

STUDIES OF LUNG VOLUME.

III. TUBERCULOUS WOMEN.

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(Received for publication, September 15, 1917.)

INTRODUCTION.

In the preceding paper (Garvin, Lundsgaard, and Van Slyke) a report was made of a series of determinations of the different lung volumes in thirty-one adult men suffering from pulmonary tuberculosis. A comparison was drawn between the actual values and the values calculated from the chest dimensions on the basis of certain ratios previously worked out on normal subjects (Lundsgaard and Van Slyke). The literature concerning pulmometry in pulmonary tuberculosis is given in the preceding paper.

The present paper is a report of similar determinations on twenty adult women with phthisis. The technique in determining the lung volumes, in measuring the chest wall, and in determining the movement of the diaphragm is fully described in Papers I and II. The presentation of the experimental and clinical observations on the women is carried out after exactly the same plan as in Paper II, where sufficient explanation can be found. Only the explanation of the symbols used in the individual diagrams (Text-figs. 1 to 20) will be repeated here:

Physical Signs.—

Light lines, slight dullness.

Heavy lines, moderate dullness.

Cross-hatching, marked dullness.

Fine dots, fine râles.

Larger dots, moderate and coarse râles.

Small rings, large crackling râles.

Crosses, pleuritic rubs.

Circles, antrum formation.

There is no difference in the interpretation of horizontal and vertical lines.

X-Ray Signs.—

Lightly shaded lines, slight density of shadow.

Heavy lines, marked density.

Circles, cavity.

Dots, stippling, the larger the dots, the coarser the stippling.

There is no difference in the interpretation of horizontal and vertical lines.

The patients are divided into three groups, the incipient (Text-fig. 21), moderately advanced, and advanced cases. The last two groups, however, are described together and the values put together in Text-fig. 22. Nos. 9 and 19 are advanced (Group III in Paper II); the rest are moderately advanced (Group II in Paper II). The reason for this is that there is, as pointed out in Paper I, no sharp difference in our results between patients belonging to Groups II and III.

Group I. Incipient Cases (Nos. 1 to 8, Text-Fig. 21).

It will be remembered that the result of the determinations on nine men with incipient tuberculosis was (1) a normal total capacity, (2) a moderately increased residual air resulting in (3) a moderately diminished vital capacity. At first sight the results on the women seem quite opposite. The values in Nos. 1, 2, 3, 4, and 8 agree with those found in the men, but in Nos. 5, 6, and 7, although they also are clinically incipient, a great decrease in the total and vital capacity is encountered. A similar drop is seen in the middle capacity, whereas the residual air is normal.

However, sufficient cause can be found to account for this. No. 5 was a patient with miliary tuberculosis of the lungs. She had râles on both sides all over the lungs. No. 6 had a bronchial stenosis on the left side; the left lung participated only to a small extent in the ventilation. It will be seen that her left diaphragm moved in the opposite direction to the normal movement in respiration. This probably was a result of the difficult passage to the left lung. The observed vital and middle capacity is about half of the calculated. No. 7 did not move her diaphragm at all. The residual air, however,

is not increased, which probably can be looked upon as indicating that her diaphragm is fixed in expiratory position. The inability to lower the diaphragm at inspiration must, of course, diminish her total capacity to a considerable extent.

The results of the determinations in these cases therefore confirm the previous findings in men, and show that if the total capacity is diminished in patients with incipient tuberculosis, some special cause is to be found, such as miliary tuberculosis, obstruction of bronchi, or inability to move the diaphragm.

Group II. Moderately Advanced and Advanced Cases (Nos. 9 to 20, Text-Fig. 22).

Group II (Nos. 9 to 20, moderately advanced and advanced cases) shows the same picture that was found in men: (1) As a rule diminished total capacity. In all the cases except Nos. 9, 10, 13, and 17, the total capacity is below the normal minimum; in these four cases it is above the normal minimum but below the normal average. (2) Decreased vital capacity. (3) Fairly normal residual air. (4) The middle capacity (not determined in all cases) is in some patients normal, in others subnormal. As mentioned before, we do not lay much stress on the determination of the middle capacity, because it is dependent not only on anatomic but also on functional factors. What the latter are we do not understand, but we have seen subjects unconsciously inflate or deflate the chest so as to change the middle capacity by several hundred centimeters.

Excursions of the Diaphragm.

The technique is described in Papers I and II. The excursions of the diaphragm are, as a whole, smaller than in normal subjects and agree with those found in the men. In one instance (No. 7) no movement was found at all. No evidence was found for a mechanical obstacle in the pleura, lungs, or abdomen. Whether the diaphragm was paralyzed through involvement of the phrenic nerves, or whether it was due to a reflex, we do not know. In another case (No. 6) the left half of the diaphragm moved in the direction opposite to the normal. Sufficient explanation is found in the fact that the left

TABLE I.

Influence of Change of Position and of Exercise on Pulse and Respiration.

No. on individual diagrams.	Case No.	Resting in bed.		Standing up.		After having run up three flights of stairs.		Other symptoms.
		Pulse.	Respirations.	Pulse.	Respirations.	Pulse.	Respirations.	
Group I.								
1	4167	94	24	120	24	124	30	Very slight dyspnea. Pulse slows quickly.
2	4247	90	24	96	24	150	26	Slight dyspnea; cyanosis of hands.
3	4164	96	18	110	25	136	32	Palpitation; dyspnea; throbbing temples.
4	4215	74	18	90	24	150	44	Very nervous; very dyspneic; face flushed; hands cyanotic.
5	4190	102	30	112	34	150	42	Palpitations; dizziness.
6	4151	74	24	80	24	130	32	Very dyspneic; face slightly flushed.
7	4309	102	30	116	30	160	36	Slight dyspnea; face flushed.
8	3996	78	18	102	18	120	24	Face flushed.
Group II.*								
9	4061	80	17	115	18	145	22	None.
10	4314	72	18	96	20	132	28	Slight dyspnea; face slightly flushed.
11	4059	102	22	120	22	140	30	Slight dyspnea; face much flushed.
12	3882	72	26	84	24	150	30	Face flushed; dizziness; very dyspneic.
13	4191	72	16	102	16	160	20	None.
14	4044	90	24	110	22	147	26	Flush.
15	4192	72	22	84	22	150	30	Moderate dyspnea; face slightly pale.
17	4283	90	18	92	18	125	28	Palpitation; face flushed.
18	4264	90	12	100	16	120	24	"
19	3908	112	22	112	22	145	28	" marked dyspnea; face flushed; weak pulse.
20	4103	64	16	75	20	145	28	Slight dyspnea; face pale; pulse very weak.

* Group II is composed of moderately advanced cases (Group II in Paper II) and advanced cases (Group III in Paper II).

main bronchus was almost obstructed. An inspiratory movement of the thoracic wall could, under these conditions, result in an upward movement of the diaphragm on this side.

Influence of Change of Position and of Exercise on Pulse and Respiration (Table I).

The increase in pulse rate on exercise is still more marked in the women than in the men. The rate of respiration is also somewhat increased. As a whole, in men no such increase in the respiration was found.

SUMMARY.

The total capacity, middle capacity, and residual air have been determined in twenty adult women suffering from pulmonary tuberculosis. The chest volumes have been determined in each case and the normal lung volumes calculated by means of the ratios worked out in Paper I and applied to thirty-one men in Paper II. The excursions of the diaphragm have been determined by fluoroscopy in all cases.

Of eight patients with incipient tuberculosis, five had lung capacities like those of men in the same group;¹ *i.e.*, about normal total capacity, slightly increased residual air, and consequently somewhat decreased vital capacity. Three had considerably diminished total capacity. In these three patients, however, clinical abnormalities were found (extensive miliary tuberculosis, obstruction of bronchus, fixation of diaphragm in expiratory position).

In twelve patients with moderately advanced and advanced tuberculosis, the results agreed with those found in men,¹ the total capacity and vital capacity being decreased, while the residual air was practically normal.

BIBLIOGRAPHY.²

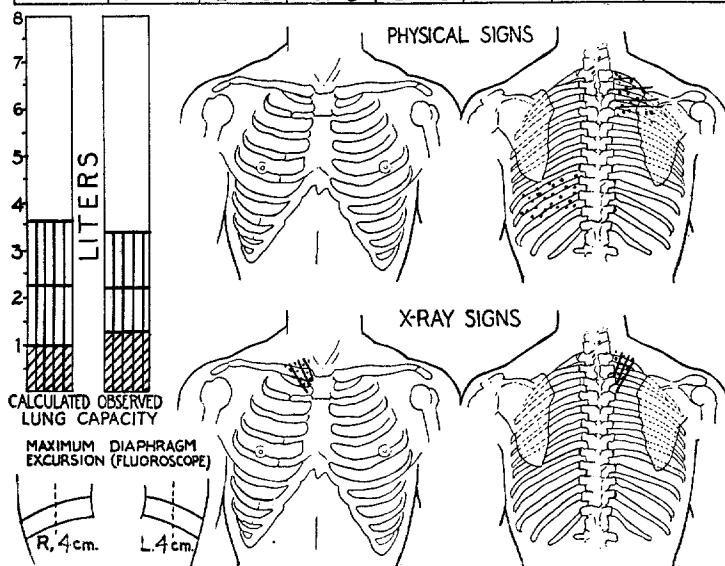
- Garvin, A., Lundsgaard, C., and Van Slyke, D. D., *J. Exp. Med.*, 1918, xxvii, 87.
Lundsgaard, C., and Van Slyke, D. D., *J. Exp. Med.*, 1918, xxvii, 65.

¹ See Paper II.

² An extensive bibliography can be found in the two preceding papers.

No.1 (CASE 4167)

POSITION	CHEST DIMENSIONS			CHEST VOLUME* liters	LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT;POST, cm.	TRANSVERSE cm.				
REST	16.8	16.1	22.2	6.00	2.15	35.8	35.0
MAX.INSP.	16.8	17.3	22.6	6.56	3.35	51.0	—
MAX.EXP.	16.8	15.1	21.5	5.45	1.25	23.0	—



TEXT-FIG. 1.

No. 1 (Case 4167).—Female, factory worker; age 22 years. Incipient; active. Sputum — — +, on admission, in course of treatment, and at present.

Onset 17 months ago with slight cough, blood-streaked sputum, and loss of weight and strength. Under treatment has gained weight but disease is still slightly active. Physical signs have increased slightly in the past 7 months, and a previous negative sputum has become positive.

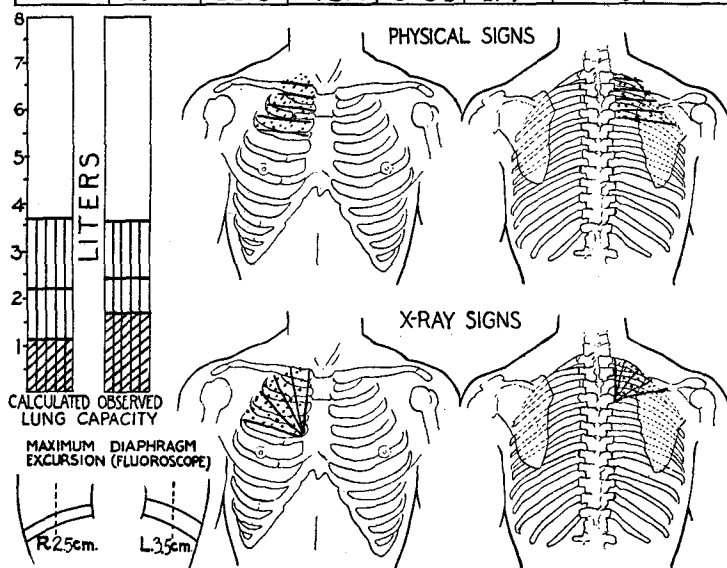
Height 157 cm. Theoretical normal weight.....	kg.	53.5
Present weight.....		48.0
Patient's idea of normal weight.....		43.0
Date of highest weight 2 months ago.....		48.5
“ “ lowest “ 12 “ “.....		41.0
Treatment duration 7 months.		

Physical Signs.—April 9, 1917. Right, no impairment of resonance; breathing harsh; fine râles with cough only posteriorly to fourth spine. Left, upper lobe normal; posteriorly there are moist râles from base to ninth dorsal spine with aid of cough; no dullness or breath sound change in this area, and signs are intrapulmonic (not affected by breathing and diaphragm has a normal excursion). (See illustration of normal volume.)

X-Ray Signs.—April 7, 1917. Right apex moderately densely infiltrated. Root slightly infiltrated. Left lung practically normal (see physical examination). Mediastinal contents normal.

No. 2 (CASE 4247)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm	ANT. POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	15.0	16.8	23.8	6.00	2.4	40.0	25.0
MAX. INSP.	15.0	17.4	25.5	6.65	3.6	54.2	—
MAX. EXP.	15.0	16.0	23.7	5.69	1.7	29.9	—



TEXT-FIG. 2.

No. 2 (Case 4247).—Female, student; age 18 years. Incipient; inactive. Sputum — = +, on admission, in course of treatment, and at present.

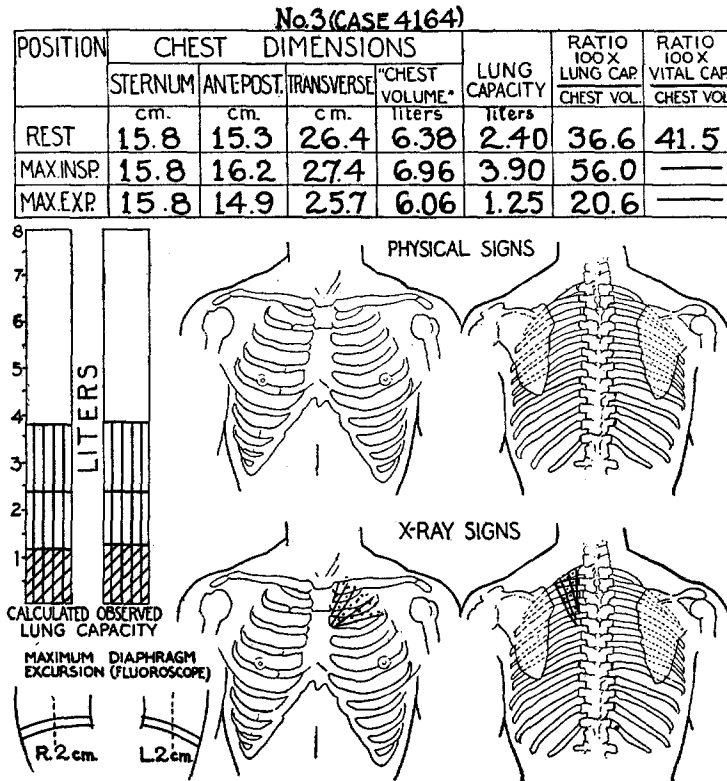
Onset 16 months ago with cough and blood-streaked sputum. Under sanatorium treatment symptoms have disappeared and physical signs have diminished in number.

Height 156 cm.	Theoretical normal weight.....	52.0
Present weight.....		64.0
Patient's idea of normal weight.....		59.0
Date of highest weight 0 months ago.....		64.0
“ “ lowest “ 4 “ “.....		58.0

Treatment duration 5 months.

Physical Signs.—April 9, 1917. Right, slight impairment of resonance; breath sounds are a little harsh; fine râles appear with aid of cough to the third rib anteriorly and fourth spine posteriorly. Left lung seems normal.

X-Ray Signs.—April 7, 1917. Right apex and first, second, and third interspaces very slightly stippled and striated. Left lung normal. Mediastinal contents are a little to the right. Left lung area increased.



No. 3 (Case 4164).—Female, domestic; age 19 years. Incipient; inactive. Sputum + = —, on admission, in course of treatment, and at present.

Onset 12 months ago with malaise and loss of strength; slight cough with streaked sputum for a few days. Under sanatorium treatment symptoms have diminished and physical signs have disappeared.

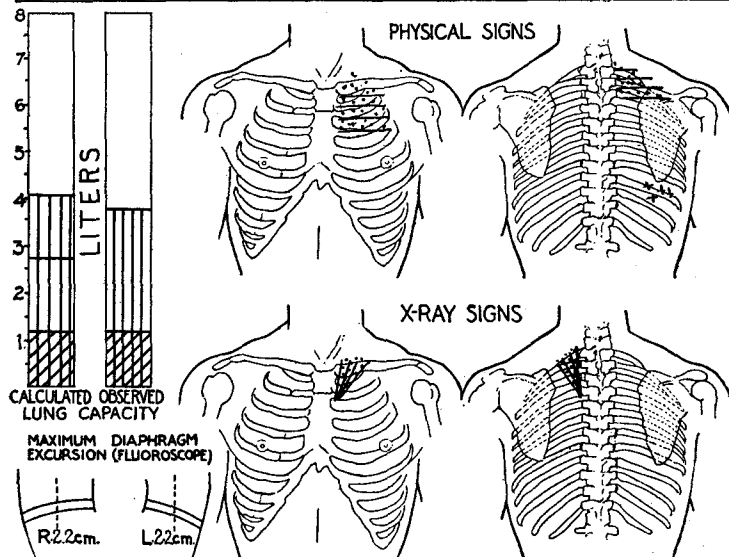
Height 152 cm.	Theoretical normal weight.....	kg. 51.0
Present weight.....		55.0
Patient's idea of normal weight.....		50.0
Date of highest weight 1 month ago.....		56.5
" " lowest " 7 months "		47.5
Treatment duration 7 months.		

Physical Signs.—April 9, 1917. Right lung seems normal. Left lung seems normal. Patient has had tubercle bacilli in sputum within 6 weeks.

X-Ray Signs.—April 7, 1917. Right lung clear. Left apex stippled and striated moderately to the second rib. Mediastinal contents normal.

No. 4 (CASE 4215)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.	*CHEST VOLUME* liters			
REST	16.7	17.2	23.4	6.71	2.52	37.0	36.0
MAX. INSP.	16.7	18.4	24.5	7.54	3.72	49.1	—
MAX. EXP.	16.7	16.3	22.5	6.12	1.22	19.9	—



TEXT-FIG. 4.

No. 4 (Case 4215).—Female, student; age 18 years. Incipient; inactive. Sputum + + -, on admission, in course of treatment, and at present.

Onset 30 months ago with cough following influenza. Under sanatorium treatment symptoms have disappeared, and physical signs diminished about 75 per cent.

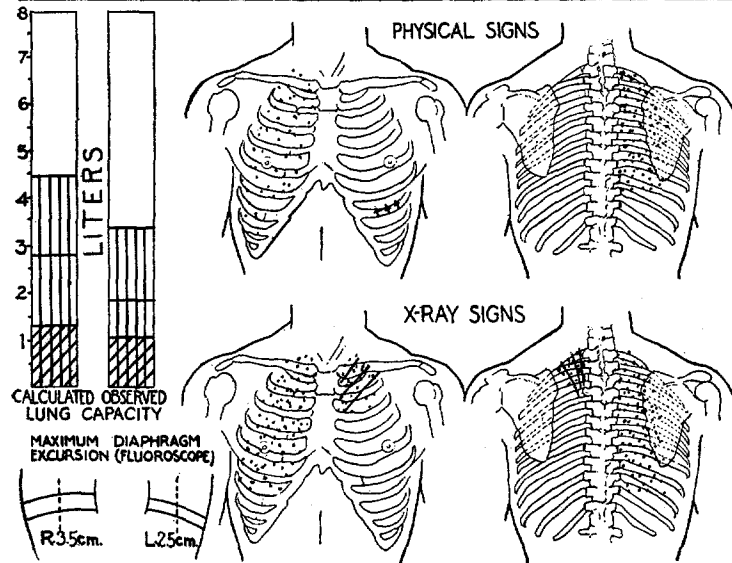
Height 155 cm.	Theoretical normal weight.....	kg. 51.0
Present weight.....		61.0
Patient's idea of normal weight.....		50.0
Date of highest weight 0 months ago.....		61.0
“ “ lowest “ 30 “ “.....		47.0
Treatment duration 7 months.		

Physical Signs.—April 9, 1917. Left apex, slight dullness; breath sounds diminished; Râles fine and moist to third rib anteriorly and to spine of scapula posteriorly. Right base posteriorly gives fine friction rubs on deep breathing.

X-Ray Signs.—April 7, 1917. Right lung fairly normal. Left apex and first inter-space moderately densely infiltrated. Mediastinal contents normal.

No. 5 (CASE 4190)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT:POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	17.7	16.7	25.7	7.60	1.82	24.0	30.5
MAX. INSP.	17.7	17.4	26.3	8.10	3.32	41.0	—
MAX. EXP.	17.7	15.7	24.9	6.92	1.02	14.7	—



TEXT-FIG. 5.

No. 5 (Case 4190).—Female, stock clerk; age 17 years. Incipient; inactive. Chronic miliary tuberculosis of the right lung. Sputum — —, on admission and in course of treatment.

Onset 7 months ago with slight cough and malaise, and dyspnea on exertion. Under treatment has improved in symptoms while the signs have remained the same.

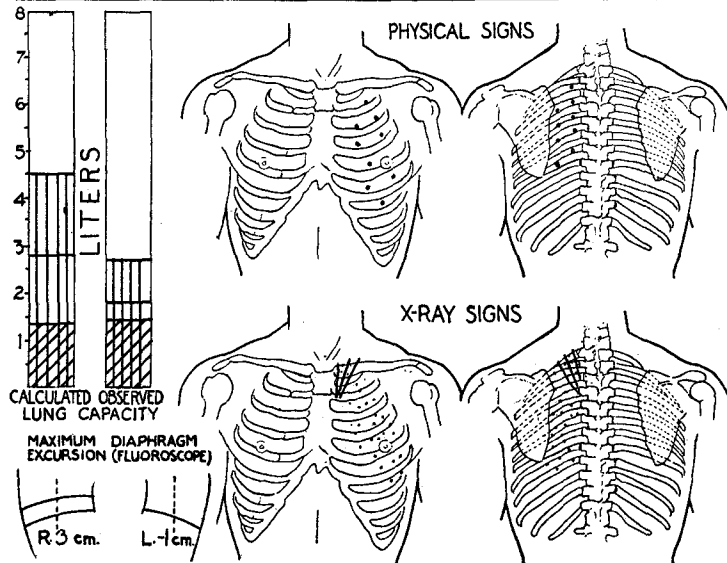
Height 158 cm.	Theoretical normal weight.....	kg. 53.5
Present weight.....		59.0
Patient's idea of normal weight.....		52.0
Date of highest weight 0 months ago.....		59.0
" " lowest " 17 " ".....		45.5
Treatment duration 6 months.		

Physical Signs.—April 9, 1917. Right, no impairment of resonance or change in breath sounds; a few râles after cough fairly well disseminated throughout the right lung. Left, no change in resonance or in breath sounds; a few friction rubs at the base.

X-Ray Signs.—April 7, 1917. Right lung shows very fine discrete spotting throughout. Left apex and first and second interspaces show slight spotting and striations. Mediastinal contents normal.

No. 6 (CASE 4151)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	18.2	17.6	23.5	7.52	1.86	24.7	18.0
MAX. INSP.	18.2	18.0	24.7	8.15	2.74	33.6	—
MAX. EXP.	18.2	16.9	22.9	7.04	1.41	20.2	—



TEXT-FIG. 6.

No. 6 (Case 4151).—Female, student; age 19 years. Incipient; inactive. Left primary bronchus obstruction (large gland). Sputum + + -, on admission, in course of treatment, and at present.

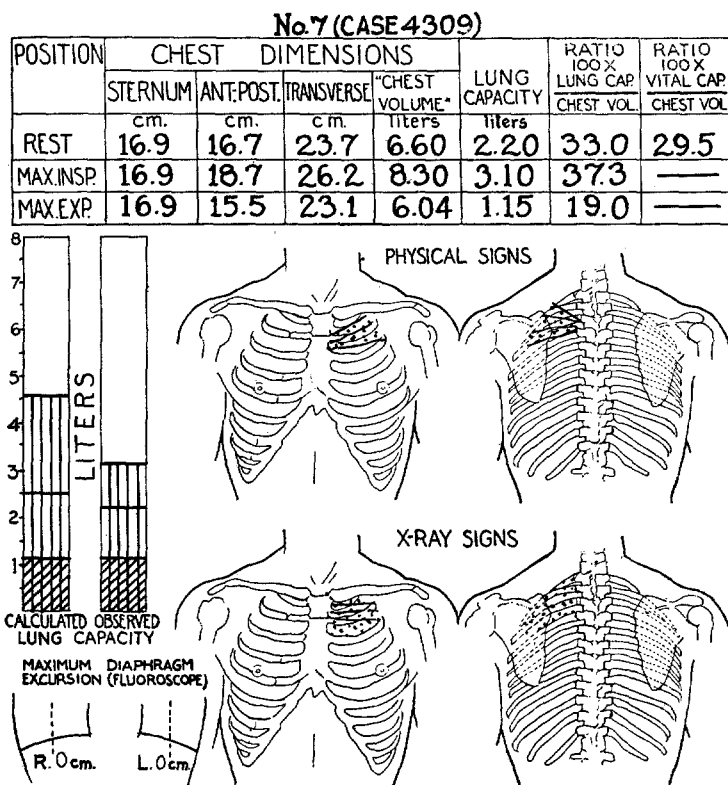
Onset 20 months ago with malaise, slight cough, and dyspnea. Under treatment she has gained much in weight, is still dyspneic, but feels much better. Physical signs unchanged.

Height 158 cm.	Theoretical normal weight.....	kg. 52.5
Present weight.....		52.5
Patient's idea of normal weight.....		54.5
Date of highest weight 22 months ago.....		56.5
“ “ lowest “ 7 “ “.....		48.5

Treatment duration 7 months.

Physical Signs.—April 9, 1917. Right, chest normal; no impairment of resonance. Left, breathing diminished; coarse loud râles throughout left chest.

X-Ray Signs.—April 7, 1917. Right lung a little hazy throughout. Left lung, apical space slightly infiltrated; rest of the lung shows very fine slight spotting on full inspiration. Mediastinal contents are to left. Right lung area much increased.



TEXT-FIG. 7.

No. 7 (Case 4309).—Female, student; age 16 years. Incipient; inactive. Sputum + + —, on admission, in course of treatment, and at present.

Onset 8 months ago with malaise and slight cough. Under treatment symptoms and signs have markedly diminished. Patient feels perfectly well.

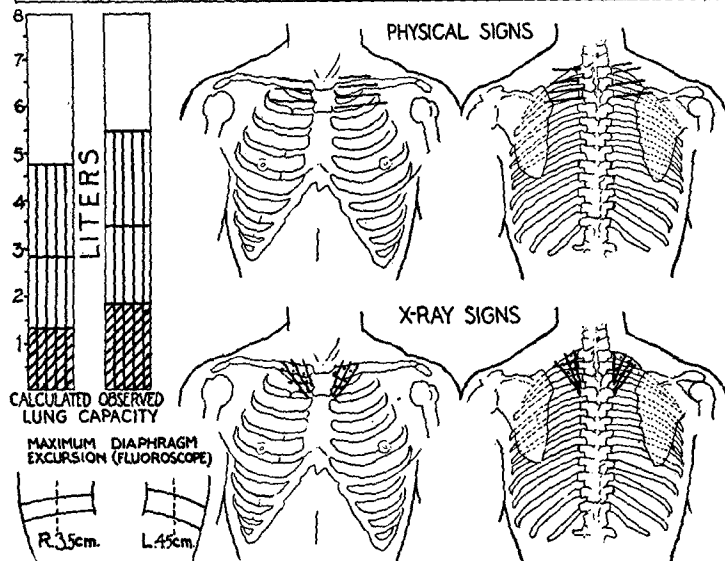
Height 157 cm.	Theoretical normal weight.....	kg. 52.0
Present weight.....		48.5
Patient's idea of normal weight.....		45.5
Date of highest weight 0 months ago.....		48.5
“ “ lowest “ 15 “ “.....		45.5
Treatment duration 3 months.		

Physical Signs.—April 9, 1917. Right lung normal. Left, slight dullness below clavicle; breath sounds are a little harsh; râles over second and third interspaces anteriorly and to fourth spine posteriorly with aid of cough.

X-Ray Signs.—April 7, 1917. Right lung normal. Left, first and second interspaces moderately densely infiltrated. Mediastinal contents normal.

No. 8 (CASE 3996)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANTE-POST. cm.	TRANSVERSE cm.	CHEST VOLUME* liters			
REST	18.7	16.7	24.4	7.61	3.42	45.0	46.7
MAX. INSP.	18.7	18.5	25.1	8.68	5.42	62.2	—
MAX. EXP.	18.7	16.0	23.4	7.00	1.87	26.7	—



TEXT-FIG. 8.

No. 8 (Case 3996).—Female, trained nurse; age 35 years. Incipient; inactive. Sputum + = -, on admission, in course of treatment, and at present.

Onset 25 months ago with malaise and cough. Under sanatorium treatment general condition much improved.

Height 172 cm.	Theoretical normal weight.....	kg. 68.0
Present weight.....		67.5
Patient's idea of normal weight.....		66.0
Date of highest weight 0 months ago.....		67.5
“ “ lowest “ 6 “ “.....		59.0

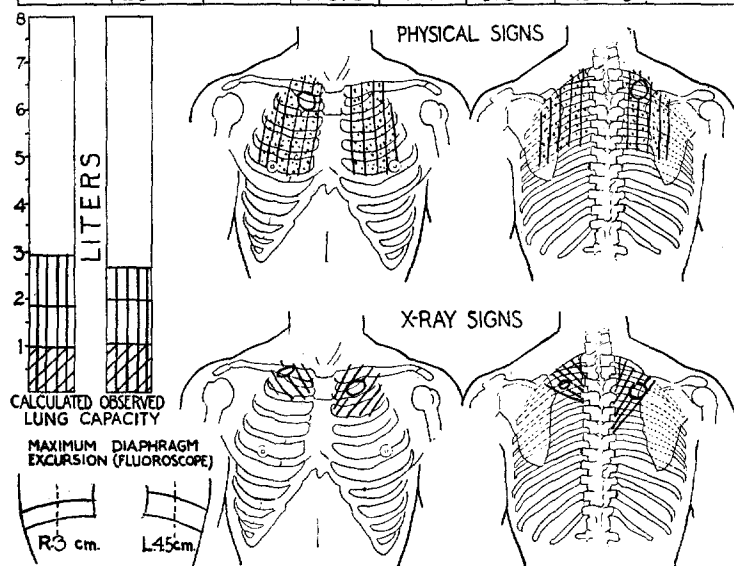
Treatment duration 11 months.

Physical Signs.—April 9, 1917. Right, slight impairment of resonance; slight increase in sharpness of breath sounds; no râles. Left, slight dullness; breath sounds slightly increased in intensity; no râles.

X-Ray Signs.—April 7, 1917. Right apex moderately densely infiltrated and spotted; rest of lung normal. Left apex moderately densely infiltrated and spotted; rest of lung normal. Mediastinal contents slightly to the left.

No. 9 (CASE 4061)

POSITION	CHEST DIMENSIONS			CHEST VOLUME* liters	LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.				
REST	15.5	15.8	20.8	5.09	1.95	38.2	32.4
MAX. INSP.	15.5	17.0	21.3	5.34	2.60	48.7	—
MAX. EXP.	15.5	15.2	20.3	4.78	1.0	20.9	—



TEXT-FIG. 9.

No. 9 (Case 4061).—Female, saleswoman; age 34 years. Advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 48 months ago with malaise, cough, expectoration, and slight loss of weight. Under sanatorium treatment general condition has slightly improved, the physical signs remaining the same.

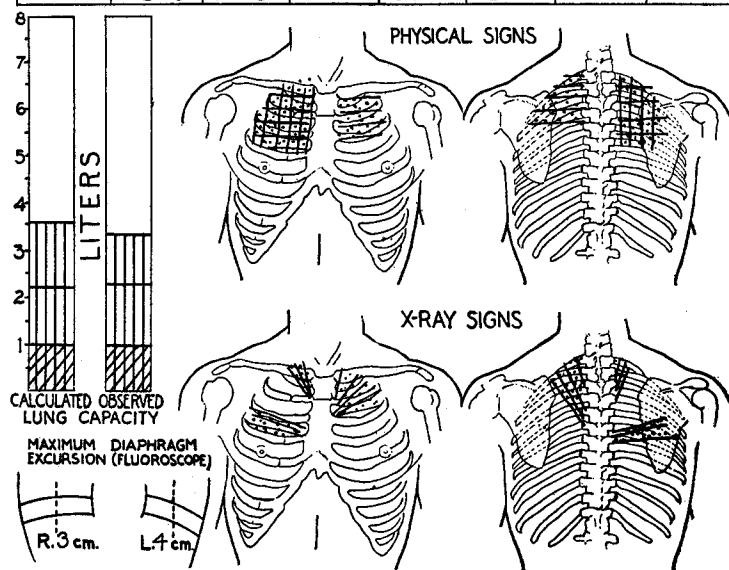
Height 160 cm.	Theoretical normal weight.....	kg. 58.5
Present weight.....		45.5
Patient's idea of normal weight.....		50.0
Date of highest weight 6 years ago.....		50.0
“ “ lowest “ 12 months ago.....		40.5
Treatment duration 10 months.		

Physical Signs.—April 9, 1917. Right, slight dullness; breath sounds are moderately harsh; râles occur at apex to fifth rib anteriorly and to sixth spine posteriorly with aid of cough; cavernous breathing at right apex. Left, moderate dullness; breath sounds are markedly harsh; râles of medium moist type to fifth rib anteriorly and to sixth spine posteriorly, greatly increased by aid of cough.

X-Ray Signs.—April 7, 1917. Right apex and first interspace densely infiltrated; cavity under the clavicle $1\frac{1}{2}$ by $3\frac{1}{2}$ cm. Left apex and first and second interspaces quite densely infiltrated; cavity below the clavicle 4 by 3 cm. Mediastinal contents centrally placed.

No. 10 CASE 4314

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANTE-POST. cm.	TRANSVERSE cm.	*CHEST VOLUME* liters			
REST	18.0	14.6	22.1	5.81	2.25	38.8	40.5
MAX. INSP.	18.0	14.9	24.0	6.43	3.35	52.1	—
MAX. EXP.	18.0	13.9	21.5	5.38	1.0	18.6	—



TEXT-FIG. 10.

No. 10 (Case 4314).—Female, housewife; age 30 years. Moderately advanced; active. Sputum — — —, on admission, in course of treatment, and at present.

Onset 16 months ago with malaise, cough, and expectoration; loss of strength followed; slight temperature. Under treatment symptoms became stationary, but lesion has progressed slightly.

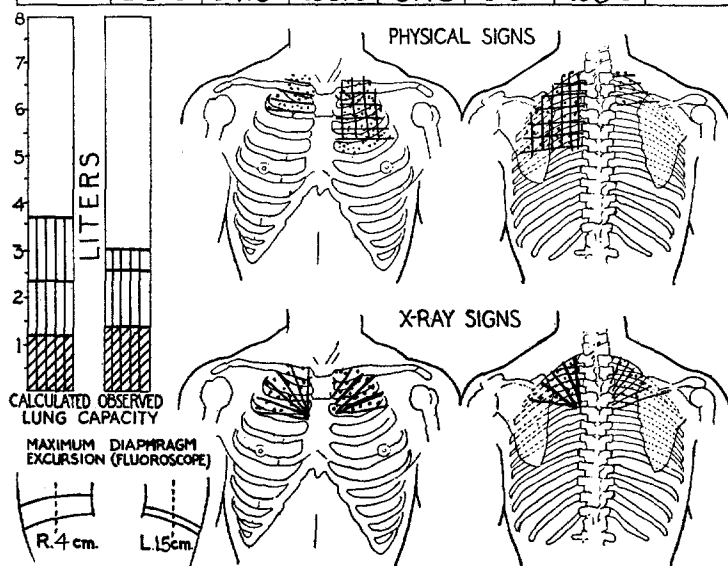
Height 155 cm.	Theoretical normal weight.....	53.5
Present weight.....		40.5
Patient's idea of normal weight.....		47.5
Date of highest weight 8 years ago.....		47.5
" " lowest " 3 months ago.....		38.5
Treatment duration 3 months.		

Physical Signs.—April 9, 1917. Right, marked impairment of resonance; breath sounds harsh; coarse moist râles on breathing, with an increase in number with cough to fourth rib anteriorly and sixth spine posteriorly. Left, slight impairment of resonance; no change in breath sounds; fine moist râles increased by cough to third rib anteriorly and fourth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex densely spotted; first and second interspaces clear; third interspace moderately densely spotted. Left apex and first and second interspaces moderately densely spotted. Mediastinal contents normal.

No. 11 (CASE 4059)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANT:POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	18.3	15.9	21.7	6.32	2.5	39.6	27.0
MAX. INSP.	18.3	16.4	22.3	6.68	3.0	44.9	—
MAX. EXP.	18.3	14.9	21.0	5.73	1.3	23.6	—



TEXT-FIG. 11.

No. 11 (Case 4059).—Female, stenographer; age 20 years. Moderately advanced; active. Sputum — + +, on admission, in course of treatment, and at present.

Onset 18 months ago with cough, malaise; and loss of weight. Under sanatorium treatment general condition improved and symptoms diminished markedly although physical signs increased.

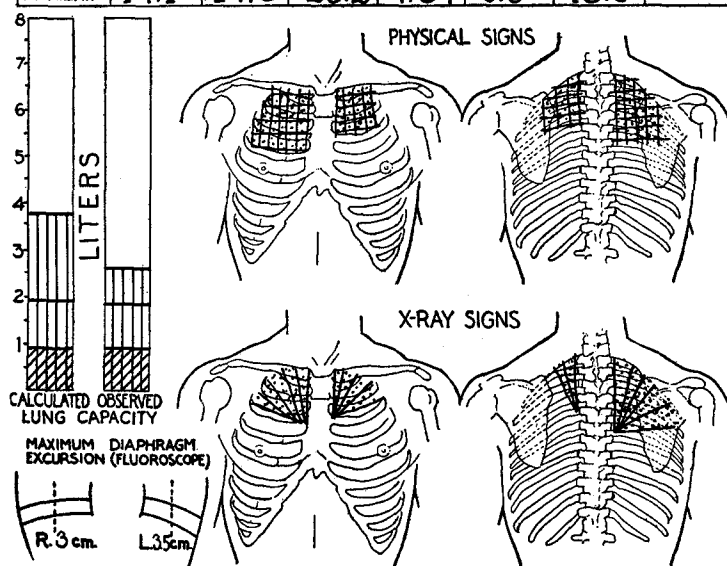
Height 160 cm.	Theoretical normal weight.....	kg. 54.5
Present weight.....		46.0
Patient's idea of normal weight.....		45.5
Date of highest weight 3 months ago.....		48.5
“ “ lowest “ 10 “ “.....		37.5
Treatment duration 10 months.		

Physical Signs.—April 9, 1917. Right, slight dullness; breath sounds slightly harsh; fine moist râles to second rib anteriorly and to third spine posteriorly, much increased with cough. Upper part of left lung, marked dullness at apex to third rib anteriorly, and to sixth spine posteriorly; breath sounds amphoric anteriorly, harsh posteriorly; medium moist râles to fourth rib anteriorly and to fifth spine posteriorly. Cough increased the number of signs.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately spotted. Left apex and first interspace very dense; second interspace very finely stippled. Mediastinal contents entirely to the left. Right lung area much increased.

No. 12 (CASE 3882)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.	CHEST VOLUME* liters			
REST	14.1	15.4	23.6	5.12	1.8	35.3	31.5
MAX. INSP.	14.1	16.4	25.1	6.80	2.6	38.2	—
MAX. EXP.	14.1	14.8	23.2	4.84	0.9	18.6	—



TEXT-FIG. 12.

No. 12 (Case 3882).—Female, clerk; age 21 years. Moderately advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset with cough 3 years ago; malaise and loss of weight followed. Later a high temperature with right base fluid which cleared up spontaneously in 60 days. Under treatment, symptoms have markedly improved and lesion has become stationary.

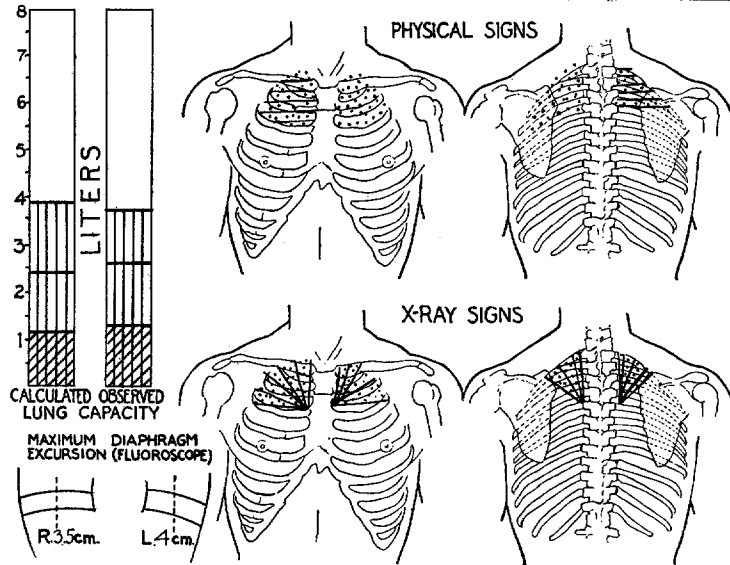
Height 157 cm. Theoretical normal weight.....	kg. 53.5
Present weight.....	55.0
Patient's idea of normal weight.....	53.5
Date of highest weight 1913.....	56.0
“ “ lowest “ 16 months ago.....	46.0
Treatment duration 15 months.	

Physical Signs.—April 9, 1917. Right, marked dullness to fourth rib; harsh breathing; medium moist râles numerous with, and fewer without aid of cough to fourth rib anteriorly and sixth spine posteriorly. Left, marked dullness to third rib; harsh breathing; râles are rather moist, increased by cough, to third rib anteriorly and fourth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely stippled and striated. Left apex and first interspace moderately densely stippled and striated. Mediastinal contents normal.

No. 13 (CASE 4191)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	16.5	16.4	23.9	6.46	2.6	40.3	38.6
MAX. INSP.	16.5	17.6	24.8	7.20	3.7	51.4	—
MAX. EXP.	16.5	15.0	23.2	5.74	1.2	20.9	—



TEXT-FIG. 13.

No. 13 (Case 4191).—Female, factory worker; age 18 years. Moderately advanced; active. Sputum — — +, on admission, in course of treatment, and at present.

Onset 6 months ago with hemoptysis. With sanatorium treatment symptoms markedly decreased, but physical examination shows an increase in the size of the lesion.

Height 157 cm.	Theoretical normal weight.....	kg. 51.0
Present weight.....		57.0
Patient's idea of normal weight.....		52.0
Date of highest weight 2 months ago.....		57.5
“ “ lowest “ 11 “ “.....		48.0

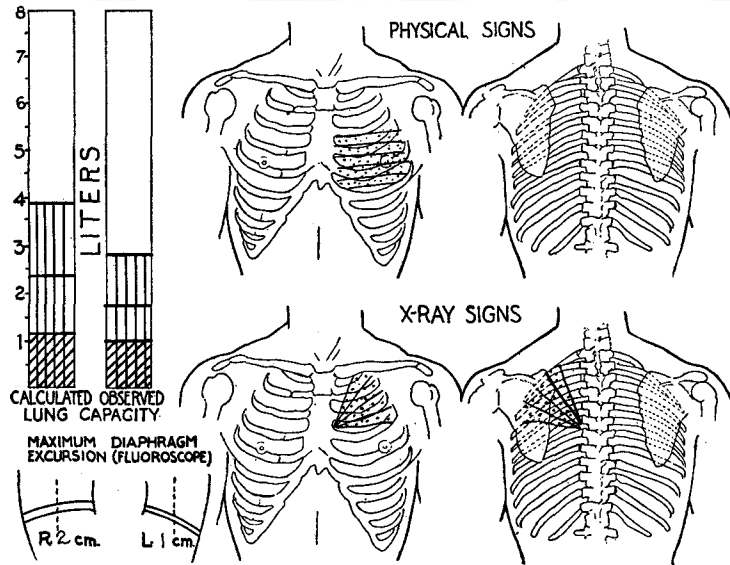
Treatment duration 6 months.

Physical Signs.—April 9, 1917. Right, slightly dull; breath sounds slightly harsh; medium moist râles to third rib anteriorly and to fourth spine posteriorly, very much increased by cough. Left, no dullness; breath sounds slightly harsh; medium moist râles to third rib anteriorly and to fourth spine posteriorly, much increased with the aid of cough.

X-Ray Signs.—April 7, 1917. Right apex and first and second interspaces moderately densely infiltrated. Left apex and first and second interspaces moderately densely infiltrated. Mediastinal contents a little to the left.

No.14(CASE 4044)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANT:POST. cm.	TRANSVERSE cm.	*CHEST VOLUME* liters			
REST	17.2	16.4	23.5	6.62	1.70	25.6	27.2
MAX.INSP	17.2	17.6	24.3	7.34	2.80	38.1	—
MAX.EXP	17.2	15.8	23.0	6.25	1.0	16.0	—



TEXT-FIG. 14.

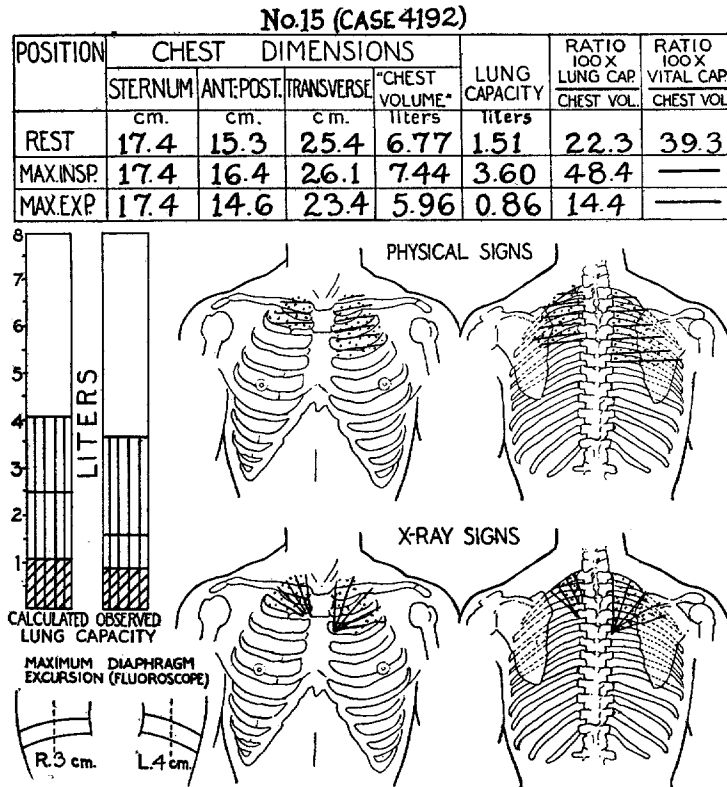
No. 14 (Case 4044).—Female, stenographer; age 17 years. Moderately advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 17 months ago with cough and expectoration; no physical discomfort. Under treatment cough has diminished and weight increased. Physical signs have diminished markedly.

Height 156 cm. Theoretical normal weight.....	kg. 50.5
Present weight.....	59.0
Patient's idea of normal weight.....	48.5
Date of highest weight 1 month ago.....	60.0
“ “ lowest “ 19 months “	47.5
Treatment duration 11 months.	

Physical Signs.—April 9, 1917. Right lung normal. Left, slight dullness over third, fourth, and fifth interspaces anteriorly; breathing harsh over this area; fine rales after cough in this area. Posteriorly there are no physical signs.

X-Ray Signs.—April 7, 1917. Right lung clear. Left, first, second, and third interspaces moderately densely infiltrated. Mediastinal contents markedly to the left. Right lung area is much increased.



TEXT-FIG. 15.

No. 15 (Case 4192).—Female, clerk; age 16 years. Moderately advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset 18 months ago with cough and slight hemoptysis. Under treatment general condition improved slightly, but râle area indicates increase of disease.

Height 163 cm.	Theoretical normal weight.....	53.0
Present weight.....		55.0
Patient's idea of normal weight.....		50.5
Date of highest weight 2 months ago.....		55.5
“ “ lowest “ 5 “ “		50.5

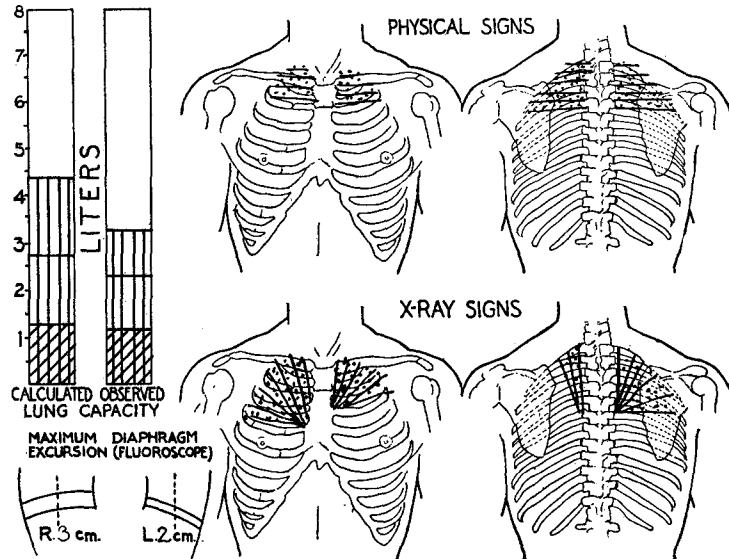
Treatment duration 6 months.

Physical Signs.—April 9, 1917. Right, slight dullness; breath sounds slightly harsh; medium fine moist râles to second rib anteriorly and sixth spine posteriorly with aid of cough. Left, slight dullness; breath sounds normal; medium moist râles at apex to third rib anteriorly and fourth spine posteriorly with aid of cough.

X-Ray Signs.—April 7, 1917. Right apex and first interspace slightly stippled and striated. Left apex and first and second interspaces moderately stippled and striated. Mediastinal contents normal.

No. 16 (CASE 3947)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANT:POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	19.7	15.6	23.3	7.15	2.20	30.8	29.3
MAX. INSP.	19.7	16.4	24.8	8.00	3.20	40.0	—
MAX. EXP.	19.7	14.7	22.7	6.58	1.10	16.7	—



TEXT-FIG. 16.

No. 16 (Case 3947).—Female, cashier; age 20 years. Moderately advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 14 months ago with malaise, loss of weight, pleurisy, and cough with expectoration. Under sanatorium treatment general condition and weight improved, and physical signs have diminished.

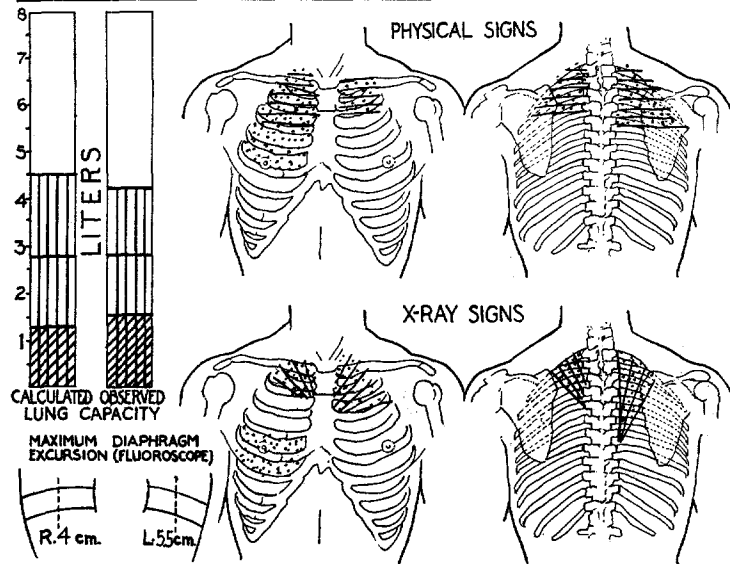
Height 156 cm.	Theoretical normal weight.....	kg. 52.0
Present weight.....		50.0
Patient's idea of normal weight.....		52.0
Date of highest weight 36 months ago.....		60.0
“ “ lowest “ 14 “ “.....		47.0
Treatment duration 12 months.		

Physical Signs.—April 9, 1917. Right, slight dullness to second rib; no breath sound change; râles after cough to second rib anteriorly and fourth spine posteriorly. Left lesion gives the same signs to almost exactly the same extent. In 12 months the physical signs have diminished about one-half.

X-Ray Signs.—April 7, 1917. Right apex and first interspace moderately densely spotted and striated; second and third interspaces finely stippled. Left apex and first and second interspaces present a mixture of coarse and fine stippings. Mediastinal contents normal.

No. 17 (CASE 4283)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP. CHEST VOL.	RATIO 100 X VITAL CAP. CHEST VOL.
	STERNUM cm.	ANTE-POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	18.9	16.3	24.6	7.57	2.8	37.0	34.4
MAX. INSP.	18.9	17.1	25.3	8.18	4.2	51.3	—
MAX. EXP.	18.9	15.6	23.3	6.86	1.6	23.4	—



TEXT-FIG. 17.

No. 17 (Case 4283).—Female, domestic; age 39 years. Moderately advanced; inactive. Sputum + + +, on admission, in course of treatment, and at present.

Onset insidious 6 months ago, with malaise, slight cough, and slight hemoptysis. Under sanatorium treatment symptoms disappeared and physical signs have diminished in number.

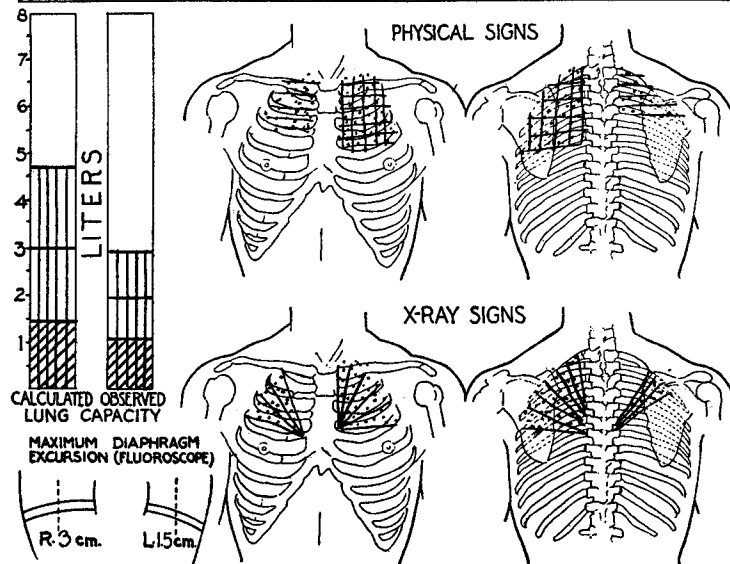
Height 171 cm.	Theoretical normal weight.....	kg.	67.5
Present weight.....			56.5
Patient's idea of normal weight.....			54.5
Date of highest weight 40 months ago.....			58.0
“ “ lowest “ 9 “ “.....			51.0
Treatment duration 3 months.			

Physical Signs.—April 9, 1917. Right, resonance impaired to third rib; harsh breathing; fine râles after cough to fourth interspace anteriorly and fifth spine posteriorly. Left, resonance impaired to second rib; breathing is diminished in intensity; fine râles after cough to second rib anteriorly and fourth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex and first interspace slightly stippled and striated; the fourth and fifth interspaces are very slightly stippled. Left apex and first and second interspaces are slightly striated and stippled. Mediastinal contents centrally placed.

No. 18 (CASE 4264)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANT. POST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	19.4	16.4	25.6	8.15	—	—	23.4
MAX. INSP.	19.4	17.3	26.0	8.72	2.9	33.2	—
MAX. EXP.	19.4	15.7	25.0	7.62	1.0	13.1	—



TEXT-FIG. 18.

No. 18 (Case 4264).—Female, factory worker; age 19 years. Moderately advanced; active. Sputum + — —, on admission, in course of treatment, and at present.

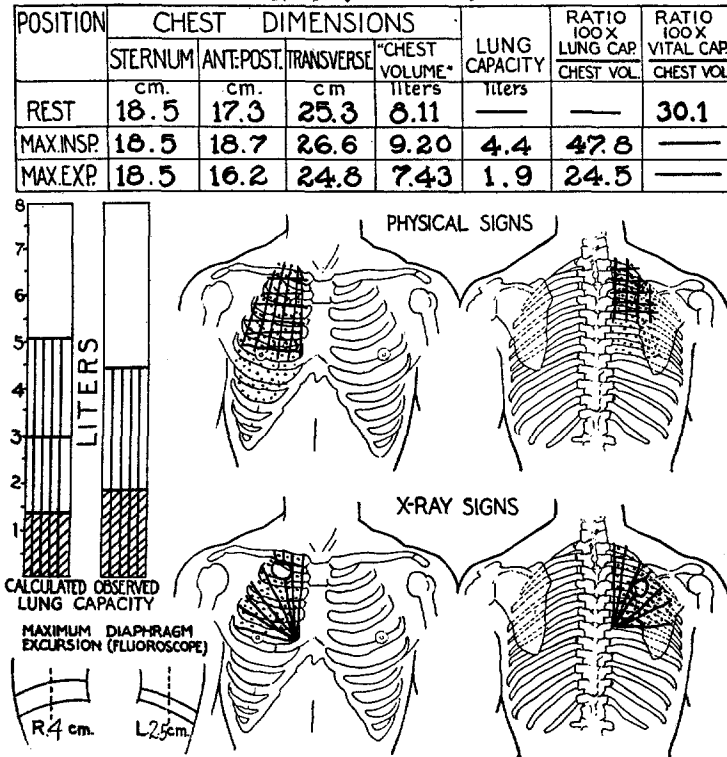
Onset 12 months ago with cough and expectoration; later marked temperature developed. Under treatment symptoms have improved, but physical signs have increased slightly.

Height 157 cm.	Theoretical normal weight.....	kg. 52.5
Present weight.....		62.0
Patient's idea of normal weight.....		54.5
Date of highest weight 3 months ago.....		63.5
“ “ lowest “ 9 “ “		51.5
Treatment duration 5 months.		

Physical Signs.—April 9, 1917. Right, slight impairment of resonance; breath sounds are a little increased in intensity; numerous fine and moist râles with cough to third rib anteriorly and fourth spine posteriorly; a few râles in this area on breathing without cough. Left, marked dullness; breath sounds are diminished in intensity; râles on breathing, but much increased in number by cough, extending to fourth rib anteriorly and sixth spine posteriorly.

X-Ray Signs.—April 7, 1917. Right apex clear; first, second, and third interspaces slightly spotted and striated. Left apex and first and second interspaces very dense; third interspace less dense. Mediastinal contents to the left. Right lung area increased.

No. 19 (CASE 3908)



TEXT-FIG. 19.

No. 19 (Case 3908).—Female, factory inspector; age 23 years. Advanced; active. Sputum + + +, on admission, in course of treatment, and at present.

Onset 25 months ago with malaise, slight loss of weight, slight cough, and slight temperature. Aphonia for last 10 months (tuberculous laryngitis). Under sanatorium rest temperature has become normal; lung lesion has progressed slightly.

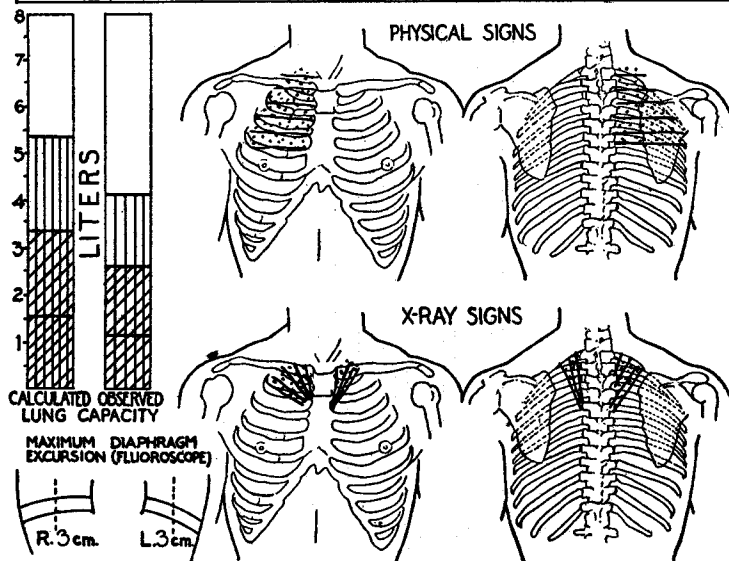
Height 173 cm.	Theoretical normal weight.....	64.0	kg.
Present weight.....		70.0	
Patient's idea of normal weight.....		60.0	
Date of highest weight 14 months ago.....		77.5	
“ “ lowest “ 2 “ “.....		69.5	
Treatment duration 14 months.			

Physical Signs.—April 9, 1917. Right, dull to fifth interspace; harsh breathing; numerous very moist râles without cough through the lung anteriorly, and to the seventh spine posteriorly. Left lung seems normal.

X-Ray Signs.—April 7, 1917. Right lung moderately densely spotted and striated to the fourth interspace; cavity under the clavicle 5 cm. in diameter. Left lung clear. Mediastinal contents very markedly to the right. Left lung area greatly increased.

No. 20 (CASE 4103)

POSITION	CHEST DIMENSIONS				LUNG CAPACITY liters	RATIO 100 X LUNG CAP CHEST VOL.	RATIO 100 X VITAL CAP CHEST VOL.
	STERNUM cm.	ANTEPOST. cm.	TRANSVERSE cm.	"CHEST VOLUME" liters			
REST	18.6	17.8	27.3	9.05	2.60	28.7	31.5
MAX. INSP.	18.6	18.5	28.5	9.80	4.15	42.3	—
MAX. EXP.	18.6	16.6	26.2	8.08	1.20	14.9	—



TEXT-FIG. 20.

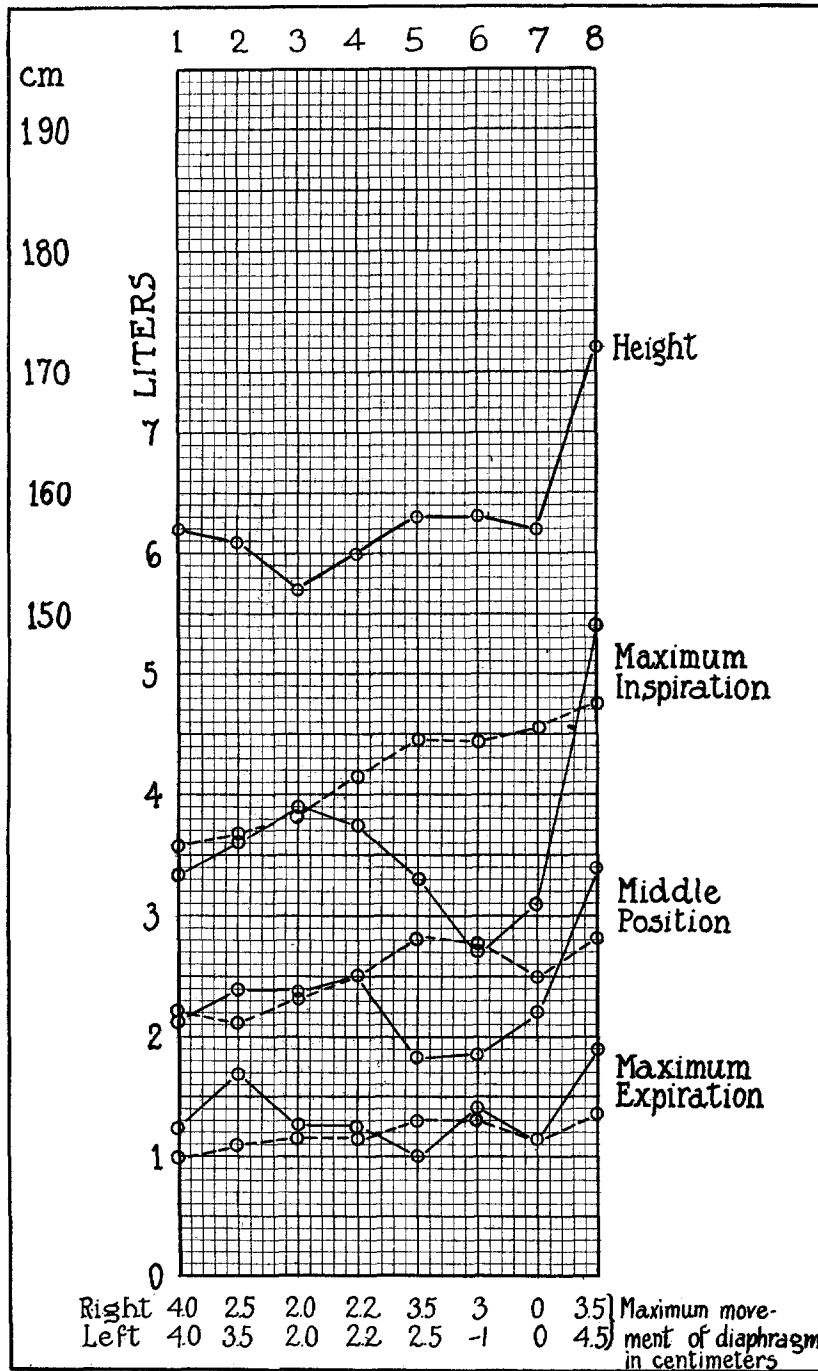
No. 20 (Case 4103).—Female, cotton mill worker; age 25 years. Moderately advanced; active. Sputum + + -, on admission, in course of treatment, and at present.

Onset 14 months ago with malaise, loss of weight, cough, and hemoptysis. Under sanatorium treatment the symptoms almost disappeared, and the signs are greatly diminished in number.

Height 170 cm.	Theoretical normal weight.....	kg. 62.5
Present weight.....		76.0
Patient's idea of normal weight.....		68.0
Date of highest weight 3 months ago.....		79.0
“ “ lowest “ 15 “ “.....		61.0
Treatment duration 9 months.		

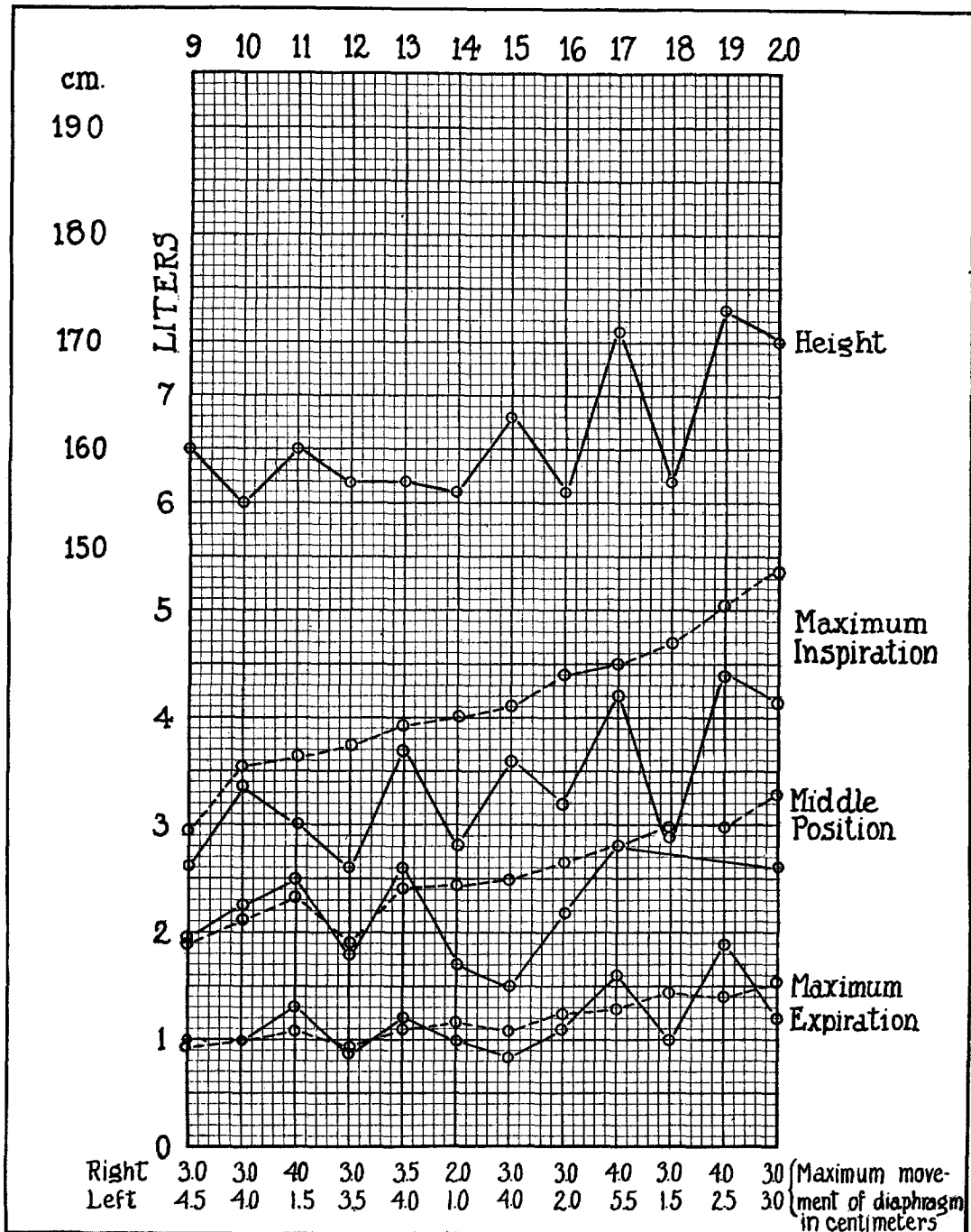
Physical Signs.—April 9, 1917. Right, moderate impairment of resonance; breath sounds increased in intensity and medium moist râles from apex to fourth rib anteriorly and to sixth spine posteriorly with aid of cough. Left lung seems normal.

X-Ray Signs.—April 7, 1917. Right apex and first interspace moderately densely infiltrated. Left apex slightly infiltrated. Mediastinal contents normal.



The numbers below indicate the maximum excursion of the right and left diaphragm. The numbers above the chart refer to the individual diagrams and descriptions.

TEXT-FIG. 21. Lung volumes in women with incipient pulmonary tuberculosis as determined (solid lines) and calculated (broken lines) from thoracic measurements.



TEXT-FIG. 22. Lung volumes in women with moderately advanced and advanced (Nos. 9 and 19) pulmonary tuberculosis as determined (solid lines) and calculated (broken lines) from thoracic measurements.