OBSERVATIONS

WITH

HUTCHINSON'S SPIROMETER.

BY

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Amongst the inferences drawn by Dr. Hutchinson from his admirable researches with the spirometer, the one wherein he states that there does not exist "any direct relation between the circumference of the chest and the vital capacity,"—implying, by that term, the greatest quantity of breath which can be expired at one expiration after the largest possible inspiration,—is especially calculated to arrest attention. Flowing from this inference, Dr. Hutchinson deduces several other conclusions equally at variance with our preconceptions. Thus, he is of opinion that "there is no relation between the volume of the lungs and the vigour of the constitution, nor between the size of the cavity of the thorax and the amount of air which can be respired; * * * that "there is good reason to believe that in a healthy man there is no relation between the extent of mucous surface in the lungs and the amount of aëration or oxidation of the blood;" * * * that, "in fact, aëration need have no relation to the thoracic dimension; and, for the same reason, the size of the chest no relation to the vigour of the whole man. Indeed," he continues, "we incline to the contrary, viz., that it is most likely the respiration is most vigorous in the narrow-chested man, when the mobility is greatest. The vigour of the lungs, like every other organ in the body, we believe, has no relation to the dimension. One person may have a brain one pound lighter or one-third less than another person, and yet their capacity and mental qualities shall not appear different." * * * "The *function* of the chest, as indicated by the quantity of air which we can expel, is in strict relation to the minute difference of a single inch of stature, or to ten pounds of weight. It appears probable that the function of an organ may be exactly relative to the size of the body, increasing or decreasing with it, while the organ itself bears no visible relation of volume either to its own activity or to the dimensions of the body."*

From observations upon nearly 5000 men, Dr. Hutchinson obtained the average vital capacity for every inch of stature, ranging from five feet to six feet. He found that this average followed the remarkable rule of increasing by eight cubic inches of air for every additional inch of stature from five feet to six feet. In accordance with this rule, he has furnished a table entitled, "Vital Capacity Volume (temp. 60° Fah.) Necessary to Health at the Middle Period of Life."† The quantity stated in this table will be here referred to as the standard vital capacity for the given stature.

Desirous of ascertaining how far this mean quantity, or statistical average, was practically useful in its application to individuals taken indiscriminately as we meet with them in practice, and having my curiosity excited in respect to the physiological points above stated, in 1848 I examined with the spirometer the greater number of persons who called at my house professionally, whether themselves invalids or not. As I was then residing in an agricultural part of Cheshire, the majority of my cases were agriculturists, and all were persons accustomed to live much in the open air.

It is necessary to premise that the standard vital capacity is considered by Dr. Hutchinson to be modified by temperature, weight, and age.

Temperature.—When the temperature of the room is maintained at about 60° Fah., no correction is required; but when it departs considerably from this a correction becomes necessary. The change in the bulk of the air, however, is only $\frac{1}{500}$ for every degree Fah.

* Cyclopœdia of Anatomy and Physiology, Art., "Thorax;" also, an Epitome of Dr. Hutchinson's Paper, from Medico-Chirurgical Transactions for 1846.

† Table V., Art. "Thorax;" Cyclopœdia of Anatomy, p. 1072, vol. iii.

of variation of temperature. For eight months out of the year, Dr. Hutchinson states, there needs no correction.

Weight.—Dr. Hutchinson has given a table of the mean weight for heights ranging from four feet six inches to six feet, founded upon 3000 cases.* At the height of five feet eight inches, the weight should be about eleven stone. It is expected that more extended observations will prove that the weight increases by 7lbs. for every inch of stature. When the mean weight at a given stature is exceeded by 7 per cent., the vital capacity decreases one cubic inch per pound for the next 35lbs. above this weight. Dr. Hutchinson justly remarks that the usual weight of an individual when in health may be taken to represent his mean weight,—an observation which goes far to lessen our confidence in the actual value of the calculated mean weights as guides in practice.

Age.—According to Dr. Hutchinson's table on the "Effect of Age,"† the vital capacity increases by five cubic inches during the period of from 15 to 35 years of age; diminishes by 19 cubic inches from 35 to 45; by 11 cubic inches from 45 to 55; by 13 cubic inches from 55 to 65. This conclusion is founded upon observations on 1775 healthy men, yet says Dr. Hutchinson, "although this appears by calculation, yet we do not strictly follow this ratio, as we find by experience that the effect of age may be more diminished;" and, in his own tables, Dr. Hutchinson has not "brought in the effect of time before the age of 55 years." From 55 to 65, five cubic inches per cent. are deducted from the standard quantity, and from 65 to 75, eight cubic inches per cent.

The modifying influence of temperature, and of weight and age, may be borne in mind, but in practice they are commonly neglected, and, with the exception of temperature, are, perhaps, not sufficiently ascertained to be trustworthy when applied to individuals.

In my own observations the temperature was correct, but no correction was made for either weight or age. In the few instances of children, and of persons below five and above six feet in height, I have affixed as the standard vital capacity a quantity calculated at eight cubic inches for every inch of stature, although Dr. Hutchinson restricts this rule to middle age, and to the stature ranging from five to six feet. The same standard vital capacity

* Tables X. and Y., p. 1074, l. c.

† Table CC., p. 1077, l. c.

also is applied to females as to males, which probably is not intended, as it is not mentioned by Dr. Hutchinson.

The total number of cases detailed in the tables which follow is 121. Of these, 90 were males; 31 females. Two of the cases, that of an American giant and that of the Devonshire pedestrian, have been observed recently, and are added as being interesting in themselves.

In age, 92 were from 20 to 55 years; 9 from 55 to 69 years; 17 from 10 to 20 years; 3 under 10 years.

The vital capacity was precisely the standard quantity in one case only, that of a tall shoemaker, 18 years of age, scrofulous, and having anchylosis of the right knee; was higher than the standard in 25; lower than the standard in 95.

Of those who had a vital capacity above the standard, all were males; 21 were in good health; 4 unhealthy.

Of those who had a vital capacity below the standard, 56 were in good health; 39 unhealthy.

Of the four unhealthy cases above the standard, one was a case of convalescence after pleurisy, with an excess of merely one cubic inch; another, hypochondriasis, with an excess of thirty cubic inches; the third, congestive headache, with an excess of thirty-four cubic inches; the fourth, thoracic pains two years subsequent to an attack of pneumonia of the right lung, with an excess of six cubic inches.

Of the thirty-nine unhealthy cases below the standard, one was a case of anæmia; one of dyspepsy; one of dysentery; two of pneumonia; one of chronic gastritis; one of pleurisy; fifteen of disease of the liver; five of bronchial irritation; one of peritonitis; nine of pulmonary tubercles; one of constipation; one of chronic metritis.

Of the healthy cases below the standard, 44 were males. If we take the mean of their vital capacity, we find it to be $197\frac{9}{10}$ cubic inches. This, taking Dr. Hutchinson's calculation that 230 cubic inches is the average vital capacity for all heights taken together, shows a deficiency of $32\frac{1}{10}$ cubic inches for each of the 44 individuals. Not one happened to present precisely this amount of deficiency. To take an impartial view, we add the 21 healthy males, whose vital capacity was above the standard, the healthy males, now 65 in number, give a mean vital capacity of $215\frac{3}{10}$

cubic inches; which is still below the standard, but to the smaller amount of $14\frac{7}{10}$ cubic inches. Now, this mean vital capacity, correct as regards the gross number of the sixty-five, is not correct in a single instance when applied to each individual of the gross number. This may serve to illustrate the radical distinction between an average quantity in figures, which is perfectly true for all purposes of calculation on a large scale, but absolutely untrue, or, if ever true, only so by accident, when applied to an individual case, and one of those proper facts on which medical experience is built, where the conclusion is modified by considerations too inexact to be reduced to figures, but too real to be left out of consideration.

A mean quantity drawn from a very large number must represent truly the share theoretically belonging to each; but the standard so obtained, although an important guide, may be expected in practice to be widely departed from on each side. In my own experience I found this to be the case in regard to the spirometer.

Dr. Hutchinson states, that "a man below 55 years of age, breathing 193 cubic inches instead of 230 cubic inches, unless he is excessively fat, is probably the subject of disease;" and he is of opinion that a deficiency of vital capacity to the extent of 16 cubic inches per cent. should induce a suspicion of disease. In proportion to the importance of these statements, if correct, is the desirableness of investigating their accuracy. The largest calculated deficiency given above ($32\frac{1}{10}$ in 230 cubic inches) is just above the line of 16 per cent., but many of the individuals who furnished that average presented a much greater deficiency in reality, and yet were, as far as we generally signify by the expression, in good health. Even supposing that unknown disease may have existed in a few, the result would not be greatly altered; and such a supposition is less probable than ordinary from the class of persons in question.

In an adult male, I believe that we are not in a position to decide from the vital capacity as compared with stature alone, what precise amount of deviation from the standard on the side of defect implies disorder or disease. Excess of vital capacity, of course, never indicates disease.

In 10 healthy adult females, who presented deficiencies varying from 36 to 98 cubic inches, the average deficiency, using the same standard as for males, amounted to $62\frac{9}{10}$ cubic inches.

In 14 healthy males, under 20 years of age, using the same standard, the real deficiency observed varied from 4 to 60 cubic inches, whilst the mean deficiency amounted to $32\frac{4}{10}$ cubic inches.

Dr. Hutchinson's conclusion, that size of chest, as measured by its circumference and vital capacity, are not necessarily connected, seems to be unquestionable, if size of chest be viewed apart from all other circumstances. Thus (although no proof can be needed in addition to that adduced by the discoverer), of two healthy men at six feet, one, with a chest of 41 inches, had an excess of 18 cubic inches in his vital capacity; the other, with a chest of 45 inches, a deficiency of 42 cubic inches. One giant, of 7 feet (mentioned by Dr. Hutchinson, "D"), 27 years of age, with a chest of 50 inches, had an excess of 106 cubic inches; whilst another (Table XIV., No. 13), of 7 feet 3 inches, 18 years of age, with a chest of 51 inches, had a deficiency of 12 cubic inches.*

"There is a certain rude relation," says Dr. Hutchinson, "between the thoracic dimensions and the vital capacity; if, for instance, one man has a chest 35 inches in circumference and three inches mobility, and another man has a chest 40 inches in circumference and four inches mobility, then the latter will surely displace a larger volume of air than the former, but, omitting this, we expect as large a vital capacity from a man with a thin and narrow thorax, as from a man with a broad and deep thorax." But has not size of chest a more extensive influence than this? Of two chests equal in circumference (say each 35 inches) but unequal in mobility (say one three inches, the other four,) the more mobile will have the larger vital capacity; and, therefore, for the larger chest with the larger mobility to have no more, is still to ignore size as an element, since the larger mobility by itself will account for the augmented vital capacity. We find, indeed, that

* Thomas Stanhope Goode, of Rochester, New York, aged 18, 7 feet 3 inches in height, is stated in his advertisement to be 7 feet 8 inches; was 6 feet at 13 years of age. Circumference of chest is 51 inches. Weight, 20 stone. Vital capacity, 370 cubic inches. Is straight and well-built; his limbs feel wiry, hard, and free from fat. Pulse strong, steady, 60. Heart's action strong and regular. Has always had excellent health. Does not eat more than his companion, who is a thin, bilious-looking man, of 5 feet 7 inches. Father is of middle height; mother, 5 feet 7 inches; maternal grandfather was 6 feet 9 inches; maternal uncle is 6 feet 5 inches. He is strong, fond of exercise, and before he exhibited as a show-giant he worked as a ship carpenter.

although a small chest combined with large mobility will surpass a much larger chest in vital capacity, yet it does so only when the larger chest possesses but a small mobility. Moreover, we find that in cases of excessive vital capacity, the chest is usually large, and scarcely ever of the minimum size. A glance at the following table will show that of 21 healthy males who had a vital capacity higher than the standard some had large chests; with one exception, none had small ones. The exception was a country clergyman, perfectly healthy, very active, six feet two inches in height, with an excess of 25 in his vital capacity, and a chest of 35 inches in circumference.

TABLE A.

Twenty-one Healthy Males above the Standard in Vital Capacity.

Stature		Excess over standard vital capacity	Circumference of chest	Standard circumference of chest for same stature*			Largest chests with less than standard vital capacity at same stature	Deficiency of these in vital capacity	Remarks
				Minimum	Medium	Maxm.			
Ft.	In.	Cub. in.	In.	Inches	Inches	Inches	Inches	Cub. in.	
5	6	6	34	32¾	37½	40⅞	37	4	Above minimum size.
,,	,,	6	41	...	...	...	...	...	Above maximum size.
,,	,,	56	37	...	...	...	...	...	Nearly medium size.
,,	,,	106	38	...	...	...	...	...	Above medium size.
5	7	10	34	33¼	38⅛	41½	37	22	Above minimum size.
,,	,,	22	35	...	...	...	...	...	Ditto.
5	8	20	37	33¾	38⅝	42⅛	39	45	Ditto.
,,	,,	10	35	...	...	...	...	...	Ditto.
5	9	4	37	34¼	39¼	42¾	42	38	Ditto.
,,	,,	12	36	...	...	...	...	...	Ditto.
,,	,,	2	38	...	...	...	...	...	Ditto.
5	10	12	38	34⅝	39⅝	43¼	40	46	Ditto.
,,	,,	4	37	...	...	...	...	...	Ditto.
,,	,,	4	36	...	...	...	...	...	Ditto.
,,	,,	19	39	...	...	...	...	...	Nearly medium size.
5	11	41	41	35¼	40¼	44	37	114	Above medium size.
,,	,,	36	42	...	...	...	...	...	Ditto.
6	0	18	41	35⅝	40¾	44⅝	45	42	Ditto.
6	1	10	42	...	...	...	...	...	Ditto.
,,	,,	30	38	...	...	...	...	...	Above minimum size.
6	2	25	35	...	...	...	...	...	Below minimum size.

Before the completion of growth, the size of the chest appears to have a more direct relation to the vital capacity, although here still, as in the adult, the influence of stature is paramount. During

* See Dr. Hutchinson's Art. "Thorax," in Cyclopœdia of Anatomy and Physiology, p. 1040.

infancy and youth the mobility of the thorax is relatively greater than in mature age, notwithstanding that in quiet respiration it is less called into request, because breathing in the child is less costal than in the adult. Now, whilst the chest is not yet consolidated, its expansion indicates more exactly the extent of the lungs than in after-life, when *cæteris paribus* the rule seems to be that large lungs have less mobility of chest than small ones. Yet, taking the standard vital capacity as 174 cubic inches for five feet of stature, children less than five feet, even if they had that standard capacity at five feet, (which they have not, as it is calculated for the adult and not for the child,) would only possess a vital capacity after the rate of $2\frac{9}{10}$ cubic inches for every inch of stature below five feet; whilst in man the vital capacity is eight cubic inches for every inch of stature above five feet up to six feet. Consequently, the thoracic mobility is relatively greater in childhood, whilst the vital capacity is relatively smaller than in manhood, in the proportion of $2\frac{9}{10}$ to eight. For example, a healthy boy, four feet three inches in height at nine years of age, having a thoracic mobility of $2\frac{1}{2}$ inches, and a chest 24 inches in circumference, may present a vital capacity of 94 cubic inches. At 27 years of age his chest may measure 36 inches, his stature be five feet eight inches, his thoracic mobility be three inches, and his vital capacity 230 cubic inches. He has gained only one-sixth in mobility, and one-fourth in stature, but one-third in circumference of chest, and one-half in vital capacity. The gain in mobility does not keep pace with the increase in height and size. The gain in vital capacity is the largest; that of circumference of chest the next. Here, then, there does seem to be a tolerably direct connection between size and vital capacity.*

* In children, the ordinary quiet breathing is abdominal; in men, chiefly abdominal, but with more movement of the lower thoracic ribs than in children; in women, chiefly costal, with more movement in the higher ribs than in men. Hence, in the movement of the thorax of quiet respiration there is a sliding scale upwards, according to age and sex. Most movement below in children, progressing upwards in men, highest in women; descending again in old age, so that in second childhood, as in the first, respiration is abdominal. In both sexes, and at all ages, the upper portion of the chest is the part whose activity is most increased by energetic voluntary respiration. Hence the different physical effect of the joyous cries of children at play, and of the dull, monotonous reading or repeating of lessons at school; of speaking with a will and speaking against the will. The deformity called *chicken-breast* is referred by Mr. Shaw and by Dr. Hutchinson to the existence of some cause of deficient ingress of air, occasioning forcible inspiratory efforts, which, not meeting with

The universality of Dr. Hutchinson's great discovery, that of all elements taken singly, stature is incomparably the most important in governing the vital capacity, is well seen by comparing growing persons one with another. In Table B, 14 healthy males, under 20 years, are enumerated according to their age. So long as stature increases with age so long does the vital capacity increase, but no sooner does stature lessen than vital capacity also lessens. Thus, a boy aged 14, with a stature of five feet four inches, expires 160 cubic inches, whilst another of the same age, but seven inches lower in stature, expires only 90 cubic inches. Again, by reading the list in the order of the stature, the progressive augmentation of vital capacity is striking. There is some correspondence also between the size of the chest taken alone and the vital capacity, and none of those marked contrasts which are so noticeable in adults.

sufficient air, suck in the walls of the chest. Even enlarged tonsils, when they occasion dyspnœa, are found to be an adequate cause. Undoubtedly, when dyspnœa and chicken-breast co-exist, the cause of the one may occasion the other also, but chicken-breast is very frequently seen in delicate children under a certain age, without anything abnormal in the respiration to account for it. The deformity is most noticeable when the child is breathing quietly; when the child breathes vigorously, as in active play, the hollow on each side of the lower part of the sternum is greatly lessened, or even obliterated for the time. As the thorax becomes stronger and more developed with age, and as the lower thoracic ribs enter more into action in ordinary inspirations, the chicken-breast almost or entirely disappears. A child which was very chicken-breasted at three years of age, is often perfectly well-formed at 13. On the other hand, some without any disorder of the respiratory organs will remain chicken-breasted for life. The explanation is, that in feeble children the naturally very flexible costal cartilages, to which the diaphragm is attached, are more yielding than usual, the energy of the voluntary muscles is small, and in ordinary respiration the diaphragm is left almost alone to do the work of inspiring; when it contracts, it draws in the yielding cartilages, and causes a hollow on each side of the lower part of the sternum—chicken-breast, because the intercostal muscles do not elevate the ribs so as to antagonise the depressing influence of the diaphragm. But when the child makes its intercostal muscles act, by breathing vigorously, then the raising of the costal cartilages prevents their being drawn in by the diaphragm, and the deformity is diminished; and when the period arrives at which the ribs are habitually more raised in quiet inspiration, the deformity may vanish entirely. The indication is obviously to call into frequent play the voluntary action of the respiratory muscles, before growth is so far advanced that the costal cartilages are fixed in their abnormal shape, and until the age when ordinary inspiration naturally calls the elevating influence of the lower thoracic intercostal muscles into co-operation with the downward and inward traction of the diaphragm. The grand remedy is, not machinery, or even elaborate gymnastics, but unrestrained romping in the open air with playmates, and but little of school.

TABLE B.

Fourteen Healthy Males under Twenty Years of Age.

Age	Stature		Circumference of chest	Vital capacity	Deficiency	Sequence according to stature
Years	Ft.	In.	Inches	Cubic in.	Cubic in.	
8	4	2	24	70	16	1
9	4	4	24	80	22	2
12	5	1	24	130	44	5
14	5	4	27	160	38	8
14	4	9	26	90	60	3
14	4	10	27	120	38	4
15	5	3	31	150	40	7
16	5	2	32	140	42	6
17	5	6	33	180	34	9
17	5	7	32	170	52	11
18	5	7	33	180	42	12
18	5	10	36	220	26	13
18	7	3	51	370	12	14
19	5	6	34	210	4	10

In females there appears to be a somewhat closer connection between the size of the chest and the vital capacity than in men; possibly, because their chests being smaller are proportionably more expansible. In Table C, 10 healthy adult females are enumerated in the order of the progressive increase of vital capacity, and we see that a tolerably progressive range of increase of girth of chest corresponds.

TABLE C.

Ten Healthy Females above Twenty Years of Age.

Sequence in order of deficiency	Deficiency	Standard quantity*	Circumference of chest
	Cubic inches	Cubic inches	Inches
1	86	198	25
2	98	238	27
3	72	182	26
4	72	182	27
5	64	174	29
6	62	182	31
7	50	190	26
8	48	198	30
9	41	206	37
10	36	206	31

* Calculated at eight cubic inches for each inch of stature, as directed for adult males.

As it is evident that health is consistent with a considerable and perhaps undetermined range of vital capacity, have we any right to conclude that the vital capacity is in health a correct measure of the extent to which the lungs exercise their function in ordinary respiration? We find very strong athletic men, with large chests but small mobility, who possess only a small vital capacity. Must we conclude that in such persons the lungs do not adequately perform their work? There is no proof of it. Professor Jackson, of Jefferson Medical College, contends that muscular power and not height governs the vital capacity*; but he is undoubtedly mistaken in this opinion. Muscular strength by itself does not appear to regulate at all the amount of vital capacity. In Table VII., case 9, is that of a strong muscular man, stature five feet six inches, with an excess in vital capacity of 56 cubic inches; case 10, that of a spare, compact, but not very muscular man, of the same stature, with an excess of 106 cubic inches. On the other hand, Truman, the Devonshire pedestrian, whose feats indicate his muscular vigour and power of endurance, with a stature of five feet four inches, presents a deficiency of 18 cubic inches.† Case 6, Table XI., was a man of herculean mould, very powerful, 5 feet 10 inches in height, with a deficiency of 46 cubic inches. Case 5, Table XIII., was another unusually powerful man, six feet in height, with a deficiency of 42 cubic inches. For the most part, the wide-chested men were powerful and muscular men, whatever their vital capacity.

* American Medical Examiner, 1851, p. 51.

† John Truman, on May 27th ult., the weather being dry and warm, walked 100 miles in 23½ hours. Three weeks previously, he had walked 400 miles in six days. Eight hours after completing the hundred miles in less than 24 hours, he felt free from weariness, had slight pains in the middle of each thigh, no soreness of feet; very slight swelling of feet and hands; pulse steady, firm, 80. He had slept for six hours. After a night's rest he felt perfectly fresh and as usual. He is 53 years of age, 5 feet 4 inches in height; circumference of chest, 33 inches; thoracic mobility, 3½ inches; vital capacity, 180 cubic inches; respirations 13 per minute; pulse firm, strong, steady, 72. Father died at 58. Mother is 82. Maternal grand-parents both above 80 at death. Parternal grand-parents died younger, but at what age he does not know. Is a house plasterer; has always drunk moderately, and occasionally gets intoxicated. Never feels the worse for it next morning; is always ready for work. Never had headache in his life; never was ill. Is married; has had nine children; eight are living and strong. Is a moderate eater; always has an appetite. Bowels act once a day. Never had diarrhœa, even during cholera-time. Is not a particularly good boxer, nor a good runner. His complexion is brown and sallow, hair black, eyes hazel. Never weighed ten stone.

By the vital capacity we only measure directly the quantity of breath which a person can give out, and indirectly the quantity of air which he can take in. Inasmuch as he never inspires up to his capability in ordinary breathing, this measure indicates not what a person *does* breathe, but what he *can* breathe. If then the quantity inspired were the quantity used, the vital capacity would only show what amount could by possibility be used in case of need, and not what actually was generally used. But the whole of the air inspired may not be used in ordinary respiration. If the quantity inspired did necessarily indicate the amount of activity of respiration, any person, by voluntarily deepening his inspirations, might increase the oxygenation of his blood to an almost indefinite extent. Considering that in ordinary quiet breathing we are supposed to inspire not more than from 12 to 20 cubic inches at each inspiration, and that the standard vital capacity is rated at 230 cubic inches, this arbitrary power of hyperoxidating the blood would be extreme. But we do not possess it. By general exercise we can, it is true, increase oxygenation, and for this end the inspirations are larger and more frequent, but it is because we have set in action Nature's chain of causation; we have worked the tissues faster, and the tissues have required more oxygen from the blood in consequence. The demand has evoked the supply. We may sit still and deepen our inspirations in vain, beyond the effect of the exertion required to do this, so far as adding oxygen to the blood is concerned. Merely filling the chest with air permits the breath to be held for a longer interval, but it does not impart more oxygen to the blood in a given fraction of that interval. Consequently, the man whose vital capacity exceeds his ordinary requirements by 100 cubic inches, may have all his pulmonary functions just as energetically and as completely fulfilled, so far as regards mere quantity of air, as the man with a surplus of 200 cubic inches.

The only difference would be that the latter in extraordinary circumstances will have a greater breathing power in reserve; he will last longest in a race. Individual differences in the functional capabilities of the textures of the lungs, and in the blood when circulating through them, have probably a greater influence on the activity with which ordinary respiration is performed, than has the vital capacity. An animal, after division of the *paria vaga*, provided an opening be made below the glottis, makes large and deep inspirations, takes in much air, has a large vital capacity, yet it dies asphyxiated. Abundance of air is taken into the chest, but the lungs are unable to make use of it when there. Here the vital capacity is no measure of the activity of the respiratory function; and although there is no parallelism between this and the case of a healthy man, it will serve to illustrate the point, that a man may inspire more air than he can use. It is not assumed that he usually does so: but neither does he usually employ all his vital capacity.

There is no proof that persons with large vital capacity are in the habit of inspiring a larger quantity of air at once in ordinary respiration than those who possess a smaller vital capacity. Nor, again, that a man who possesses large lungs but only a small vital capacity, does not habitually make larger inspirations than another who possesses smaller lungs but a larger vital capacity. It must be that more air is constantly present in large lungs than in small ones, and if, as we have every reason to conclude, enough of fresh air be constantly inspired to maintain the contained breath sufficiently pure, whether the lungs be large or small, it will follow that more air is likely to be taken into large lungs than into small ones, in quiet breathing, quite irrespective of the vital capacity. The vital capacity represents a latent, and not a constantly employed power. The functional excellence of the lungs and of the blood being the same, more aëration goes on in large than in small lungs, notwithstanding that their vital capacity (in its present signification) may be less. In a word, energy of respiration depends upon the quantity of air which is used, not upon the quantity which can be inspired. The vital capacity measures only the quantity which can be taken in, not that which is used. Consequently, the vital capacity is not necessarily a criterion of the energy with which the function of respiration is habitually performed.

On this ground, then, there appears to be no reason for exempting the lungs from that law of nature which affirms that, other things being equal, size indicates power; quantity indicates force. There is nothing in nature of the figment that by lessening quantity we can increase power. A large healthy lung is a powerful breathing lung; a large healthy brain is, whether judiciously employed or otherwise, a powerful brain. So far, if not in their strange circular mode of developing an organ from a function, and a function from an organ, the phrenologists certainly seem to be correct.

But although there be no physiological ground for denying to a man with spacious healthy lungs the perfect and energetic performance of the function of respiration, merely on the score of his possessing a small vital capacity, yet such a man does lose certain advantages which a large vital capacity always confers. He is, of course, less fitted for those emergencies which demand unusual extent of respiratory movement, less capable of temporarily enlarging the superficies of his chest for the more advantageous action of his muscles during extraordinary muscular exertion, and has less available space to compensate for any encroachment on his chest by disease. Clearly, to possess a large vital capacity is a great advantage. The question is, however, how great is the disadvantage entailed by a small vital capacity? To ascertain this, we must review the conditions on which smallness of vital capacity depends, and some one or more of which its presence indicates.

Laying stature aside, these conditions in the adult of both sexes appear to be the following:—

1. Large healthy lungs with small mobility.
2. Small healthy lungs with average mobility.
3. Small healthy lungs with small mobility.
4. Lungs whose expansion is obstructed by disease either of their own tissues or of other parts, without any necessary diminution of thoracic mobility, as usually measured with the tape.
5. Disease which occasions obvious lessened mobility of the walls of the chest.
6. Morbid impatience of holding the breath sufficiently to do justice to the actual capacity of the chest.

1. The greatest bulk of lung lies behind the front part of the fourth intercostal space during expiration. A tape drawn around the chest, just below the nipples, covers this space in front. The circumference of the chest so obtained, regard being had to the fatness or spareness of the individual, indicates the size of the lungs; not accurately, for the perpendicular bulk of the lungs may differ, but with sufficient correctness. The degree in which the person can extend this tape from the completest expiration to the fullest inspiration, is the measure of the thoracic mobility. A source of fallacy to be avoided in making the observation consists in the patient separating and approximating the inferior angles of

the scapulæ out of correspondence with the expansion and contraction of the walls of the chest. The rule of health, according to Drs. Hutchinson and Sibson, is, that a person of ordinary stature and weight, and of middle age, should be able to extend the tape three inches. It may be that this is the best standard we can have, but in every healthy man whose chest was large and vital capacity small, I found the thoracic mobility less than this. When the mobility amounts to three inches, and the chest is large, the person healthy and of adult age, the vital capacity is always good. On the other hand, the chest may be large, the mobility less than three inches, the vital capacity small, and yet the person may be quite healthy. We must, therefore, check the vital capacity by the mobility. Large lungs with full thoracic mobility, but small vital capacity, show that something is abnormal. But does not the vital capacity test the thoracic mobility as well as the capability of inspiring? It does so positively, but not negatively. A large vital capacity necessarily indicates a large mobility; but a small vital capacity does not necessarily imply a small mobility; and it is the small vital capacity alone that is the subject of protracted inquiry. The giant, seven feet three inches in height, with a chest of 51 inches, and a thoracic mobility of six inches, possessed a vital capacity of 370; whilst the other giant, three inches lower in stature, having a thoracic mobility less by two inches, and a chest one inch less in circumference, presented a vital capacity of 464. The former was only 18 years of age, the latter 27. The largest vital capacity was possessed by the man with the smallest thoracic mobility. Whenever, then, an apparently healthy individual, with a large chest, presents but a small vital capacity, we must ascertain, before we attach significance to this, whether or not he has a full amount of mobility. If he has, the defective vital capacity is suspicious; if he has not, the next question is, whether or not the small mobility be normal. If so, the small vital capacity in itself does not indicate anything wrong; it merely indicates a smaller mobility than usual.

In healthy children the mobility is always large and the vital capacity small.

2. In females, as in males, before the completion of growth of the viscera, there may be three inches of thoracic mobility and even more, and yet deficient vital capacity, owing to the lungs

being small, though healthy. In a gentleman about to insure his life, examined whilst writing this, I find, with a stature of five feet six inches, and a thoracic mobility of 3½ inches, a deficiency of 14 cubic inches in his vital capacity. His health appears to be perfect, but his lungs are small, the circumference of his chest being only 33½ inches.

3. If large lungs with small mobility may present but a small vital capacity, small lungs with small mobility necessarily cannot present any other. It appears, however, to be more common for large-chested than for small-chested men to possess small thoracic mobility. The latter can less spare the power of obtaining extra room for breathing purposes. Here also the practical question recurs, is the small mobility normal?

4. It is the rule that any disease within the chest which mechanically opposes the performance of complete respiration, prevents the full movement of the walls of the chest. But chronic pneumonia may exist and lessen the vital capacity without diminishing the expansion of the walls of the chest, as ordinarily measured by the tape. Here we may have small vital capacity conjoined with large chest and large mobility. Indeed, a smaller amount of deficiency is suspicious when the chest is ample and the mobility large—conditions which in health would insure a large vital capacity—than when the thoracic mobility is normally small.

5. Disease which obviously lessens the thoracic mobility will necessarily lessen the vital capacity. Phthisis furnishes an example the commonest and best. But the significance of a given amount of deficiency should be estimated by comparing it with the capacity which the patient once possessed, rather than with any fixed standard. For instance, if a man of five feet eight inches in stature, could once expire 270 cubic inches, and can now expire only 190, the alteration is full of moment; but if his vital capacity never was greater than now, he may be in perfect health, and yet have a vital capacity not exceeding 190 cubic inches. The important point, then, to be ascertained is rather,—has the vital capacity undergone a change on the side of deficiency, than,—is the vital capacity smaller than a given standard? As this can rarely be known from prior examination with the spirometer during health, it is to be inferred from the mode and degree in which the walls of the chest now move in respiration. Ample directions for this

purpose are given in the works of Stokes, Williams, Walshe, and others, but I cannot avoid referring to the ingenious chest-measurer of Dr. Sibson, by which we learn all that the tape can demonstrate, and distinguish abnormities of movement too local for detection by that ruder means of examination. In all cases of disease whatever in which the spirometer is useful, in my opinion, the chest-measurer is ancillary to it.

6. I believe that there are some cases in which the vital capacity, as shown by the spirometer, indicates neither the amount of thoracic mobility nor yet the quantity of air which the lungs can hold;—cases in which the patient is unable to retain his breath so as to "slowly make the deepest expiration," which Dr. Hutchinson recommends. The morbid sensibility of the air-passages in influenza exemplifies this. To a smaller extent, the same fact is manifested by the healthiest lungs when the expiratory effort to fill the spirometer is made either much too quickly or much too slowly. I have particularly noted this in case 3, Table XII., because this man possessed an excess of 41 cubic inches over the standard vital capacity. When he expired with moderate and equal effort, after the deepest inspiration, he reached 295 cubic inches, but when he expired either very quickly or very slowly, he could not reach this amount by 15 cubic inches. The same holds good with all. I select the above as being, from his large vital capacity, an unexceptionable instance. The explanation may be, that when a large expiration is performed with undue quickness, the bronchial muscular tubes do not contract with their normal regularity and completeness, so as to expel all the breathing air, and a larger quantity of residual air is left. Conversely, if expiration be too prolonged, the bronchial muscles may lose somewhat of their contractile force, and the same result ensues. Of course the walls of the chest are not drawn in to the same extent as in the more perfect expiration, since we cannot by volition, under any circumstances, prevent the thoracic walls from accommodating themselves to the state of the lungs. In addition to this, the impression which dictates an inspiration may become irresistible, when expiration is too slow, before the lungs have given out quite all the air which, by a more perfect performance of the expiratory act, they could expel.

I have frequently found a smaller vital capacity than ordinary in cases of marked anæmia, without any apparent thoracic disease to account for the deficiency. Here there is impatience of holding the breath, owing to the morbid condition of the blood. Desire for breath is always a sign that the blood requires oxygen. Anæmic blood is badly oxygenated blood. It is, consequently, less able to bear a momentary interruption to the supply of air. Hence one of several reasons for the breathlessness of anæmic subjects, and one reason for the temporary diminution in their vital capacity.

In all cases of subacute and chronic disease of the liver attended with enlargement, I have found the vital capacity diminished. This result may obviously depend upon mechanical obstruction to the descent of the diaphragm, arising from enlargement and tenderness of the liver. But it has often appeared to be more than commensurate with the degree of hepatic enlargement, so far as this could be ascertained. Breathlessness on exertion is so common an accompaniment of deficient excretion of bile, that cholæmia may not improbably act like simple anæmia in rendering the lungs impatient of holding the breath. Indeed, cholæmia usually is anæmia *plus* the excrementitious elements of bile.

In conclusion, I must observe that no one can be more sensible than myself of the vast disparity in numbers between my observations and those of Dr. Hutchinson, nor more disposed to rely implicitly on the accuracy of his. If I have ventured to question the applicability of some of his inferences as strict guides in practice, it is because my observations, however insufficient as a foundation for new general principles, are numerous enough to test those already laid down; and because I cannot think that inferences which merely express the mean of a number of observations can ever prove trustworthy as standards for individuals. It is the province of statistics to build up individual matters of chance into gross matters of certainty. However certain the calculation on a large scale may prove, no dealing with the individual elements can by possibility render one of them less a matter of chance than before. An evil is always corrected by a counter evil. Over-drugging leads to homœopathy; neglect of the use of water to hydropathy; intemperance to teetotalism. The pendulum always at first swings too far in the opposite direction. It may be that the abuse of numbers is *the* evil necessary for correcting carelessness in observing and laxity in thinking; but an evil it undoubtedly is to divert the average of numbers from calculations which concern numbers, and to apply it to an individual as an individual. The average concerns him only as a constituent unit of the mass of figures, whose excess covers some other unit's deficiency, or whose deficiency is covered by some other's excess. In him as a constituent of the mass, the excess or the deficiency is alike unimportant; to him as an individual, the excess or the deficiency is all-important.

Still there is no other mode of obtaining a standard for reference but that which Dr. Hutchinson has adopted, nor, regard being had to the classes which furnished the subjects of his observations, can any better standard for adult males be found. But, taking the standard given, I should rate its practical importance lower, and allow a much wider departure from it to be consistent with health, than Dr. Hutchinson does.

The following are stated as provisional propositions to be confirmed or refuted by further inquiry :—

1. The close connection between the vital capacity and the stature, which constitutes Dr. Hutchinson's greatest and very important discovery, throws into the shade its other relations, yet size of chest, as measured by its circumference, does appear to exercise an influence, when not nullified by co-existing with a small thoracic mobility.

2. Narrow chests more constantly possess a full mobility than broad ones, both being healthy.

3. Consequently, both size and mobility are to be taken into account in estimating the significance of the vital capacity; for, if a large chest with a large mobility present even a moderate vital capacity, this may virtually imply greater defect than a smaller vital capacity in a chest of the same size, but which normally possesses a smaller mobility.

4. The only *exact* standard for any individual being his own normal vital capacity when in health, and this being rarely ascertainable, we must be guided by what we can learn of departure from it, by examining the chest and its amount and kind of mobility, in connection with the vital capacity, rather than by the actual degree of deviation of the vital capacity from the standard quantity laid down. Thus, a given deficiency taken in conjunction with any other ground of suspicion adds force to the latter; but

in the entire absence of such, taken alone, it does not necessarily indicate anything abnormal.

5. The limit of deficiency from the standard quantity laid down, which is consistent with health, cannot be stated with precision. It is probably a variable quantity, special in every individual. I apprehend that the limitation to 16 per cent. will be found too low in adult males, and considerably too low in females.

6. Dr. Hutchinson may not intend his standard scale of vital capacity to be applied to females, or to males before the completion of visceral growth. For both these classes the standard is too high.

7. When a deficient vital capacity co-exists with any cause of impatience of holding the breath, or with hurried breathing on slight exertion, which is not on other grounds referable to the lungs, it does not by itself necessarily indicate disease of the lungs. This, which is but a truism in the case of ovarian dropsy and such like causes of dyspnœa, also applies to cases of anæmia and of chronic disease of the liver, in which a small vital capacity need not by itself induce suspicion of tubercle of the lungs.

8. When the evidence furnished by the spirometer is distinctly favourable, it is valuable, trustworthy when taken singly, and needs no qualification. But, when the evidence appears to be unfavourable, although still valuable, it is not trustworthy when taken singly, but requires to be carefully checked by every other means of diagnosis, more especially by the use of the chest-measurer, before we can justly deduce from it the existence of any deviation from health.

TABLE I.—*Stature*, 5 *Feet*. *Standard Quantity*, 174 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	J. M., female	Farmer	58	29	110		64	Healthy.
2	C. T., female	Lady	16	26	100		74	Anæmia. No pulmonary disease.
3	E. S., female	Milliner	30	25	100		74	Recovering from hepatitis.

TABLE II.—*Stature*, 5 *Feet* 1 *Inch*. *Standard Quantity*, 174 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	C. C., female	Schoolmistress	69	32	80		94	Congested liver; habitual constipation.
2	M.W., female	Farmer	63	34	100		74	Chronic hepatitis.
3	S. S., female	Farmer	39	24	80		94	Hepatitis.
4	S. W., male	Gentleman	12	24	130		44	Healthy.

TABLE III.—*Stature*, 5 *Feet* 2 *Inches*. *Standard Quantity*, 182 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	S. P., female	Innkeeper	20	26	110		72	Healthy.
2	S. B., female	Butcher	23	27	110		72	Healthy.
3	M. B., female	Farmer	20	31	120		62	Healthy.
4	T. B., male	Farmer	16	32	140		42	Healthy.
5	M.W., female	Lady	15	25	70		112	Bronchitis.
6	S. L., female	Farmer	20	33	120		62	Recovering from peritonitis.
7	J. C., male	Farmer	29	33	140		42	Healthy.

TABLE IV.—*Stature*, 5 *Feet* 3 *Inches*. *Standard Quantity*, 190 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	W. B., male	Farmer	15	31	150		40	Healthy.
2	S. P., female	Farmer	32	30	110		80	Bronchitis.
3	R. B., female	Miller	27	29	140		50	Latent tubercles.
4	S. J., female	Farmer	31	28	140		50	Congested liver.
5	W. J., female	Farmer	31	26	140		50	Healthy.

TABLE V.—*Stature*, 5 *Feet* 4 *Inches*. *Standard Quantity*, 198 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	J. C., male	Farmer	27	36	190		8	Healthy.
2	S. C., female	Lady	21	25	112		86	Healthy.
3	M. S., female	Schoolmistress	36	28	130		68	Phthisis. 2nd stage.
4	E. M., female	Cooper	46	30	150		48	Healthy.
5	W. W., male	Gentleman	14	27	160		38	Healthy.
6	J. T., male	House plasterer	53	33	180		18	Healthy. The Devonshire pedestrian.

TABLE VI.—*Stature*, 5 *Feet* 5 *Inches*. *Standard Quantity*, 206 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	H. A., female	Tailor's wife	43	30	80		126	Phthisis, 2nd stage, of eight years' duration; still living.
2	A. N., female	Farmer	40	37	165		41	Healthy; sanguineous
3	A. B., female	Lady	32	30	130		76	Chronic metritis; bilio-sanguineous.
4	F. S., female	Lady	33	28	150		56	Constipation; bilio-lymphatic.
5	E. F., female	Lady's maid	29	31	170		36	Healthy; bilious.
6	E. W., female	Farmer	19	26	80		126	Phthisis, 1st stage.

TABLE VII.—*Stature*, 5 *Feet* 6 *Inches*. *Standard Quantity*, 214 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	G. S., male	Farmer	45	36	200		14	Chronic hepatitis.
2	J. B., male	Farmer	19	34	210		4	Healthy.
3	J. T., male	Shoemaker	43	37	210		4	Healthy.
4	W. S., male	Farmer	29	34	220	6		Healthy.
5	J. G., male	Shoemaker	43	32	200		14	Healthy.
6	E. G., male	Gentleman	26	41	220	6		Healthy; sanguineous, stout and fat
7	W. B., male	Farmer	21	35	174		40	Phthisis, 1st stage.
8	J. R., male	Gentleman	17	33	180		34	Healthy.
9	J. H., male	Blacksmith	27	37	270	56		Healthy.
10	J. B., male	Farmer	32	38	320	106		Healthy; spare habit; is a good runner; father a famed boxer; his grandmother died at the age of 110.

TABLE VIII.—*Stature*, 5 *Feet* 7 *Inches. Standard Quantity*, 222 *Cubic Inches.*

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	J. C., male	Miller	20	34	223	1		A month after an acute attack of pleurisy.
2	J. C., male	Farmer	28	34	232	10		Healthy.
3	J. H., male	Farmer	18	33	180		42	Healthy.
4	T. H., male	Farmer	67	34	180		42	Enlarged and indurated liver; tender epigastrium; spare habit.
5	J. S., male	Farmer	60	40	150		72	Very corpulent; congested liver.
6	T. J., male	Sailor	36	36	220		2	Dysentery.
7	W. B., male	Miller	25	35	244	22		Healthy.
8	W. C., male	Gardener	60	39	100		122	Bronchial catarrh (influenza)
9	S. B., male	Butcher	21	34	180		42	Bronchial catarrh (influenza)
10	P. K., male	Farmer	17	32	170		52	Healthy.
11	R. T., male	Farmer	26	37	200		22	Healthy.
12	S. B., male	Butcher	26	37	120		102	Recovering from pneumonia. A week afterwards, 180 cubic inches.
13	J. C., male	Farmer	61	39	250		28	Chronic gastritis.
14	S. P., female	Farmer	25	28	54		168	Pneumonia.

TABLE IX.—*Stature*, 5 *Feet* 8 *Inches. Standard Quantity*, 230 *Cubic Inches.*

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	J. C., male	Farmer	31	37	250	20		Healthy.
2	G. R., male	Farmer	59	36	180		50	Healthy.
3	J. A., male	Tailor	47	36	194		36	Healthy.
4	S. W., female	Lady	36	26	100		130	Latent tubercles in both lungs.
5	J. A., male	Farmer	49	38	200		30	Died a year afterwards, from hydatids in liver.
6	C. O., male	Farmer	50	39	260	30		Hypochondriasis. No local disease ascertainable.
7	G. S., male	Bookbinder	30	35	240	10		Healthy.
8	J. P., male	Farmer	39	39	185		45	Healthy.

TABLE X.—*Stature*, 5 *Feet* 9 *Inches*. *Standard Quantity*, 238 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	F. H., male	Miller	23	34	200		38	Healthy; spare habit
2	R. J., male	Farmer	38	37	200		38	Recovery from jaundice from congested liver.
3	P. R., male	Farmer	56	38	180		58	Healthy.
4	W. L., male	Farmer	65	37	210		28	Healthy.
5	J. W., male	Farmer	64	37	242	4		Healthy.
6	S. B., male	Farmer	43	38	230		8	Healthy.
7	H. L., male	Gardener	30	36	250	12		Healthy.
8	J.P.W., male	Gentleman	44	37	200		38	Healthy; stout, full, sanguineous habit.
9	J. C., male	Farmer	28	37	200		38	Bronchial catarrh (influenza)
10	W. S., male	Butcher	40	35	160		78	Congested liver
11	S. D., male	Mason	27	38	240	2		Healthy.
12	S. B., female	Farmer	40	27	140		98	Healthy; spare habit
13	W. H., male	Farmer	51	42	200		38	Healthy.
14	W. L., male	Cheesefactor	45	34	166		72	Phthisis, 1st stage; died two years afterwards.
15	J. T., male	Carpenter	49	41	230		8	Healthy.
16	J. J., male	Station-Master	30	37	200		38	Congested liver.

TABLE XI.—*Stature*, 5 *Feet* 10 *Inches*. *Standard Quantity*, 246 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	D. A., male	Farmer	18	36	220	34	26	Healthy.
2	J. G., male	Farmer	21	38	280			Congestive headache. Sanguineous. Very stout and fat.
3	J. B., male	Grocer	24	35	200		46	Strumous constitution, but in health.
4	J. M., male	Farmer	40	37	140		106	Hepatic congestion
						12		and enlargement.
5	J. L., male	Farmer	30	38	260			Healthy.
6	G. A., male	Gamekeeper	50	40	200		46	Very athletic; had been noted as a pugilist.
7	A. J., female	Milliner	25	29	60		186	Phthisis, 1st stage;
						4		since dead.
8	J. D., male	Farmer	32	37	250	4		Healthy.
9	J. M., male	Farmer	24	36	250			Healthy.
10	W. D., male	Farmer	23	40	230	19	16	Healthy.
11	I. J., male	Farmer	29	39	265			Is in health. Has lost three brothers and two sisters from rapid phthisis.
12	J. F., male	Actuary	32	40	220		26	Healthy.
13	E. H., male	Farmer	25	35	200		46	Healthy.

TABLE XII.—*Stature*, 5 *Feet* 11 *Inches*. *Standard Quantity*, 254 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	S. P., male	Farmer	42	37½	150		104	Recovery from pleurisy
2	T. L., male	Farmer	47	48	190		64	Very stout and fat. Dyspeptic.
3	I. N., male	Farmer and blacksmith	41	41	295	41		Athletic. If he expired either very quickly or very slowly, only 280 cubic inches.
4	T. J., male	Farmer	47	37	140		114	In health.
5	I. B., male	Farmer	24	36	200		54	Healthy.
6	T. B., male	Farmer	48	42	290	36		Healthy; athletic.
7	J. S., male	Gentleman	45	44	235		19	Corpulent; congested liver; lithic gravel.

TABLE XIII.—*Stature*, 6 *Feet*. *Standard Quantity*, 262 *Cubic Inches*.

No.	Initials and sex	Rank	Age	Circumference of chest	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Cubic inches			
1	J. P., male	Farmer	48	39	250		12	Healthy; spare habit
2	J. A., male	Farmer	36	39	260		2	Healthy.
3	P. J., male	Farmer	41	41	244		18	Healthy.
4	C. P., male	Publican	38	37	240		22	Healthy.
5	J. S., male	Policeman	32	45	220		42	Healthy; stout, athletic, and fat; bilio-lymphatic.
6	J. O., male	Farmer	25	37	240		22	Healthy.
7	W. L., male	Farmer	53	39	224		38	Healthy.
8	W. P., male	Shoemaker	18	36	262			Scrofulous. Anchylosis of right knee.
9	S. S., male	Farmer	45	41	280	18		Healthy.

TABLE XIV.—*Stature, below* 5 *Feet and above* 6 *Feet.*

No.	Initials and sex	Rank	Age	Circumference of chest	Stature		Standard quantity	Vital capacity	More than standard	Less than standard	Remarks
				Inches	Ft.	In.	Cubic inches				
1	M. R., female	Farmer	12	22	4	1	78	75	·	3	Healthy.
2	E. J., female	Farmer	36	31	4	11	166	100		66	Chronic hepatitis.
3	R. G., male	Farmer	14	26	4	9	150	90		60	Healthy.
4	J. G., male	Farmer	14	27	4	10	158	120		38	Healthy.
5	A. A., female	Tailor	10	24	4	6	126	80		46	Healthy.
6	W. B., male	Farmer	8	24	4	2	86	70		16	Healthy.
7	D. M., male	Farmer	9	24	4	4	102	80		22	Healthy.
8	W. N., male	Farmer	35	40	6	6	310	280		30	Healthy.
9	J. B., male	Farmer	31	42	6	1	270	280	10		Healthy; sanguineous.
10	E. W., male	Merchant	33	37½	6	1	270	276	6		Thoracic pains; two years before, pneumonia of right lung.
11	G. B., male	Farmer	32	38	6	1	270	300	30		Healthy; sanguineous.
12	W. D., male	Clergyman	34	35	6	2	270	295	25		Healthy; an excellent walker; sanguineous.
13	T. S. G., male	Show giant	18	51	7	3	382	370		12	Healthy, muscular, not fat; chest expands by tape measure 6 inches.