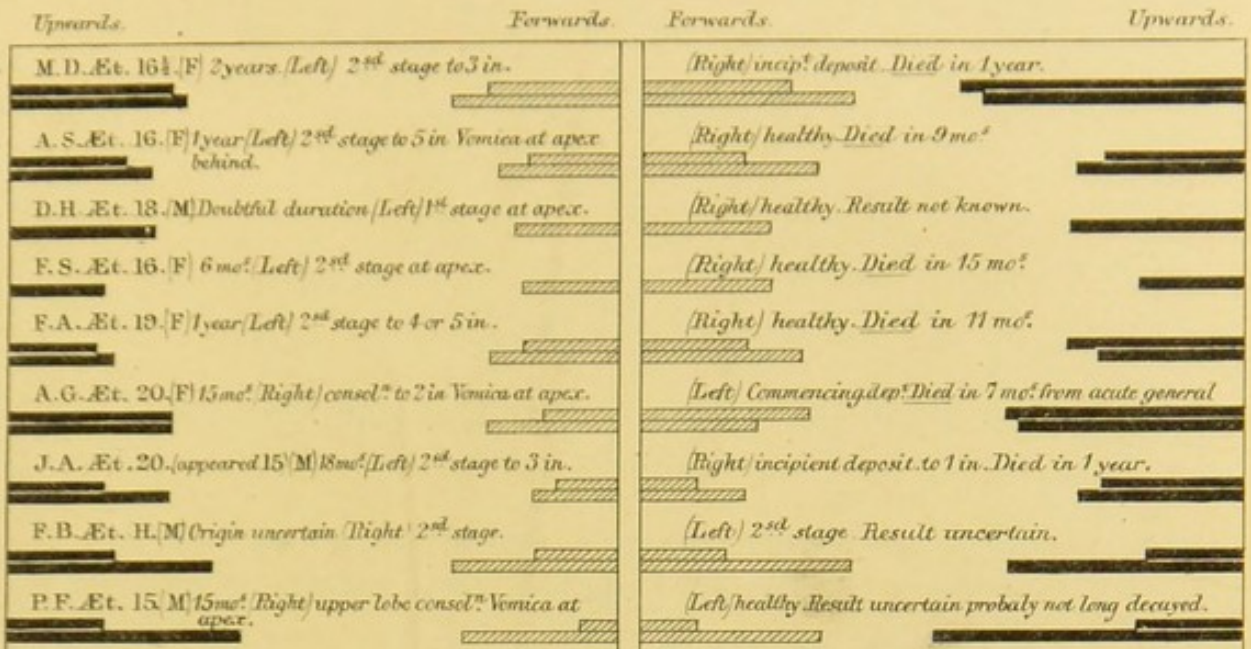
I apprehend that an explanation of this fact must be

found in the much greater elasticity of the thoracic bones in females than in males, and it tallies with the observation presently to be noted, that in the young the active deposition of tubercle may proceed to a considerable extent, without greatly affecting the mobility of the chest wall.

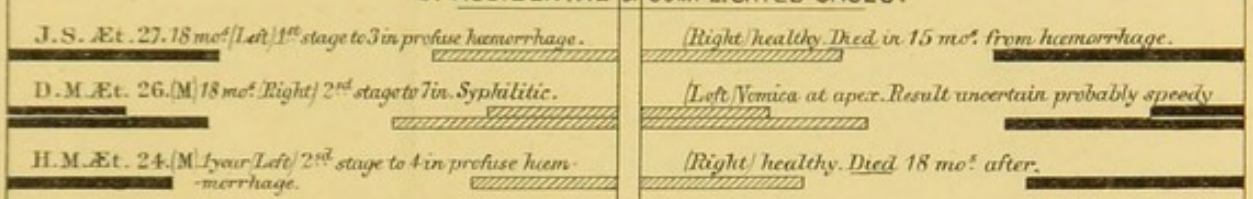
Chart 5.

EXCEPTIONAL CASES.

a. YOUTHFUL CASES.

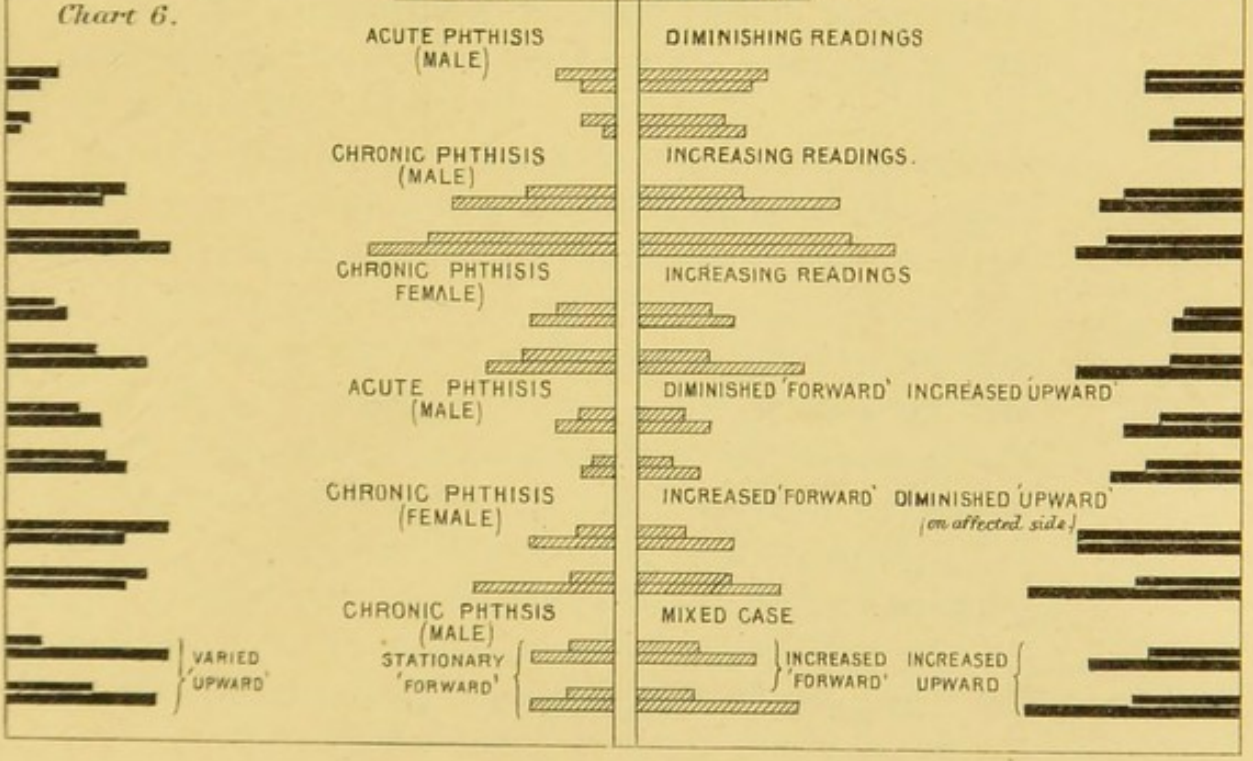


b. ACCIDENTAL & COMPLICATED CASES.



REPEATED MEASUREMENTS.

Chart 6.



CHAPTER XI.

CIRCUMSTANCES AFFECTING PROGNOSIS FROM STETHOMETRY IN PHTHISIS.

BEFORE proceeding further to discuss other peculiarities of chest movement to be found in the tables, it will be needful to note at once certain apparently exceptional results, that lie in the way of applying the simple test of measurement to any given essay at prognosis.

1. It will be observed that in the upper and lower portions of the charts there is a tendency to an overlapping of the records of the two series of cases, especially amongst the male patients. The worst of the chronic patients, *i.e.* the few first registers of Chart I equal or exceed in their movements the best of the acute cases (*i.e.* the last three or four of Chart II.).

If this circumstance arose from a gradual improvement in the acute cases, and a shorter duration of the earlier chronic cases, this occurrence would not trouble us much, as it would only apply to the extremes of each class of cases; but, as we shall see presently, there is no such graduation of longevity. It will be found, however, that much of the anomaly disappears when the respective ages of the patients is taken into account. Age, as well as disease, undoubtedly exerts an important influence in impeding respiratory movements, and, in the first four cases of Chart I. it has certainly had a restraining effect. All of these patients were over forty years of age, and at this

time of life the solidification of the bones and cartilages already, even in healthy people, diminishes the extent of movements of the ribs, especially in the forward direction.[1]

All the last four cases of the male acute series were under forty; two of them were under twenty; and the two others were not of a severely acute type.

Amongst the female cases only four overlap to an appreciable extent—the first three of Chart III. and the last of Chart IV. One of the chronic cases was over fifty years of age, and another was the subject of pneumothorax, and the last two of the acute cases were also not of very short duration.

But after all, these instances do not amount to more than this. They show that each case will have to be judged upon its own merits, and this, as I have remarked before, is less difficult when we are face to face with our patient. The art of prognosis cannot be turned into a simple mechanical problem; there will always be ample scope for the sagacity of the well-trained physician.

2. A much more important hindrance to right judgment in prognosis from chest measurement will be found in the list of exceptional cases grouped together in Chart V. All these cases display a considerable extent of chest movement, and yet they were probably none of them long lived. How is this anomaly to be accounted for? I am bound to show that about these cases there are truly exceptional circumstances, circumstances that can be recognised at the outset as likely to interfere with the rule thus far observed—that freedom of respiratory movement accompanies chronicity of disease.

The most important point observable in the first nine of the cases is their youthfulness.

It is remarkable how large, in the healthy state, are

[1] See Table I. p. 12.

the dimensions of the chest movements in childhood and in youth before the bones have lost their elasticity; and in *disease*, even when the morbid action is both extensive and rapid in its progress, the chest walls often seem to retain their great elasticity. This fact, along with the greater danger in early life of tubercular deposits in other organs, may well make us cautious in pronouncing an opinion as to the future of youthful sufferers from consumption.

The first nine cases of Chart V. are all under twenty years of age, and the two aged twenty (Nos. 6 and 7) were remarkable for their juvenile appearance and stunted growth. The freest movements are those of the two boys aged respectively eleven and fifteen years (Nos. 8 and 9), and the girl (No. 1), aged sixteen and a half years; and, although the result was not definitely ascertained in the two boys, the physical signs showed that the disease was very extensive and serious.

It is true that even in youth the movements may sometimes be much impaired, as in Cases 10 and 17 in Chart II. (acute cases, males), and when this fact is noticed we may, with much probability, give an unfavourable prognosis; but in any patient under twenty years of age, my experience would make me hesitate to draw a favourable augury from even an extensive play of chest movement.

Again, it is certain that, even in adult life, we may have our judgment falsified by accidental circumstances, such as the occurrence of hæmorrhage, or the supervention of acute tuberculosis, or albuminuria.

Two of the remaining patients in Chart V. died of hæmorrhage or its consequences, and the third was the subject of constitutional syphilis.

I consider, therefore, that this list, though it gives an emphasis to the cautious expression of our opinion, yet takes away but little from the value of the other tables.

CHAPTER XII.

GENERAL OBSERVATIONS CONCERNING THE RELATION OF CHANGES IN THE MOVEMENTS OF LIMITED REGIONS OF THE CHEST, TO LOCALISED MORBID CHANGES IN THE LUNGS.

WE are not left simply to the general magnitude of the respiratory motions as our sole guide to prognosis from stethometry. We have also the evidence to be derived from peculiarities in the behaviour of the bones situated over or in the neighbourhood of the seat of disease.

For successful prophecy as to the future of a case of phthisis, in addition to an accurate knowledge of the extent of the disease and of its rate of progress, we need some indication of the amount to which it taxes the vital resources, and, if possible, some measure of its gravity as estimated by the system itself.

The influence of disease upon the system may often be made less obvious owing to the natural vivacity and hopefulness of the patient, and very frequently those whose frames most resent the injury, and in whom it makes the most rapid progress, are the very persons to make light of the ailment and to show a cheerful countenance during its attacks.

It would certainly be no small gain to us, if we could have the evidence of an automatic apparatus, independent of the emotions and of the will, to show the estimate taken by the nervous system of the degree of danger likely to assail the patient.

I think that we may find this evidence in the behaviour of the muscles of respiration placed near or over the seat of disease.

The very fact, just noticed, that the movement records cannot be directly connected with the extent of disease, might of itself permit us to hope that they really tell us something respecting the constitutional vigour of the patient, and of the comparative safety with which the movements may be carried on. And the probability of this surmise becomes much strengthened by a consideration of other similar morbid processes. Thus, in diseases of the joints, we know that an early sign of mischief is pain in the nerves and rigidity of the muscles, or some other effort made to preserve the immobility of the part, an effort often directly proportioned to the gravity of the disorder. Mr. Hilton, in his admirable lectures on "Rest and Pain," points out that there is a special arrangement of the nerves supplying the joints and muscles, in order apparently to secure rest to the injured part.

But Mr. Hilton is also able to show that the same anatomical law of distribution holds good with regard to the pleura, for he says (p. 256, ed. 1880): "The same intercostal nerves which supply the intercostal muscles moving the ribs, supply also the serous membrane lining the thoracic parietes and the skin over those different but physiologically associated structures, in order to produce harmonious and concerted action during the varied states of respiration. Here, then, we have the pleura representing the synovial membrane; the intercostal muscles representing the muscular apparatus connected with and moving a joint; and the cutaneous branches of the nerves spread over the intercostal muscles, assimilated in their arrangement to the cutaneous branches which supply the skin over the insertions of the muscles moving the joint."

He then goes on to ask the question (p. 259): "May not the irritation of an inflamed pleura bring on a contracted condition of the muscles between the ribs (intercostals), and thus engender *the limited breathing* and painful cramps and 'stitches,' from which such patients suffer, in addition to that which results directly from any local inflammation of the pleura, and which induces pleuritic patients to limit their respiration as far as possible to the action of the diaphragm? This spasmodic contraction of the intercostal muscles, induced by the inflammatory condition of the pleura, is precisely analogous to what we see in joint disease."

These deductions seem to me to be perfectly correct, but what is of almost more importance for our present object is the probability that the converse of Mr. Hilton's proposition is also true, and that when the contraction of the muscles over a diseased lung is relaxed, and the rib is again allowed to move more freely, we may infer a cessation of the activity of the disease, and may pronounce a more hopeful prognosis than could have been given had the ribs remained immovable, or, at least, much restrained in their action.

This observation, again, is greatly increased in value when we recognise the fact that the ribs have each, to a certain extent, a power of individual action. This point is worthy of a little closer examination.

Independent rib movements.—In the course of observations on the respiratory movements, I very early noticed the fact that even in health there is no essential relation between the motions of the several parts composing the framework of the thorax, and that the range of movement of the ribs, in two directions at least (*i.e.* forwards and upwards) is under the control of the intrinisc muscles of respiration, which can, upon occasion, be made to act in obedience to the will.

In ordinary healthy but forced breathing it is possible voluntarily to commence the inspiratory or expiratory act at the upper or lower regions of the chest, and also so to control the movements of the ribs as to produce an excess of either upward or forward motion.[1]

In disease, still more marked variations of movement may take place unconsciously, not in regions, but in more limited parts of the chest ; and these variations, as we have seen, often give important information as to the condition of the underlying lung.

It appears, also, that other observers have come to the same conclusion.

Andral (in his *Clinique Medicale*, tome iv., Paris, 1804) shows that the ribs possess a certain power of individual action, that each rib can, within certain limits, move independently of its neighbours, and that they have not merely movement in common.

This observation was confirmed, and its bearing thoroughly discussed by Mr. Hutchinson in his article on the Thorax in the *Cyclopædia of Anatomy and Physiology*. Thus, speaking of pathological respiratory movements, he says :

"The twelve intercostal muscles move in every combination, as if to meet impending difficulties, tenacious of life, and yielding only by compulsion to the advance of disease. Throughout the long list of diseases which attack men, these instinctive movements have to contend, shifting about, or growing less and less. . . .

"But, again, there are reasons for thinking that these movements may be changed from other causes not so purely physical ; because sometimes no dyspnœa is to be perceived, and yet the movements are deranged, or they may change backwards and forwards, as if aërating specific

[1] A Stethogram of this occurrence is given in *Stethometry*, p. 107, fig. 39.

portions of the lungs, *acting as a curative remedy to some incipient form of lung-disease.*

"*Of limited breathing movement.*—The mobility of parts when disease attacks the chest may be surprisingly drawn forth. . . . It is not uncommon in phthisical patients to see strong and well-marked respiration kept up by the first, second, and third ribs, or by the tenth, eleventh, and twelfth. These ribs are movable, but it requires disease to bring their mobility forth. We are satisfied that there is a latent respiratory mobility during health, which is manifested only in disease."[1]

These observations of Mr. Hutchinson, made independently of instrumental measurements, are abundantly corroborated by my tables, and I may further note that, as a consequence of the individual action of the ribs, certain variations of mobility of the chest wall are to be observed, not only over the ribs themselves, but at times also in the breast bone and clavicle.

One of the most remarkable features in the chest registers of phthisical patients is, indeed, the occasional predominance of the movement of the clavicle over that of the third rib. (The occurrence is to be noticed in Case 13, Chart I.; Cases 5, 7, 9, and 20, Chart II.; Case 18 Chart III.; and in Cases 5, 14, 16, 17, 18, and 19, Chart IV. It is thus much more common in acute than in chronic cases, and in females than in males.)

To any one who had not watched and measured these movements it would appear impossible that one or other of the third ribs could have its mobility impaired by adhesions and by other causes, and yet that the upper part of the sternum could be carried forward to such an extent, as to permit of the clavicle being pushed forward to the limit

[1] Mr. Hutchinson is referring here to the ordinary movements of respiration, and not to the extreme limits of the movements in forced breathing.

of 0·2, or even (as in Case 20, Table II.) of 0·25 inch in advance of the third rib on the same side.

It may be remarked that there is a possible source of error in this observation, in that the shoulders may have been instrumental in tilting forwards the clavicles during forced efforts at inspiration, but precautions were especially taken against this contingency, and although I cannot deny the possibility of its occurrence in some instances, I feel convinced from repeated trials, that the excess of clavicle action over that of the third rib is possible without any other than ordinary forced respiratory movements.

The flexibility of the costal cartilages during life is such that the movements of the sternum bear no constant relation to the movements of the ribs. The anterior ends of certain of these bones may move, or may be prevented from moving, without greatly affecting the raising or pushing action of the other ribs. Each rib uses to a certain limited extent its power of independent movement, and thus overcomes the resistance offered by the bones, whose motion is checked by adhesions or by some other less mechanical impediment.

It will be readily perceived what an important bearing these remarks have upon the question of prognosis, especially when they are taken in conjunction with Mr. Hilton's observations on the restraint exercised by disease upon the different sets of intercostal muscles.

It becomes not only possible, but highly probable, that measurements showing local limitation of motion or increased freedom of movement will have a distinct prognostic significance, and that exact records of the extent of these variations will give important assistance in determining the probable future of many cases of

phthisis. In illustration of this remark I desire to direct attention especially to two points:

1. To the action of portions of the chest wall over the site of a vomica.

2. To the demonstration of excessive motions, in the forward and upward direction, in some parts, to compensate for the loss of power of movement in others.

CHAPTER XIII.

CHEST MOVEMENTS OVER THE SITE OF A VOMICA.

ONE of the most striking differences between the two series of cases, whose stethometric registers appear on the diagrams, is to be found in the respective behaviour of the upper bones of the chest over the site of a chronic cavity or over a rapidly softening deposit of tubercle. The freedom of movement over the one, and the absence of movement or its impairment over the other, are usually very distinct, and often enable us to judge from this sign alone to which class any given patient belongs.

This statement will be found to be borne out by an analysis of the two sets of tables now before us.

In order to determine the question I have extracted from the four tables all the cases in which the third stage of the disease had been reached.

Naturally the largest proportion of such cases is to be found in the acute series. Of these latter patients 21 (9 females and 12 males) had arrived at this stage. Whilst of the chronic group only 12 are to be found with signs of a cavity, viz. 4 females and 8 males. The numbers are small but they are sufficient to display the contrast between their respective measurements.

The mean reading of the forward push of the clavicles amongst the acute series was only 0·14 in. amongst males,

and 0·15 in. amongst females; and in two only of the patients (No. 20, males, and No. 18, females) was the forward push of this bone more than 0·25 in.

Amongst the chronic cases, the average forward push of the clavicle was more than double that of the acute set, namely, 0·31 for both males and females, and in two cases only (Nos. 1 and 3, males) was this dimension less than 0·20 in. of movement.[1]

It is noteworthy also that in half of the chronic cases, four males (Chart I., Nos. 1, 4, 13, and 14) and two females (Chart III., Nos. 15 and 18), there is actually a larger extent of motion over the site of the vomica than on the less affected side.

This circumstance is not to be observed in any of the acute series.

The third ribs give less frequently the surface marks of an underlying cavity, but in chronic cases this bone also frequently shows considerable freedom of movement when a vomica extends downwards so far, or when the disease in the lung has proceeded to the third stage to this point before its progress has been arrested.

In acute cases the motion is much more restricted.

In Charts II. and IV. (acute cases) there are fourteen cases in which the softening of previously consolidated lung has overpassed the limit of the third rib—ten males and four females—and the average motion forwards of the bone is only 0·165 inch.

Amongst the chronic cases (Charts I. and III.) there are twelve thus conditioned, but the forward movement of the third rib averages 0·46 inch, nearly three times the

[1] It is important to observe that this freedom of movement of the bones over a quiescent vomica does not invalidate the correctness of the observation that it is a favourable sign when these bones collapse somewhat and permit of a sinking of the chest wall at these points. In spite of this sinking the mobility of the bones is often very considerable.

extent of movement of the acute series; and in three cases (Chart I., No. 13, and Chart III., Nos. 9 and 15) the motion of the third rib over the excavated lung exceeds that of the opposite side, and amounts on an average to 0·70 inch.

The explanation of these results is probably as follows: When an acute third stage of phthisis has been reached, nature makes an effort to limit the mischief; barriers of exuded lymph are thrown out, adhesions are formed with surrounding structures, and finally, the movements of the chest wall are kept within the narrowest limits compatible with safety to life. In acute cases of phthisis, therefore, even in a lull of the disorder, the readings of measurements over the site of a vomica, or over a rapidly softening lung, are the smallest that are ever met with in chest disease. Conversely, when the cavity becomes lined with a pyogenic membrane, that gradually ceases its activity and begins to secrete muco-purulent matter in small quantities only, air is permitted to pass more freely into the lung beyond the diseased part, and the system gathers strength again, both generally and locally, in the muscles of respiration; in this case there is a return of elasticity to the lung, increased mobility in the bones overlying the site of the cavity, and increased readings of the stethometric register.

We may, therefore, with much probability give a favourable prognosis when in any adult case we find a dry or tolerably quiescent vomica with a considerable extent of movement in the bone overlying it, and this is especially the case when the forward motion of this bone is greater than that of corresponding parts on the opposite side of the chest.

CHAPTER XIV.

COMPENSATORY MOVEMENTS OF THE CHEST IN DISEASE, ESPECIALLY IN CASES OF PHTHISIS.

THE next point to which I would direct attention is of an entirely different character from the simple release from bondage of parts situated, in chronic cases, over the site of a vomica. I refer to the efforts often made by some portions of the expiratory apparatus to compensate for the forced abstention of others.

It is a matter of common observation that attempts may be made by one portion of the organism to supplement the shortcomings of another that has been disabled by disease.

In chest disease, accordingly, we contiually see abdominal breathing take the place of costal movement, and it is not unusual for one lung to encroach to the extent of several inches towards the opposite side when, after pneumothorax or after the absorption of fluid, the other lung remains compressed by adhesions, or after the contraction and healing of an abscess in the lung. But, besides this, the movement of the ribs may be exaggerated in one direction to make up for loss in another.

In selecting instances of such compensatory movements it has been assumed, in the following pages, that only those records were of this nature, in which one or other of

the dimensions of motion on one side were palpably in excess of those on the opposite, usually the more healthy side.

In cases in which both sides of the chest were diseased it has also been regarded as probable that the compensatory principle was at work, when the bones nearest to the disease are much restricted in movement, whilst their neighbours on the same side are obviously moving to an excessive extent.

In three instances also, Chart I. (14), Chart III. (3) and (23), an excessive forward movement of the clavicle, out of all proportion to the motion of the third rib, has been held to be an attempt at succour. In thus limiting the selection, it is of course possible that our list may be short of the truth, seeing that attempts at compensation may have been made by ribs which did not succeed in surpassing their neighbours, and yet did more work than they had done at first. But it is obvious that these attempts would not be easy to detect, and they could hardly be reckoned as efficient unless they did exceed the motions of the other neighbouring parts of the chest.

On the other hand, also, it is possible that some of the larger readings of the instrument may have been due, not to any special efforts at compensation, but to greater freedom from impediments underlying certain of the thoracic bones.

Even in this last-named case, however, I apprehend that such freedom from restraint would have to be regarded as a favourable sign, and thus our ultimate object of assisting in the classification of the case would not be imperilled.

The letter (*c*) is, in the diagrams, placed opposite to the dimension of movement thus assumed to be exaggerated and compensatory.

These compensatory efforts may, indeed, have a favourable or an unfavourable significance when we are contemplating them with a view to prognosis; and, judging from my own observations, they may almost be classed in the one or the other category, according as they take place in the forward or in the upward dimension of movement.

In my work on *Stethometry*, attention is several times called to this kind of succouring action on the part of certain of the ribs, and it is there shown that in several diseases, and especially in pleurisy, there is usually an increased compensatory movement of the chest bones. The fact is well shown in the diagram, reprinted at p. 32 of the present work.

In this disease (pleurisy) it is always the upward rise that is exaggerated, in order to compensate for the loss of forward and lateral movement due to adhesions.

The extent of this compensatory upward motion, so far as it has any prognostic significance, augurs badly, as it shows that the adhesions are of a firm, unyielding character, and that they are likely to be permanent; and the subsequent history of the cases of which I have a record fully bears out this conclusion.

In phthisis there is more scope for a discriminating judgment. The compensatory movements are not so constant as they are in pleurisy, and they are more difficult to recognise, in consequence, perhaps, of the low standard of physical vigour in these patients.

They are also not confined to one dimension of the motion, but are to be found in exaggerations of both the upward and the forward readings of the instrument.

1. *Compensatory upward movements.*—An excessive upward rise of the bones in this disease must probably be looked upon either as an unfavourable sign, as in pleurisy, or else as only a measure of the muscular power that the

patient can bring to bear upon the obstruction to healthy breathing. In the latter case, the extent of motion may be regarded as in some sort a measure of the degree of vital power possessed by the patient, and thus, when it is great it will rank, so far as it goes, as a favourable circumstance. It probably also indicates a certain power of resistance to the disease, but it tells us little or nothing of its gravity, or of the probable rapidity of its course.

These remarks will be found to be fully borne out by a careful study of the several chest registers contained in the tables.

As might have been anticipated, the majority of instances of exaggerated upward rise of the bones are to be found amongst the chronic cases. There are nineteen such cases in Charts I. and III.—the male and female chronic patients;[1] but there are also six instances of increased upward readings amongst the acute group of cases,[2] and in most of them there was present a considerable extent of active mischief.[3]

It will be found that in these six acute cases there was a very small extent of forward motion, just as we usually find in cases of pleurisy; and, in the chronic series, the number of patients with exaggerated upward movements who have also limited forward dimensions is about equal to the number of those in whom this movement is comparatively free.

Compensatory upward movement cannot therefore be

[1] Chart I., Nos. 4, 6, 7, 9, 12, 14, 16, 17, 18, 20, and 22; in Chart III., Nos. 2, 3, 9, 13, 14, 16, 18, and 20.

[2] In Chart II., males, Nos. 4, 7, and 15; in Chart IV., females, Nos. 4, 15, and 19.

[3] Thus, free forward movements are found in five males, Nos. 4, 13, 15, 18, and 22, and three females, Nos. 13, 16, and 18; in all the others the forward push of the ribs is much restricted, and we may suppose that the large upward rise has been intended to overcome this obstruction to respiration.

taken as a proof of slowness of advance of morbid action.

Moreover, in the fact that in the chronic group, the male cases supply the majority (in the proportion of eleven to eight) of examples of this action, we may perhaps see a further proof of the hypothesis, that the extension of motion in the upward direction is due to the greater muscular vigour of the patients, rather than to simple chronicity of the complaint.

2. *Compensatory forward movements.*—The case is quite different with excessive and presumably compensatory *forward* movements of the chest.

These expansive motions seem usually to be tolerated only when the disease in the underlying lung is quiescent, or is going through the process of cure, and they are rarely found in adults in rapidly advancing forms of lung disease.

Amongst the forty acute cases in Charts II. and IV. there are only two (cases 13 and 19, females,) that show some faint indications of an excessive forward motion. In No. 13 it is observable in the third rib on the worst side of the chest; in No. 19 it shows in the clavicle on the least afflicted side. In both these cases also it is probable that the disease was quiescent at the time, on the side on which the increased motion was observed.

In the chronic group, on the other hand, there are no fewer than fifteen instances of some extension of the forward push of the ribs or of the clavicles, and in most of these instances the compensatory excess of motion was well marked. It is noteworthy, too, that in almost every case where the exaggerated motion is on the same side, the neighbouring bone immediately over the disease has a very slight extent of movement, thus making the compensatory effort more palpable.

The clavicles move forward freely in five cases: two males, Chart I. (Nos. 13 and 21), and three females, Chart III. (Nos. 3, 23, and 24).

The third ribs on one side or the other in ten cases, six males and four females (see Chart I., Nos. 1, 6, 13, 14, 15 and 20; Chart III., Nos. 9, 10, 16, and 19), show evident signs of exaggerated motion. In the forward motions of both ribs and clavicles, in chronic cases, there is thus not only a larger general movement than in acute cases, but the movements frequently become increased apparently in order to make good deficiencies in other parts of the breathing apparatus.[1]

We may then, I think, from the data before us, fairly claim the attempt at compensation on the part of portions of the chest wall, as a sign that the disease at the time of the observation is not making rapid progress, and we may conclude that, if other conditions are favourable, it gives promise of a longer duration of life.

[1] I have found this compensatory action not only in phthisis, but in other diseases, in which the action of certain parts of the chest has been interfered with; for example, in cancer, in aneurism, and in one case of accident.

CHAPTER XV.

THE VALUE OF STETHOMETRIC OBSERVATIONS IN CASES OF PHTHISIS ILLUSTRATED BY THE RESULTS OF REPEATED MEASUREMENTS.

In many cases a more accurate prognosis may be made by repeating the stethometric measurements at intervals of a few weeks or months. If the readings remain stationary at a high figure, or if there is evidence of improvement, our favourable opinion is much strengthened; and, on the other hand, if the records diminish in magnitude, with more or less rapidity, we must give an unfavourable or at least a guarded prognosis. Very frequently we shall find that the physical signs accord closely with the chest register; but, even if they do not, our judgment will receive valuable assistance from the evidence of failing or of increasing strength.

It will not be necessary to give many examples of these assertions, but it may perhaps be useful to illustrate them by an example of each kind, and to note a few of the variations that have been observed.

Chart V. gives the results of two measurements each, of six patients.

1. The first is simply a case of rapidly advancing phthisis in a young man, aged twenty-one, with disease on both sides, but pneumothorax on the left. This latter circumstance accounts for the small amount of movement

of the third rib on that side, but it does not diminish the value of the proof given by the stethometer of failing vigour. He died six months after the last record was made.

2. Cases 2 and 3 show precisely the converse condition in a male and female subject. No. 2, a male, is still living, two years after the last register was taken, and has much improved, the disease being now quite quiescent. No. 3 died two years after the observation, but at the time it was made she was improving in general health. Her illness dated from eight years beforehand, when she had been pronounced consumptive by the late Dr. Symonds, of Clifton.

3. In Case 4 I give an instance of increased "upward" movement, along with a diminished forward push. This has several times occurred in persons of much energy, but in whom the disease was making progress. I therefore regard this circumstance as merely a sign of a struggle with the increased difficulty met with in moving the bony levers, and not as any proof of improvement in the condition of the lung.

4. Case 5 displays the converse of the last-named observation. I have several times noticed that whilst there has been an increase in the forward movement as the case went on, there has been at the same time a very distinct diminution in the extent of the upward rise of the ribs. As this event has occurred in my observation chiefly amongst the chronic cases, I have usually taken it as a favourable sign, and have attributed it to the cessation of the need for an extraordinary effort at compensation.

5. Lastly, Case 6 shows a stationary condition of one side of the chest, with some increase both in the forward and upward movements in the other. This variation would also probably be a favourable sign of some improvement,

if not of the lung, at any rate in the general condition of the patient.

The several tables present other interesting variations of movement.

Thus, there are some persons in whom the clavicles and third ribs both possess a small degree of movement; in others, both move with considerable freedom on the sounder side of the chest. Again, in a third class, the third ribs greatly exceed the clavicles in extent of movement both forward and upward. And, lastly, there are a few individuals in whom, upon the diseased side, the clavicles move rather more freely even than the third ribs.

These peculiarities must, for the present, be referred to individual idiosyncrasies, but they may, on more extended observation, be found to possess prognostic significance.

To sum up, stethometry makes a claim only to be an adjunct to our ordinary methods of examining the chest. It is one of at least some importance, and I feel convinced that any physician who may be induced to employ the instruments of measurement steadily, and with due precautions, through a series of years, will find great help in its indications. He will get clearer views of the action of the respiratory machinery, his diagnosis by means of percussion and auscultation will be checked and extended by this additional physical sign, and, lastly, his power of prognosis will be augmented, both by a study of the automatic indications given by the muscles and nerves presiding over the respiratory act, and by the intelligence given by the instrument as to the vigour and muscular power of the patient.

TABLE VI. *Phthisis.—Chronic Cases (Males). Chest movements in tenths of an inch.*

No.	Initials.	Age.	Clavicles.				3rd ribs.				Duration in years.†		Remarks.
			F.	U.	F.	U.	F.	U.	F.	U.	Before.	After.	
1	J. W.	65	15	30	20	30	35	30	30	30	35	L. 5	Formerly vomica at apex, now no physical signs.
2	E. W.	48	10	15	15	15	35	60	50	65	5	L. 1½	(Right) deposit to 4 in. ; (Left) healthy.
3	J. K.	40	18	25	23	45	17	50	52	55	5	...	(Left) large dry vomica to 4 in. ; (Right) 2nd stage to 6 in.
4	A. G. S.	40	25	60	25	60	30	60	35	55	9	L. 10	(Right) formerly vomica at apex, now no physical signs.
5	R. H.	31	12	50	30	40	40	95	52	120	2	L. 1½	(Left) 1st stage to 1½ in. ; (Right) healthy.
6	J. W.	17	10	75	20	70	35	80	35	80	1	L. 8	(Left) 1st stage to 2 in. ; (Right) healthy.
7	J. J.	35	15	20	27	40	35	70	50	65	2	D. 2	(Left) 2nd stage to 5 in. ; (Right) 1st stage to 1½ in.
8	N. G.	26	*	*	*	*	40	45	60	65	6	D. 2	(Left) deposit to 6 in. ; (Right) healthy.
9	C. C.	57	20	60	25	65	35	70	55	65	10	L. 8	(Left) 2nd stage to 4 in. ; (Right) healthy.
10	D. L.	26	25	40	40	50	38	65	50	95	3	...	(Right) dry vomica to 3 in. ; (Left) deposit to 1½ in.
11	J. D.	42	20	50	25	60	50	100	60	100	4	...	(Right) 1st stage to 2 in. ; (Left) incipient deposit.
12	G. S.	25	20	65	50	95	50	95	75	125	1	D. 3	(Left) 1st stage to 3 in. ; (Right) healthy.
13	A. W. L.	54	50	40	50	42	40	50	68	60	2	L. 11	(Left) 1st stage to 1½ in. ; (Right) consolidation to 4 in. ; vomica at apex.
14	F. C.	25	20	50	40	40	75	80	60	75	7	D. 2	(Right) 1st stage to 2 in. ; (Left) consolidation to 4 in. ; vomica at apex.
15	J. G.	62	20	55	45	55	75	70	70	50	34	L. 2	(Left) formerly vomica, now no physical signs.
16	A. W.	29	15	50	50	25	70	60	100	60	4	D. 2	(Left) upper lobe, 2nd stage ; (Right) healthy.
17	T. R.	36	30	50	50	60	65	110	70	100	3	L. 2	(Left) 2nd stage to 1½ in. ; (Right) healthy.
18	F. A.	27	40	40	45	50	70	35	85	60	5	L. 5	(Left) consolidation of apex ; (Right) healthy.
19	W. C.	38	20	50	20	50	90	70	95	65	5	L. 7	(Left) formerly consolidation, now no physical signs.
20	G. L.	48	25	40	30	40	100	100	75	90	9	L. 8	(Left) consolidation to 2 in. ; (Right) incipient deposit at apex.
21	E. S.	17	55	80	80	90	60	90	80	100	1	L. 3	(Right) 1st stage at apex ; (Left) healthy.
22	J. T.	18	65	60	85	80	65	80	110	70	3	L. 2	(Right) 2nd stage to 2 in. ; (Left) deposit under clavicle.
23	J. P.	25	55	40	90	40	70	40	115	75	4	D. 4	(Left) deposit to 5 in., large cavity ; (Right) upper lobe, 2nd stage.
24	T. G.	61	35	70	55	60	70	95	85	100	1	D. 10	(Right) 1st stage to 2 in. ; (Left) healthy.
25	W. L.	27	50	80	75	100	95	100	110	120	2	L. 3	(Left) 1st stage to 2 in. ; (Right) healthy.

* Not taken. † The letter D. signifies that the patient died so many years after the examination ; L. that he was still living at the date of this paper.

TABLE VII.—*Phthisis. Acute Cases (Males). Chest movements in tenths of an inch.*

No.	Initials.	Age.	Clavicles.				3rd ribs.				Remarks.
			F.	U.	F.	U.	F.	U.	F.	U.	
1	D. W.	49	6	15	10	0	11	30	16	10	4 *months'* duration; (Left) extensive deposit in 3rd stage; (Right) incipient disease; died a few months afterwards.
2	J. G.	27	10	40	15	40	13	55	25	50	3 *months;* (Left) 2nd stage to 3 in.; (Right) 3rd stage to 1½ in.; died 18 months after.
3	J. P.	21	3	10	20	30	20	35	40	50	4 *months;* (Right) 3rd stage to 4 in.; (Left) incipient deposit; result uncertain.
4	I. K.	28	10	40	16	40	13	55	25	50	8 *months;* (Left) 3rd stage to 4 in.; (Right) vomica at apex; died in 16 months.
5	E. S.	21	15	10	35	30	5	5	45	40	1 *year;* (Right) 3rd stage, pneumothorax; (Left) healthy; died 1 year after.
6	J. H.	34	*	*	*	*	15	30	25	50	1½ *year;* (Right) 2nd stage to 4 in.; (Left) deposit to 1½ in.; died 4 months after.
7	J. M.	25	25	45	35	30	23	38	15	30	1 *year;* (Left) large vomica; (Right) 2nd stage to 4 in.; died in 1 year.
8	J. C.	28	15	30	20	35	25	40	30	50	16 *months;* laryngitis; (Left) 3rd stage to 6 in.; (Right) 2nd stage to 2 in.; died in 1 year.
9	S. E.	22	25	20	55	40	15	10	45	40	1½ *year;* (Right) 3rd stage; (Left) 2nd stage to 4 in.; died in 6 months.
10	W. C.	19	15	20	15	10	28	20	35	30	1½ *year;* (Left) 2nd stage to 4 in.; (Right) vomica at apex; died in 1 week, suddenly.
11	C. J.	67	15	15	15	13	30	45	35	45	3 *months;* (Right) 2nd stage to 3 in.; (Left) healthy; died in 3 months.
12	H. S.	22	12	15	20	35	28	50	30	60	4 *months;* (Left) 2nd stage to 2 in.; (Right) healthy; died in 9 months.
13	J. S.	52	20	30	30	40	30	37	35	40	6 *months;* (Left) 2nd stage to 4 in.; (Right) deposit at apex; died in 6 months.
14	J. W.	48	10	15	15	15	20	60	50	70	1 *year;* (Left) deposit to 4 in.; (Right) incipient deposit; living 4 months after
15	M. D.	36	10	15	15	20	30	50	20	30	1½ *year;* (Right) deposit to 1½ in.; (Left) to 6 in.; vomica at apex; died 1 year after.
16	D. L.	45	15	20	20	30	35	20	25	30	1 *year;* (Right) 3rd stage to 6 in.; (Left) 2nd to 2½ in.; died in 1 year.
17	W. C.	17	20	30	25	40	30	40	35	50	1½ *year;* (Left) 1st stage to 1½ in.; (Right) 2nd stage to 5 in.; vomica at apex; died a few months after.
18	C. D.	36	*	*	*	*	45	40	60	50	2 *years;* (Right) 3rd stage to 4 in.; (Left) 3rd stage to 3 in.; died in 2 months.
19	J. B.	30	30	50	45	60	35	70	50	70	(Left) 2nd stage to 5 in.; (Right) healthy; died in 18 months.
20	A. B.	19	35	40	45	50	10	10	50	50	1 *year;* (Right) consolidation vomica at apex; (Left) incipient deposit; died in a few months.

* Not taken.

TABLE VIII.—*Phthisis. Chronic Cases (Females). Chest movements in tenths of an inch.*

No.	Initials.	Age.	Clavicles.				3rd ribs.				Duration in years.†		Remarks.
			F.	U.	F.	U.	F.	U.	F.	U.	Before.	After.	
1	Mrs. J.	30	15	50	30	70	35	60	50	80	4	D. 1½	(Right) 2nd stage to 4 in. ; (Left) healthy.
2	„ B.	50	15	50	25	35	40	70	48	60	4	L. 10	(Right) 2nd stage to 2 in. ; (Left) healthy.
3	„ W.	25	15	80	43	80	30	130	45	120	8	L. 5	(Left) large vomica, pneumothorax ; (Right) healthy.
4	„ B.	32	18	45	37	54	40	60	67	80	3	D. 2	(Right) deposit to 5 in. ; vomica under 3rd rib ; (Left) incipient deposit.
5	„ S.	34	18	50	30	68	50	70	65	95	5½	L. 1	(Right) 2nd stage to 2 in. ; (Left) healthy.
6	E. G.	27	28	30	25	50	30	50	50	55	2	D. 2	(Left) 3rd stage to 4 in. ; (Right) incipient deposit.
7	F. J.	28	20	50	25	55	50	80	50	95	2½	D. 2	(Right) 1st stage to 3 in. ; (Left) healthy ; died of uterine hæmorrhage.
8	A. P.	30	20	30	25	50	33	80	60	80	1	L. 2	(Right) incipient deposit to 4 in. ; (Left) healthy.
9	L. G.	35	25	60	30	60	35	75	35	75	2	L. 8	(Left) deposit to 3 in. ; 2nd stage at apex ; (Right) healthy.
10	Mrs. D.	30	20	40	25	25	45	55	40	55	1½	L. 6	(Left) 1st stage to 1½ in. ; (Right) healthy.
11	S. W.	29	*	*	*	*	33	50	60	80	3	D. 2	(Left) large dry vomica ; (Right) incipient deposit at apex.
12	G. S.	28	20	70	30	70	35	100	50	100	10	L. 5	(Right) consolidation of apex ; (Left) healthy.
13	Mrs. S.	30	20	30	30	60	35	50	50	55	2	L. 8	(Right) consolidation to 3 in. ; (Left) healthy.
14	F. M.	23	20	60	40	70	63	50	63	50	1½	D. 3	(Right) consolidation to 2 in. ; (Left) healthy.
15	I. F.	20	30	30	40	38	70	70	55	60	8	D. 2	(Left) large dry vomica at back ; (Right) 1st stage to 3 in.
16	Mrs. W.	27	30	30	50	80	70	80	60	80	4	D. 2	(Right) softening to 4 in. ; (Left) incipient deposit to 1½ in.
17	„ G.	29	25	30	35	65	50	80	50	95	1	L. 6	(Left) deposit to 2 in., 2nd stage ; (Right) healthy.
18	J. F.	23	40	56	45	50	30	50	55	60	4	L. 1½	(Right) deposit to 2 in. ; vomica at apex ; (Left) healthy.
19	M. R.	23	30	70	58	90	75	100	60	100	2	L. 9	(Left) 1st stage to 2 in. ; (Right) healthy.
20	S. J.	25	40	60	50	60	45	65	85	80	3	L. 5	(Left) 2nd stage to 6 in. ; (Right) healthy.
21	S. K.	35	40	70	40	80	70	100	85	100	1	L. 5	(Left) incipient deposit to 2 in. ; frequent hæmoptysis ; (Right) healthy.
22	Mrs. J.	33	40	80	55	80	80	100	85	100	3	L. 7	(Right) deposit to 2 in., 2nd stage ; (Left) healthy.
23	„ S.	42	55	75	75	75	70	80	70	90	8	L. 1	(Right) consolidation of upper lobe ; (Left) healthy.
24	R. C.	20	78	95	75	95	80	110	100	130	2	D. 2½	(Right) consolidation to 3 in. ; (Left) healthy.
25	E. H.	36	50	120	60	120	63	130	85	135	1	L. 2	(Right) apex consolidated ; (Left) healthy.

* Not taken. † The letter D. signifies that the patient died so many years after the examination ; L. that she was still living at the date of this paper.

TABLE IX.—*Phthisis. Acute Cases (Females). Chest movements in tenths of an inch.*

No.	Initials.	Age.	Clavicles.				3rd ribs.				Duration.†		Remarks.
			F.	U.	F.	U.	F.	U.	F.	U.	Before.	After.	
1	S. G.	30	0	5	5	10	*	*	*	*	Doubtful	D. in 3 weeks	(Left) extensive deposit; vomica at apex; (Right) 2nd stage to 6 in.
2	Mrs. R.	39	0	10	30	30	*	*	*	*	8 months	D. 6 mos.	(Right) 3rd stage to 6 in.; (Left) incipient deposit.
3	M. S.	20	7	3	7	30	7	0	30	30	1 year	D. 1 mo.	(Right) 2nd stage throughout; (Left) incipient deposit.
4	B. H.	24	10	5	10	20	20	35	25	20	Doubtful	D. 6 mos.	(Left) deposit to 6 in.; vomica at apex; (Right) apex, 2nd stage.
5	B. C.	26	12	30	15	40	11	30	20	45	Origin uncertain	D. 3 mos.	(Right) 2nd stage to 4 in.; (Left) 3rd stage to 2 in.
6	J. T.	25	10	23	15	50	16	50	20	55	18 months	D. 5 mos.	(Right) 3rd stage to 4 in.; consolidation to 3 in.
7	M. R.	25	12	20	15	45	15	25	35	40	8 months	D. 6 mos.	(Left) deposit to 5 in. 3rd stage; (Right) 2nd stage to 2½ in.
8	M. H.	47	18	20	20	25	30	35	30	40	5 months	...	(Left) 2nd stage to 5 in.; (Right) 2nd stage to 3 in.; vomica at apex.
9	M. W.	33	12	20	30	20	30	20	35	35	Doubtful	D. 6 mos.	(Left) extensive deposit, 2nd stage; (Right) incipient deposit at apex.
10	M. R.	26	15	30	30	30	15	40	40	45	18 months	D. 6 mos.	(Right) 2nd stage to 4 in.; (Left) incipient deposit.
11	M. S.	45	10	25	35	60	30	50	75	80	3 months	D. 1 year	(Lft.) deposit to 3 in.; vomica under clavicle; (Rt.) healthy.
12	M. J.	38	15	28	25	40	25	50	35	60	2 years	D. 8 mos.	(Left) 2nd stage to 6 in.; (Right) incipient deposit at apex.
13	A. L.	36	15	30	30	60	40	70	35	85	1½ year	D. 6 mos.	(Left) deposit to 5 in., 2nd stage at apex; (Right) 2nd stage to 1 in.
14	E. J.	20	25	30	20	35	12	25	25	30	1½ year	Doubtful	(Left) deposit to 6 in., 3rd stage; (Right) 2nd stage to 4 in.; vomica at apex.
15	S. B.	25	20	60	25	50	30	60	50	65	2 months	D. 4 mos.	(Right) incipient deposit to 1 in.; (Left) 3rd stage at apex.
16	H. M.	20	25	30	45	50	17	30	40	50	5 months	D. 6 mos.	(Right) consolidation to 6 in.; vomica at apex; (Left) healthy.
17	C. H.	23	28	20	35	40	25	15	40	45	3 months	Doubtful	(Left) 2nd stage to 2 in.; (Right) healthy.
18	M. M.	29	35	30	45	35	30	40	45	50	4 months	D. 5 mos.	(Left) 2nd stage to 2½ in.; vomica at apex; (Right) 2nd stage to 1½ in.
19	A. M.	27	25	25	43	35	50	60	35	85	9 months	Uncertain	(Right) consolidation to 1½ in.; vomica at apex; (Left) 2nd stage throughout, except lower lobe behind.
20	M. M.	24	13	70	20	70	35	50	40	70	1½ year	D. 2 years	(Right) consolidation to 6 in., 2nd stage; (Left) healthy.

* Not taken. † The letter D. signifies that the patient died so many years after the examination.

TABLE X.—*Phthisis. Exceptional Cases.*

No.	Sex.	Initials.	Age.	Clavicles.				3rd ribs.				Duration.†		Remarks.
				F.	U.	F.	U.	F.	U.	F.	U.	Before.	After.	
1	F.	M. D.	16½	55	65	65	120	70	75	90	110	2	D. 1	(Left) 2nd stage to 2 in. ; (Right) incipient deposit.
2	F.	A. S.	16	50	50	45	55	50	60	75	65	1	D. 9 mos.	(Left) 2nd stage to 5 in.; vomica at apex behind ; (Right) healthy.
3	M.	D. H.	18	*	*	*	*	45	60	55	70	U.	U.	(Left) 1st stage at apex ; (Right) healthy.
4	F.	F. S.	16	*	*	*	*	40	40	55	45	6 mos.	D. 15 mos.	(Left) 2nd stage at apex ; (Right) healthy.
5	F.	F. A.	19	40	30	45	40	55	75	70	65	1	D. 11 mos.	(Left) 2nd stage to 5 in. ; (Right) healthy.
6	F.	A. G.	20	35	70	70	95	55	70	70	90	15 mos.	D. 7 mos.	(Right) deposit to 2 in. ; (Left) incipient deposit ; D. of acute tubercle.
7	M.	J. A.	20	25	45	25	60	35	70	45	70	1½	D. 1	(Left) 2nd stage to 3 in. ; (Right) incipient deposit to 1 in.
8	M.	F. B.	11	35	45	35	45	70	90	90	100	U.	U.	(Right) 2nd stage ; (Left) 2nd stage.
9	M.	P. E.	15	15	40	25	45	65	100	80	130	15 mos.	U.	(Right) upper lobe consolidated ; vomica at apex ; (Left) healthy.
10	M.	J. S.	27	*	*		*	80	90	85	105	1½	D. 15 mos.	(Left) 1st stage to 3 in. ; (Right) healthy ; D. of hæmorrhage.
11	M.	D. M.	26	55	50	55	40	95	85	95	100	1½	U.	(Right) 2nd stage to 7 in. ; (Left) vomica at apex (syphilis).
12	M.	H.M.	24	*	*	*	*	60	70	70	90	1	D. 1½	(Left) 2nd stage to 4 in. ; (Right) healthy ; D. of hæmorrhage.

* Not taken. † The letter D. signifies that the patient died so many years after the examination ; U. that the duration was somewhat uncertain.

CHAPTER XVI.

PROFESSOR DRACHMANN ON STETHOMETRY.

IT is always interesting to note the results of other independent observers, especially on a subject which involves much careful research. Also, the larger the body of facts from which conclusions are drawn, the greater will be our confidence in their correctness.

I am fortunate therefore in being able to give independent testimony to the value of Stethometry from the observations of Professor Drachmann, of Copenhagen, who has now for some years carried on researches with my 3-plane stethometer, and who has published a paper on the subject.[1]

Professor Drachmann has used this instrument in the wards of the Copenhagen Infirmary, and gives the results in 150 consumptive patients and other persons affected by emphysema and empyema.

Many of the cases were those of female children, but many healthy individuals of both sexes were also examined.

He publishes five tables. The first giving the dimensions of the chest movements in healthy people; the second, in cases of incipient phthisis; the third, of patients suffering

[1] "Om Stetometri," *Aftryk fra Nord. Med. Arkiv.* 1880. Bind xii. Nr. 25. I am indebted to Dr. Lindeman of the Owens College Medical Library for a translation of this work.

from phthisis in all its stages; the fourth, of cases of other chronic diseases of the chest; and the fifth, of female children who had gone through a shorter or longer course of "developmental gymnastics." All the measurements are given in millimetres, and this fact must be remembered in comparing his tables with my own.

From these data, amongst other things, he draws the following conclusions, which are of special interest in the present investigation.

1. As to the general dimensions of chest movement in phthisis :—

"However great may be the individual differences of motion in healthy persons, the stethometric measurements, taken as a whole, though not always greater in each dimension, yet generally far surpass those found in consumptive patients, even in the initial stage of this disease."

As instances he gives the following highest and lowest measurements met with in the healthy and the consumptive groups respectively :—

Cases.	Direction.	Dimensions in Millimetres.		
		Mid-Sternum.	3rd ribs.	
			Right.	Left.
B. D. Healthy, æt. 17	F.	38	38	34
	U.	36	36	34
	O.	—	7	7
Chas. S., æt. 21. Incipient phthisis	F.	35	30	27
	U.	33	32	20
	O.	—	8	6
Niels, J., æt. 37. Healthy... ...	F.	25	19	29
	U.	25	29	29
	O.	—	7	9
Hascoe, J., æt. 30. Incipient phthisis	F.	12	12	20
	U.	18	17	17
	O.	—	5	5

Respecting children he also cites the following two cases :—

Cases.	Direction.	Mid-Sternum.	3rd ribs.	
			Right.	Left.
Martha D., æt. 12. Healthy ...	F.	42	35	40
	U.	37	40	36
	O.	—	16	12
Ingeborg, N., æt. 12. Phthisis of several months' duration (incipient)	F.	6	8	17
	U.	8	12	18
	O.	—	2	10

Respecting these cases he remarks : " The first of these cases of incipient phthisis stands quite alone, with regard to the magnitude of the numbers obtained amongst the many cases of phthisis that I have examined, and were the differences between the right and left sides not so considerable (17) I should have doubted the correctness of the diagnosis. This case is remarkable in another respect, for it is the rule to find the numbers on the healthy side diminished whenever there is the smallest affection on the other.

" In more advanced cases of phthisis the decrease in the magnitude of the numbers is so considerable, and consequently the alteration in the extension of the thoracic movements is so great, that a glance at the respective tables will make it apparent. This relatively rapid decrease in the mobility of the chest wall seems to be characteristic of phthisical disease.

" I leave undecided," he says, " the question whether the diminution is produced by a weakness " (paralysis ?) " of the respiratory muscles, a weakness accompanying the pathological process, and dependent on deterioration of the constitution, or by pathological changes in the lung tissue impeding its distension during inspiration and depriving it of its elasticity during expiration ; being, therefore, a purely secondary symptom depending on purely physical causes."

Professor Drachmann then remarks upon the value of stethometry as an additional physical sign of the presence of disease, and even as an evidence of a proclivity to disease.

"What has struck me in my stethometrical observations has been the rather frequent difference between the stethoscopic and the stethometric result. Thus it not seldom happened that the stethoscopic examination scarcely indicated any change in either apex, or in both; whilst the stethometer showed a very considerable diminution in the dimensions of the thoracic movements in all directions.

"On the other hand, when the stethoscope showed extensive changes in the lung tissue, the indications of the stethometer fully bore them out.

"Now as the stethometer gives its answer in an absolute and purely objective manner, one of two conclusions must be right. Either the stethoscope does not indicate the existing changes in their full extent, or there must be other causes acting, which lie outside the working power of the stethoscope. Only thus can this discord between the results be explained. On other occasions both stethoscope and stethometer agree, for instance, to indicate which of the two apices is the most affected. Therefore, whenever there are two conflicting medical opinions, the stethometer must be consulted and its answer taken as decisive.

"It may be asked again what importance has stethometry with regard to diagnosis, and is it possible, by means of the stethometer, to diagnose an incipient phthisis, sooner than by means of the stethoscope?

"The answer is that the present observations, compared with those made by Dr. Ransome, seem to indicate that science has indeed obtained in the stethometer an instrument which, when handled with the necessary judgment, will always be capable of affording a precious contribution

for judging of the true condition of the respiratory mechanism, and for enlightening our diagnosis—an instrument which was heretofore lacking, and which certainly is not to be looked upon as an inconsiderable gain.

"As to the last question, whether phthisis may be more readily diagnosed by means of a stethometric examination than by means of the stethoscope, I have only to say that my observations have been for the most part gathered in the hospital wards, which, as is well known, are frequented by consumptive patients in the more advanced stages of the disease, and that they are too few to allow of definite conclusions being drawn. One case, however, the first that I had occasion to observe, and which is interesting in more than one respect, may be cited as an illustration.

"A girl, 22 years of age, with quite a blooming countenance, though somewhat anæmic and nervous, had lately been affected with a dry cough, coming on in fits, and she was sent by her physician, a well-known clinician, to my institution, in order to follow a course of gymnastics, chiefly on account of her nervous disorder. Shortly before she had been subjected to a very minute stethoscopic examination with an entirely negative result.

"After a sojourn of about a month in the institution, during which time she had felt very well, she was reweighed, and I was surprised to find, that contrary to rule, she had considerably lost weight. She was forthwith submitted to a stethometric examination, and the following numbers were found :—

Direction.	Mid-Sternum.	3rd ribs.	
		Right.	Left.
F.	18	18	19
U.	7	11	8
O.	16	5	6

which when compared with the numbers obtained in healthy individuals will be found to be extremely low. I communicated the result of my examination to her physician, with the remark that Dr. Ransome took a very unfavourable view of the prognosis in incipient phthsis when, at an early period, such low numbers were met with.

"The stethoscopic examination, immediately made by her physician, showed evident signs of condensation in the left upper lobe; and she died some six months after of a somewhat rapid phthisis.

"I can throw no light on the subsequent history of those patients whom I examined in hospital, as the greater number of them either came in only to die, or left as soon as the disease was arrested or they were relieved, after which they were lost to sight. I think in this direction there is a large field for further research.

"As a supplement to this question, I may mention that in not a few individuals whom I have examined and taken as healthy, I have found either rather low numbers relatively, or not inconsiderable deviations in the magnitudes on the two sides of the chest. (Dr. Ransome states that in health it is usual to get a somewhat higher reading in females on the left, and in males on the right side.) Such persons usually bore a healthy and vigorous appearance, and were well fed; but upon more minutely interrogating them, I found, with scarcely an exception, that they were either of phthisical descent, or had shown, at an earlier period of their lives, some symptoms of phthisis, hæmoptysis, &c. Several such persons appear in the tables amongst the healthy, whereas their true place would rather be amongst the suspect."

CHAPTER XVII.

ON THE IMPORTANCE OF CHEST MEASUREMENTS IN EXAMINATIONS FOR LIFE ASSURANCE.

THE subject of prognosis in disease is closely connected with that of the fitness of candidates for life assurance. In some offices, indeed, lives that are acknowledged to be to some extent diseased, are admitted upon the payment of an extra premium, proportioned to the medical examiner's opinion as to the probable shortening of life due to the disease. In such cases the remarks that have already been made upon the indications afforded by the stethometer in various lung-diseases will show the importance of this additional aid to our judgment.

In many cases of chronic bronchitis, for instance, when the candidate presents himself in an interval of the disorder, the extent to which the lungs and other structures have been organically affected by it may be better ascertained by chest measurement, and by the use of the spirometer, than by any other method of physical examination. The same remark applies to asthma and emphysema.

In persons who have been subject to pleurisy, the presence of permanent adhesions can perhaps be demonstrated in no other way, and the observations that have been recorded, as to the after-life history of such persons,

show clearly how important it is to ascertain the relative degree of mobility of the chest wall on the healthy and on the diseased side.

With regard to phthisis, it is hardly likely that at the present day any office would accept at any premium the life of a person who had at any time shown symptoms of the presence of this disease. Yet the tables that I have now brought forward show that it would be possible to calculate the risk at a remunerative rate for a certain number of the chronic group of cases, and, in the calculation, the degree of mobility and the peculiarities of movement of the chest wall would have to be taken into account.

In any case the use of the stethometer would be an important aid in the detection of disease in the chest, and it would sometimes place a very different aspect upon the account that may have been given by the candidate of an attack of so-called bronchitis or catarrh. As I have already said, I know no means of discovering the presence of pleuritic adhesions so certain as the use of this instrument, and in the detection of incipient tubercular disease it is almost unerring in the adult, and is a valuable aid to diagnosis.

There are also, in addition to actually diseased lives, many other cases in which the stethometer is of service in revealing an extent of constitutional debility that ought to render the candidate ineligible for assurance. When no other physical signs of disease can be discovered there may be found sufficient warning in the abnormal weakness of the chest movements.

The following instances may serve to show the truth of the above remarks :—

1. C. F.—A girl, aged nineteen ; a brother had died of phthisis, and there was some other evidence of hereditary

predisposition to this disease. She had been losing flesh for some weeks and was dyspeptic, but there was no pyrexia, and no trace of thoracic mischief could be discerned by percussion and auscultation, either by myself or by an eminent Manchester physician, who saw her with me. The stethometric register in June, 1872, was as under :—

	Sternum.		Clavicles.		3rd ribs.	
	Upper.	Mid.	Right.	Left.	Right.	Left.
Forward ...	30	40	35	45	65	50
Upward ...	50	60	40	53	70	50
Outward ..	—	—	—	—	10	7

The small extent of movement in the upper part of the chest, and especially the defective working of the right clavicle and of the left 3rd rib, showed me that the case was one of much gravity, and the records enabled me to speak more decidedly to her friends than I could have done judging from the family history alone.

It was somewhat remarkable that shortly after this, in consequence of means taken to improve her nutrition (notably, nutritive enemata), she gained flesh and strength, and seemed to be about to falsify the diagnosis given, but about the month of August, 1873, hæmoptysis set in ; there was tubercular consolidation, first of the right, and then of the left apex, and she died in May, 1874. The post-mortem examination revealed extensive miliary deposits both in the lungs and in the abdominal organs.

A similar case is that of J. H., æt. 46, a clerk in a bank. He presented himself for examination in March, 1880, and although he was a thin, delicate-looking man, his family history was good, and the physical examination of his

chest revealed no evidence of disease. His stethometric register was as follows :—

	Clavicles.		3rd ribs.	
	Right.	Left.	Right.	Left.
Forward ..	30	30	45	45
Upward ...	40	40	70	60

There was also nothing in the comparative movements of the two sides to indicate the presence of disease. The small extent of power of motion, however, for a man of his age and height (5 feet 8 inches) caused me to look upon his life with suspicion, and to reject him. Eighteen months afterwards I heard that he had died in the south of France of acute tuberculosis. Under this head I may also refer to the case recorded by Prof. Drachmann at p. 90.

Stethometry is also frequently of service in supplementing the examination of the chest by other methods, and has several times in my own experience directed attention to the presence of incipient disease which might otherwise have been overlooked.

Thus in a case of pleurisy on the left side in a male, æt. 27, measurements were taken without suspicion of any further disease ; but the following register showed a deficiency of movement on the opposite side of the chest under the clavicle and third rib, and a more careful examination with the stethoscope revealed the presence of incipient tubercular deposit on that side.

The measurements were taken three months after the onset of the pleuritic attack.

Direction of movement.	Sternum.			Clavicles.		3rd ribs.		5th ribs.	
	Upp.	Mid.	Lwr.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
Forward ...	60	110	70	55	65	95	105	95	95
Upward ...	70	65	60	45	70	75	65	70	60
Outward ...	—	—	—	—	—	—	—	70	50

In not a few instances also, the effects of a previous attack of disease upon the movable structures of the chest last many years after all other physical signs have passed away. The stethometer is then sometimes a more sensitive test than any other means of examination. In the following examples there can be little doubt that at some time or other phthisical consolidation had existed in the lungs. Statements to that effect had in every instance been made by men who are justly regarded as masters of physical diagnosis, and yet when these cases came to be examined by percussion and auscultation, no symptom could be discovered showing the existence of disease. The stethometer alone showed that the lung affection had left a more permanent impression upon the hard than upon the soft structures of the thorax.

Case.	Direction.	Sternum.		Clavicles.		3rd ribs.		5th ribs.	
		Up.	Mid.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
Male, æt. 60. Thirty years before had vomica at apex of right lung ...	F.	10	30	15	20	35	30	—	—
	U.	15	30	30	30	30	30	—	—
Female, æt. 30. Two years ago consolidation under left clavicle ...	F.	25	25	25	22	—	—	40	45
	U.	25	20	40	30	—	—	55	50
Male, æt. 62. Thirty years ago softening tubercle at apex of left lung ...	F.	55	90	45	20	75	75	68	75
	U.	90	116	110	100	100	120	100	130

It is hardly necessary to point the moral of these instances. Stethometry must be valuable, since in examinations for Life Assurance, as we have seen (1) it points to predisposition to disease (2) it assists in the detection of incipient tubercle, and (3) it shows the effects of previous affections long after other physical signs have disappeared.

INDEX.

M.

P.

R.

S.

T.

V.

LONDON: R. CLAY, SONS, AND TAYLOR, BREAD STREET HILL.

BEDFORD STREET, COVENT GARDEN, LONDON,
June, 1882

MACMILLAN & CO.'S MEDICAL CATALOGUE.

WORKS in PHYSIOLOGY, ANATOMY, ZOOLOGY, BOTANY, CHEMISTRY, PHYSICS, MIDWIFERY, MATERIA MEDICA, and other Professional Subjects.

ALLBUTT (T. C.)—ON THE USE OF THE OPHTHALMOSCOPE in Diseases of the Nervous System and of the Kidneys; also in certain other General Disorders. By THOMAS CLIFFORD ALLBUTT, M.A., M.D., Cantab., Physician to the Leeds General Infirmary, Lecturer on Practical Medicine &c., &c. 8vo. 15*s.*

ANDERSON.—Works by DR. MCCALL ANDERSON, Professor of Clinical Medicine in the University of Glasgow, and Physician to the Western Infirmary and to the Wards for Skin Diseases.

ON THE TREATMENT OF DISEASES OF THE SKIN: with an Analysis of Eleven Thousand Consecutive Cases. Crown 8vo. 5*s.*

LECTURES ON CLINICAL MEDICINE. With Illustrations. 8vo. 10*s.* 6*d.*

ON THE CURABILITY OF ATTACKS OF TUBERCULAR PERITONITIS AND ACUTE PHTHISIS (Galloping Consumption). Crown 8vo. 2*s.* 6*d.*

ANSTIE.—ON THE USE OF WINES IN HEALTH & DISEASE. By F. E. ANSTIE, M.D., F.R.S., late Physician to Westminster Hospital, and Editor of *The Practitioner*. Crown 8vo. 2*s.*

ASHHURST.—THE INTERNATIONAL ENCYCLOPÆDIA OF SURGERY. A Systematic Treatise on the Theory and Practice of Surgery by Authors of Various Nations. Edited by JOHN ASHHURST, Jun., M.D., Professor of Clinical Surgery in the University of Pennsylvania. Illustrated with Chromo-lithographs and Wood Engravings. In Six Volumes. Royal 8vo. 31*s.* 6*d.* each.

*** *In Quarterly Volumes. Vol. I. January*, 1882.

Contents of the Volumes.

VOL. I.—General Surgery. Operative, Minor, and Plastic Surgery. Amputations.

VOL. II.—Injuries and Diseases which may occur in any part of the body. Venereal Diseases, Injuries and Diseases of Various Tissues of the Body.

VOL. III.—Injuries and Diseases of the Nerves, Blood-Vessels, and Bones.

VOL. IV.—Injuries and Diseases of the Joints. Excisions and Resections. Treatment of Deformities. Injuries and Diseases of various Regions of the Body.

VOL. V.—Regional Surgery, continued.

VOL. VI.—Regional Surgery, concluded. History of Surgery. Appendix. General Index to the whole of the Six Volumes.

BALFOUR.—Works by F. M. BALFOUR, M.A., F.R.S., Fellow and Lecturer of Trinity College, Cambridge.

ELASMOBRANCH FISHES; a Monograph on the Development of. With Plates. 8vo. 21*s.*

A TREATISE ON COMPARATIVE EMBRYOLOGY. With Illustrations. Demy 8vo. Vol. I. 18*s.* Vol. II. 21*s.*

BARWELL.—Works by RICHARD BARWELL, F.R.C.S., Surgeon and ate Lecturer on Anatomy at the Charing Cross Hospital.

ON CURVATURES OF THE SPINE: their Causes and Treatment. Third Edition, with additional Illustrations. Crown 8vo. 5*s.*

ON ANEURISM: especially of the Thorax and Root of the Neck. With Illustrations. Crown 8vo. 3*s.* 6*d.*

A TREATISE ON DISEASES OF THE JOINTS. Illustrated. With numerous Engravings on Wood. Second Edition, Revised and much Enlarged. Demy 8vo. 16*s.*

1,000.

BASTIAN.—Works by H. CHARLTON BASTIAN, M.D., F.R.S., Professor of Pathological Anatomy in University College, London, &c.

THE BEGINNINGS OF LIFE: Being some Account of the Nature, Modes of Origin, and Transformations of Lower Organisms. In Two Volumes. With upwards of 100 Illustrations. Crown 8vo. 28*s.*

EVOLUTION AND THE ORIGIN OF LIFE. Crown 8vo. 6*s.* 6*d.*

ON PARALYSIS FROM BRAIN DISEASE IN ITS COMMON FORMS. Illustrated. Crown 8vo. 10*s.* 6*d.*

BRODIE.—IDEAL CHEMISTRY. A Lecture, by Sir B. C. BRODIE, Bart., D.C.L., F.R.S., Professor of Chemistry in the University of Oxford. Crown 8vo. 2*s.*

BROWNE.—WATER SUPPLY. By J. H. BALFOUR BROWNE, Registrar to Railway Commissioners, &c. Crown 8vo. 2*s.* 6*d.*

BRUNTON.—Works by T. LAUDER BRUNTON, M.D., F.R.S., Assistant-Physician and Lecturer on Materia Medica at St. Bartholomew's Hospital.

PHARMACOLOGY AND THERAPEUTICS: or Medicine Past and Present. Crown 8vo. 6*s.*

TABLES OF MATERIA MEDICA. A Companion to the Materia Medica Museum. 8vo. 10*s.* 6*d.*

BUCKNILL.—Works by J. C. BUCKNILL, M.D. Lond., F.R.S., F.R.C.P., late Lord Chancellor's Visitor of Lunatics.

HABITUAL DRUNKENNESS AND INSANE DRUNKARDS. Cr. 8vo. 2*s.* 6*d.*

THE CARE OF THE INSANE AND THEIR LEGAL CONTROL. Cr. 8vo. 3*s.* 6*d.*

CALDERWOOD.—The Relations of Mind and Brain. By H. CALDERWOOD, LL.D., Professor of Moral Philosophy in the University of Edinburgh. 8vo. 12*s.*

CARTER.—Works by R. BRUDENELL CARTER, F.R.C.S., Ophthalmic Surgeon to St. George's Hospital, &c.

A PRACTICAL TREATISE ON DISEASES OF THE EYE. With Illustrations. 8vo. 16*s.*

"No one will read Mr. Carter's book without having both his special and general knowledge increased."—*Lancet.*

ON DEFECTS OF VISION WHICH ARE REMEDIABLE BY OPTICAL APPLIANCES. Lectures at the Royal College of Surgeons. With numerous Illustrations. 8vo. 6*s.*

EYESIGHT, GOOD AND BAD: a Treatise on the Exercise and Preservation of Vision. With Illustrations. Crown 8vo. 6*s.*

CHRISTIE.—CHOLERA EPIDEMICS IN EAST AFRICA. An Account of the several Diffusions of the Disease in that country from 1821 till 1872, with an Outline of the Geography, Ethnology, and Trade Connections of the Regions through which the Epidemics passed. By J. CHRISTIE, M.D., late Physician to H.H. the Sultan of Zanzibar. With Maps. 8vo. 15*s.*

COOKE (JOSIAH P., Jun.).—FIRST PRINCIPLES OF CHEMICAL PHILOSOPHY. By JOSIAH P. COOKE, Jun., Ervine Professor of Chemistry and Mineralogy in Harvard Coll. New and Revised Edition. Demy 8vo. 16*s.*

CREIGHTON.—Works by CHARLES CREIGHTON, M.D., Demonstrator of Anatomy in the University of Cambridge.

CONTRIBUTIONS TO THE PHYSIOLOGY AND PATHOLOGY OF THE BREAST AND ITS LYMPHATIC GLANDS. With Illustrations. 8vo. 9*s.*

BOVINE TUBERCULOSIS IN MAN: AN ACCOUNT OF THE PATHOLOGY OF SUSPECTED CASES. With six Plates and other Illustrations. 8vo. 8*s.* 6*d.*

FLEISCHER.—A SYSTEM OF VOLUMETRIC ANALYSIS. By Dr. EMIL FLEISCHER. Translated, with Notes and Additions, from the Second German Edition, by M. M. PATTISON MUIR, F.R.S.E., Assistant Lecturer on Chemistry, in the Owens College, Manchester. With Illustrations. Crown 8vo. 7*s.* 6*d.*

FLOWER (W. H.).—AN INTRODUCTION TO THE OSTEOLOGY OF THE MAMMALIA. Being the substance of the Course of Lectures delivered at the Royal College of Surgeons of England in 1870. By W. H. FLOWER, F.R.S., F.R.C.S., Hunterian Professor of Comparative Anatomy and Physiology. With numerous Illustrations. Second Edition, revised and enlarged. Crown 8vo. 10*s.* 6*d.*

FLÜCKIGER and HANBURY.—Pharmacographia : a History of the Principal Drugs of Vegetable Origin met with in Great Britain and India. By F. A. FLÜCKIGER, M.D., and D. HANBURY, F.R.S. Second Edition, revised. 8vo. 21*s.*

FOSTER.—Works by MICHAEL FOSTER, M.D., F.R.S.

A TEXT BOOK OF PHYSIOLOGY, for the use of Medical Students and others. Third Edition revised, with Plates. 8vo. 21*s.*

"Dr. Foster has combined in this work the conflicting desiderata in all text-books—comprehensiveness, brevity, and clearness. After a careful perusal of the whole work we can confidently recommend it, both to the student and the practitioner as being one of the best text-books on physiology extant."—*Lancet.*

A PRIMER OF PHYSIOLOGY. Illustrated. 18mo. 1*s.*

FOSTER and LANGLEY.—AN ELEMENTARY COURSE OF PRACTICAL PHYSIOLOGY. By MICHAEL FOSTER, M.D., F.R.S., assisted by J. N. LANGLEY, B.A. Fourth Edition, enlarged. Crown 8vo 6*s.*

"Equipped with a text-book such as this . . . . the beginner cannot fail to acquire a real, though of course elementary, knowledge of the leading facts and principles of physiology."—*Academy.*

FOTHERGILL. — Works by J. MILNER FOTHERGILL, M.D., M.R.C.P., Assistant Physician to the Victoria Park Chest Hospital, and to the West London Hospital.

THE PRACTITIONER'S HANDBOOK OF TREATMENT : or, THE PRINCIPLES OF RATIONAL THERAPEUTICS. Second Edition, enlarged. 8vo. 16*s.*

"We have every reason to thank the author for a practical and suggestive work. —*Lancet.*

THE ANTAGONISM OF THERAPEUTIC AGENTS, AND WHAT IT TEACHES. The Essay to which was awarded the Fothergillian Gold Medal of the Medical Society of London for 1878. Crown 8vo. 6*s.*

FOOD FOR THE INVALID, THE CONVALESCENT, THE DYSPEPTIC, AND THE GOUTY. Crown 8vo. 3*s.* 6*d.*

FOX.—Works by WILSON FOX, M.D. Lond., F.R.C.P., F.R.S., Holme Professor of Clinical Medicine, University College, London, Physician Extraordinary to her Majesty the Queen, &c.

DISEASES OF THE STOMACH : being a new and revised Edition of "THE DIAGNOSIS AND TREATMENT OF THE VARIETIES OF DYSPEPSIA." 8vo. 8*s.* 6*d.*

ON THE ARTIFICIAL PRODUCTION OF TUBERCLE IN THE LOWER ANIMALS. With Coloured Plates. 4to. 5*s.* 6*d.*

ON THE TREATMENT OF HYPERPYREXIA, as illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo. 2*s.* 6*d.*

GALTON (D.).—AN ADDRESS ON THE GENERAL PRINCIPLES WHICH SHOULD BE OBSERVED IN THE CONSTRUCTION OF HOSPITALS. By DOUGLAS GALTON, C.B., F.R.S. Crown 8vo. 3*s.* 6*d.*

GAMGEE.—A TEXT-BOOK OF THE PHYSIOLOGICAL CHEMISTRY OF THE ANIMAL BODY, including an Account of the Chemical Changes occurring in Disease. By ARTHUR GAMGEE, M.D., F.R.S., Professor in the Victoria University, Manchester; Brackenburg Professor of Physiology in Owens College. With Illustrations. Volume I. 8vo. 18*s*.

[*Vol. II. in the Press.*

GEGENBAUR.—ELEMENTS OF COMPARATIVE ANATOMY. By CARL GEGENBAUR, Professor of Anatomy and Director of the Anatomical Institute, Heidelberg. A translation by F. JEFFREY BELL, B.A., revised, with Preface by E. RAY LANKESTER, M.A., F.R.S., Professor of Zoology and Comparative Anatomy in University College, London. With numerous Illustrations. Medium 8vo. 21*s*.

GRAY.—STRUCTURAL BOTANY; or, Organography on the basis of Morphology. To which is added the Principles of Taxonomy and Phytography, and a Glossary of Botanical Terms. By ASA GRAY, LL.D., &c. With Illustrations. 8vo. 10*s*. 6*d*.

GRIFFITHS.—LESSONS ON PRESCRIPTIONS AND THE ART OF PRESCRIBING. By W. HANSEL GRIFFITHS, Ph.D., L.R.C.P.E. New Edition. 18mo. 3*s*. 6*d*.

"We recommend it to all students and junior members of the profession who desire to understand the art of prescribing."—*Medical Press.*

HANBURY.—SCIENCE PAPERS, chiefly Pharmacological and Botanical. By DANIEL HANBURY, F.R.S. Edited with Memoir by JOSEPH INCE, F.L.S., F.C.S. 8vo. 14*s*.

HOOD (Wharton.).—ON BONE-SETTING (so-called), and its Relation to the Treatment of Joints Crippled by Injury, Rheumatism, Inflammation, &c., &c. By WHARTON P. HOOD, M.D., M.R.C.S. Illustrated Crown 8vo. 4*s*. 6*d*.

"Dr. Hood's book is full of instruction, and should be read by all surgeons."—*Medical Times.*

HOOKER (Dr.).—THE STUDENT'S FLORA OF THE BRITISH ISLANDS. By Sir J. D. HOOKER, K.C.S.I., C.B., M.D., D.C.L., President of the Royal Society. Second Edition, revised and corrected. Globe 8vo. 10*s*. 6*d*.

HUMPHRY.—Works by G. M. HUMPHRY, M.D., F.R.S., Professor of Anatomy in the University of Cambridge, and Honorary Fellow of Downing College.

THE HUMAN SKELETON (including the Joints). With 260 Illustrations drawn from Nature. Cheaper Issue. Medium 8vo. 14*s*.

OBSERVATIONS IN MYOLOGY. Illustrated. 8vo. 6*s*.

THE HUMAN FOOT AND HAND. Illustrated. Fcap. 8vo. 4*s*. 6*d*.

THE HUNTERIAN ORATION, 1879. 8vo. 2*s*. 6*d*.

HUXLEY and MARTIN.—A COURSE OF PRACTICAL INSTRUCTION IN ELEMENTARY BIOLOGY. By T. H. HUXLEY, LL.D. Sec. R.S., assisted by H. N. MARTIN, M.B., D.Sc. New Edition, revised. Crown 8vo. 6*s*.

"To intending medical students this book will prove of great value."—*Lancet.*

HUXLEY.—Works by Professor T. H. HUXLEY, LL.D., F.R.S.

LESSONS IN ELEMENTARY PHYSIOLOGY. With numerous Illustrations. New Edition. Fcap. 8vo. 4*s*. 6*d*.

PHYSIOGRAPHY: an Introduction to the Study of Nature. With Coloured Plates and Woodcuts. Cheaper Edition. Crown 8vo. 6*s*.

KEETLEY.—THE STUDENT'S GUIDE TO THE MEDICAL PROFESSION. By C. B. KEETLEY, F.R.C.S., Assistant Surgeon to the West London Hospital. With a Chapter for Women Students. By Mrs. GARRETT ANDERSON. Crown 8vo. 2*s*. 6*d*.

KÜHNE.—ON THE PHOTOCHEMISTRY OF THE RETINA AND ON VISUAL PURPLE. Translated from the German of Dr. KÜHNE, and Edited, with Notes, by MICHAEL FOSTER, M.D., F.R.S. 8vo. 3*s.* 6*d.*

LANDAUER.—Blowpipe Analysis. By J. LANDAUER, Authorised English Edition by JAMES TAYLOR, and W. E. KAY of the Owens College, Manchester. With Illustrations. Extra fcap. 8vo. 4*s.* 6*d.*

LANKESTER.—COMPARATIVE LONGEVITY IN MAN AND THE LOWER ANIMALS. By E. RAY LANKESTER B.A. Crown 8vo 4*s.* 6*d.*

LEISHMAN.—A SYSTEM OF MIDWIFERY, including the Diseases of Pregnancy and the Puerperal State. By WILLIAM LEISHMAN. M.D., Regius Professor of Midwifery in the University of Glasgow: Physician to the University Lying-in Hospital: Fellow and late Vice-President of the Obstetrical Society of London, &c., &c. Illustrated. Third Edition, revised, 8vo. 21*s.*

MACLAGAN.—THE GERM THEORY APPLIED TO THE EXPLANATION OF THE PHENOMENA OF DISEASE. By T. MACLAGAN, M.D. 8vo. 10*s.* 6*d.*

"We think it well that such a book as this should be written. It places before the reader in clear and unmistakable language what is meant by the germ theory of disease."—*Lancet.*

MACNAMARA.—Works by C. MACNAMARA, F.C.U., Surgeon to Westminster Hospital.

A HISTORY OF ASIATIC CHOLERA. Crown 8vo. 10*s.* 6*d.*

"A very valuable contribution to medical literature, and well worthy of the place which it is sure to assume as the standard work on the subject."—*Medical Examiner*

DISEASES OF BONE.—CLINICAL LECTURES. Crown 8vo. 5*s.*

MACPHERSON.—Works by JOHN MACPHERSON, M.D.

THE BATHS AND WELLS OF EUROPE: their Action and Uses. With Notices of Climatic Resorts and Diet Cures. With a Map. New Edition, revised and enlarged. Extra fcap. 8vo. 6*s.* 6*d.*

OUR BATHS AND WELLS: The Mineral Waters of the British Islands. With a List of Sea-Bathing Places. Extra fcap. 8vo. 3*s.* 6*d.*

MANSFIELD (C. B.).—A THEORY OF SALTS. A Treatise on the Constitution of Bipolar (two-membered) Chemical Compounds. By the late CHARLES BLACHFORD MANSFIELD. Crown 8vo. 14*s.*

MAUDSLEY.—Works by HENRY MAUDSLEY, M.D., Professor of Medical Jurisprudence in University College, London.

BODY AND MIND: An Inquiry into their Connection and Mutual Influence, specially in reference to Mental Disorders: being the Gulstonian Lectures for 1870, delivered before the Royal College of Physicians. New Edition, with Psychological Essays added. Crown 8vo. 6*s.* 6*d.*

THE PHYSIOLOGY OF MIND. Being the First Part of a Third Edition, revised, enlarged, and in great part re-written, of "The Physiology and Pathology of Mind." Crown 8vo. 10*s.* 6*d.*

THE PATHOLOGY OF MIND. Being the Third Edition of the Second Part of "The Physiology and Pathology of Mind," recast, enlarged, and re-written. 8vo. 18*s.*

MIALL.—STUDIES IN COMPARATIVE ANATOMY.

No. I.—The Skull of the Crocodile. By L. C. MIALL, Professor of Biology in the Yorkshire College of Science. 8vo. 2*s.* 6*d.*

No. II.—The Anatomy of the Indian Elephant. By L. C. MIALL and F. GREENWOOD, Curator of the Leeds School of Medicine. Illustrated. 8vo. 5*s.*

MIVART (St. George).—Works by ST. GEORGE MIVART, F.R.S., &c., Lecturer on Comparative Anatomy at St. Mary's Hospital.

ON THE GENESIS OF SPECIES. Second Edition, to which Notes have been added in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo. 9*s.*

MIVART (St. George) *continued*—

LESSONS IN ELEMENTARY ANATOMY. With upwards of 400 Illustrations. New Edition. Fcap. 8vo. 6*s*. 6*d*.

"It may be questioned whether any other work on anatomy contains in like compass so proportionately great a mass of information."—*Lancet*.

M'KENDRICK.—OUTLINES OF PHYSIOLOGY IN ITS RELATIONS TO MAN. By JOHN GRAY M'KENDRICK, M.D., F.R.S.E., Professor of the Institute of Medicine and Physiology in the University of Glasgow. Illustrated. Crown 8vo. 12*s*. 6*d*.

MUIR.—PRACTICAL CHEMISTRY FOR MEDICAL STUDENTS. Specially arranged for the first M. B. Course. By M. M. PATTISON MUIR, F.R.S.E., Prælector in Chemistry, Caius College, Cambridge. Fcap. 8vo. 1*s*. 6*d*.

"This little book will aid the student not only to pass his professional examination in practical Chemistry more easily, but will give him such an insight into the subject as will enable him readily to extend his knowledge of it should time and inclination permit."—*Practitioner*.

OLIVER.—LESSONS IN ELEMENTARY BOTANY. By DANIEL OLIVER, F.R.S., F.L.S., Professor of Botany in University College, London, and Keeper of the Herbarium and Library of the Royal Gardens, Kew. With nearly 200 Illustrations. New Edition. Fcap. 8vo. 4*s*. 6*d*.

PARKER and BETTANY.—THE MORPHOLOGY OF THE SKULL. By W. K. PARKER, F.R.S., Hunterian Professor, Royal College of Surgeons, and G. T. BETTANY, M.A., B.Sc., Lecturer on Botany in Guy's Hospital Medical School. Crown 8vo. 10*s*. 6*d*.

PETTIGREW.—THE PHYSIOLOGY OF THE CIRCULATION IN PLANTS, IN THE LOWER ANIMALS, AND IN MAN. By J. BELL PETTIGREW, M.D., F.R.S., etc. Illustrated by 150 Woodcuts. 8vo. 12*s*.

"A more original, interesting, exhaustive, or comprehensive treatise on the circulation and the circulatory apparatus in plants, animals, and man, has never, we are certain, been offered for the acceptance of the anatomist, physiologist, or student of medicine."—*Veterinary Journal*.

PIFFARD.—AN ELEMENTARY TREATISE ON DISEASES OF THE SKIN, for the Use of Students and Practitioners. By H. G. PIFFARD, M.D., Professor of Dermatology in the University of the City of New York, &c. With Illustrations. 8vo. 16*s*.

RADCLIFFE.—Works by CHARLES BLAND RADCLIFFE, M.D., F.R.C.P., Physician to the Westminster Hospital, and to the National Hospital for the Paralysed and Epileptic.

VITAL MOTION AS A MODE OF PHYSICAL MOTION. Crown 8vo. 8*s*. 6*d*.

PROTEUS: OR UNITY IN NATURE. Second Edition. 8vo. 7*s*. 6*d*.

RANSOME.—ON STETHOMETRY. Chest Examination by a more Exact Method, with its Results. With an Appendix on the Chemical and Microscopical Examination of Respired Air. By ARTHUR RANSOME, M.D. With Illustrations. 8vo. 10*s*. 6*d*.

"We can recommend his book not only to those who are interested in the graphic method, but to all who are specially concerned in the treatment of diseases of the chest."—*British Medical Journal*.

REYNOLDS (J. R.).—A SYSTEM OF MEDICINE. Edited by J. RUSSELL REYNOLDS, M.D., F.R.S. London. In 5 Vols. Vols. I. to III., 25*s*. each; Vol. IV. 21*s*.; Vol. V. 25*s*.

VOL. I.—Part I. General Diseases, or Affections of the Whole System. Part II. Local Diseases, or Affections of Particular Systems. § I.—Diseases of the Skin.

VOL. II.—Part II. Local Diseases (continued). § I.—Diseases of the Nervous System. § II.—Diseases of the Digestive System.

REYNOLDS (J. R.) *continued*—

Vol. III.—Part II. Local Diseases (continued). § II.—Diseases of the Digestive System (continued). § III.—Diseases of the Respiratory System.

Vol. IV.—Diseases of the Heart. Part II. Local Diseases (continued). § IV —Diseases of the Organs of Circulation.

Vol. V.—Diseases of the Organs of Circulation.—Diseases of the Vessels.—Diseases of the Blood-Glandular System.—Diseases of the Urinary Organs. —Diseases of the Female Reproductive Organs.—Diseases of the Cutaneous System.

RICHARDSON.—Works by B. W. Richardson, M.D., F.R.S.

DISEASES OF MODERN LIFE. Fifth and Cheaper Edition. Crown 8vo. 6*s.*

ON ALCOHOL. New Edition. Crown 8vo. 1*s.*

HYGEIA, A CITY OF HEALTH. Crown 8vo. 1*s.*

THE FUTURE OF SANITARY SCIENCE Crown 8vo. 1*s.*

TOTAL ABSTINENCE. A Course of Addresses. Crown 8vo. 3*s.* 6*d.*

PREVENTIVE MEDICINE. 8vo. [*In the Press.*

ROSCOE.—Works by Henry Roscoe, F.R.S., Professor of Chemistry in the Victoria University, the Owens College, Manchester.

LESSONS IN ELEMENTARY CHEMISTRY, INORGANIC AND ORGANIC. With numerous Illustrations, and Chromolithographs of the Solar Spectrum and of the Alkalies and Alkaline Earths. New Edition. Fcap. 8vo. 4*s.* 6*d.*

CHEMICAL PROBLEMS, adapted to the above. By Professor T. E. Thorpe, M.D., F.R.S.E., with Preface by Professor Roscoe. Fifth Edition, with Key. 18mo. 2*s.*

PRIMER OF CHEMISTRY. Illustrated. 18mo. 1*s.*

ROSCOE and SCHORLEMMER.—A TREATISE ON CHEMISTRY. By Professors Roscoe and Schorlemmer. Vols. I. & II.—Inorganic Chemistry. Vol. I. The Non-Metallic Elements. With Numerous Illustrations and Portrait of Dalton. 8vo. 21*s.* Vol. II. Metals. 2 Parts. With numerous Illustrations. 8vo. 18*s.* each.

Volume III.—Organic Chemistry. Part I. 21*s.* [*Part II. in the Press.*

SCHORLEMMER.—A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS, OR ORGANIC CHEMISTRY. By C. Schorlemmer, F.R.S., Lecturer on Organic Chemistry in Owens College, Manchester. 8vo. 14*s.*

SEATON.—A HANDBOOK OF VACCINATION. By Edward C. Seaton, M.D., Medical Inspector to the Privy Council. Extra fcap. 8vo. 8*s.* 6*d.*

SEILER.—MICRO-PHOTOGRAPHS IN HISTOLOGY, Normal and Pathological. By Carl Seiler, M.D., in conjunction with J. Gibbons Hunt, M.D., and J. G. Richardson, M.D. 4to. 31*s.* 6*d.*

SIBSON.—THE COLLECTED WORKS OF DR. FRANCIS SIBSON. Edited by W. M. Ord, M.D. With Illustrations. Four Vols. 8vo. 3*l.* 3*s.*

SPENDER.—THERAPEUTIC MEANS FOR THE RELIEF O PAIN. Being the Prize Essay for which the Medical Society of London awarded the Fothergillian Gold Medal in 1874. By John Kent Spender, M.D. Lond., Surgeon to the Mineral Water Hospital, Bath. 8vo. 8*s.* 6*d.*

STEWART (B.).—LESSONS IN ELEMENTARY PHYSICS. By Balfour Stewart, F.R.S., Professor of Natural Philosophy in the Victoria University, the Owens College, Manchester. With Numerous Illustrations and Chromolithograph of the Spectra of the Sun, Stars, and Nebulæ. New Edition. Fcap. 8vo. 4*s.* 6*d.*

PRIMER OF PHYSICS. By the same Author. Illustrated. 18mo. 1*s.*

TUKE.—INSANITY IN ANCIENT AND MODERN LIFE, with Chapters on its Prevention. By D. Hack Tuke, M.D., F.R.C.P. Crown 8vo. 6*s*.

"This work exhibits deep research in various directions, and teems with allusions and quotations which prove the author to be not only an accomplished psychological physician, but a scholar of no mean order."—*Medical Times.*

WEST.—HOSPITAL ORGANISATION. With special reference to the organisation of Hospitals for Children. By Charles West, M.D. Founder of, and for twenty-three years Physician to, the Hospital for Sick Children. Crown 8vo. 2*s*. 6*d*.

WURTZ.—A HISTORY OF CHEMICAL THEORY from the Age of Lavoisier down to the present time. By Ad. Wurtz. Translated by H Watts, F.R.S. Crown 8vo. 6*s*.

PRICE EIGHTEENPENCE, MONTHLY,

THE PRACTITIONER:

A Journal of Therapeutics and Public Health.

EDITED BY

T. LAUDER BRUNTON, M.D., F.R.S.,

Fellow of the Royal College of Physicians;
Assistant Physician to St. Bartholomew's Hospital; and Lecturer on Materia Medica and Therapeutics in St. Bartholomew's Hospital School.

ASSISTED BY

DONALD MACALISTER, M.A., M.B., B.Sc.,

Member of the Royal College of Physicians.
Fellow and Medical Lecturer at St. John's College, Cambridge.

CONTENTS.

Original Communications—Reviews of Books—Clinic of the Month—Extracts from British and Foreign Journals—Notes and Queries—Bibliography—and the Public Health Department.

In Quarterly Parts, price 3*s*. 6*d*., *and Yearly Volumes,* 15*s*.

BRAIN:

A JOURNAL OF NEUROLOGY.

EDITED BY

J. C. BUCKNILL, M.D., M.R.C.P., F.R.S.
J. CRICHTON-BROWNE, M.D., F.R.S.E.
D. FERRIER, M.D., F.R.C.P., F.R.S.
J. HUGHLINGS-JACKSON, M.D., F.R.C.P.

Contents—Original Articles, consisting mainly of Clinical and Pathological Records and Anatomical and Physiological Researches, Human and Comparative, on the Nervous System. Signed Critical Digests and Reviews of Clinical, Experimental and other Researches in this department of Science, both at home and abroad. Foreign Correspondence. It will be the object of "Brain" to keep its readers well abreast of modern progress in Neurology, and to advance the knowledge of a class of disease respecting which it is universally admitted that much has yet to be learnt.