TABLE II.

Ratio between "chest volumes" and lung volumes. For explanation see Table I.

Author.	Number of observations.	$\frac{V_t}{C_t} \times 100$	$\frac{V_m}{C_m} \times 100$	$\frac{V_r}{C_r} \times 100$	$\frac{V_v}{C_m} \times 100$
Van Slyke and Lundsgaard	18	54.1	37.9	18.6	45.
Present paper	27	55.7	40.3	18.3	49.1

74 (2034)

Studies on lung volume. VIII. Patients with heart disease (mitral lesions).

By CHRISTEN LUNDSGAARD and KNUD SCHIERBECK.

[*From the Medical Clinic of the University of Copenhagen, Denmark.*]

The lung volumes were determined in 11 adult patients with mitral lesions. Three of the patients were in the uncompensated state of the disease. Nine were in the compensated stage. In these last patients the second pulmonary sound was markedly accentuated indicating an increased pressure in the pulmonary circulation. Our technique was as previously described.[1] Care was taken to secure full mixture in determining the total capacity. All the lung volumes are given at room temperature and observed pressure as in previous publications of the series.

Results. Discussion will appear more complete elsewhere [2, 3] and only the main results will be given here. Relative lung volumes are given in Table I in percentage of the normal relative value for total capacity, middle capacity, residual air, and vital capacity, respectively (100, 62.0, 24.7, and 75.3) established in a previous paper.[4] These values show in all instances

1 Lundsgaard, C., and Schierbeck, K., Paper No. 6 of this series.

2 Lundsgaard, C., *Journ. Amer. Med. Ass.*, 1923.

3 Lundsgaard, C., and Schierbeck, K., Paper No. 6 of this series.

a decrease in the vital capacity and an increase in the residual air. The values for the middle capacity vary. These results are in accordance with the results of other investigators.

Calculated normal values and observed values. The normal values for the different lung volumes in each patient are calculated from the size of the chest which was determined according to the procedure of Van Slyke and Lundsgaard. On account of the diminished range of chest movement only the ratio $(\frac{54}{100})$ for the total lung volume was used. The other lung volumes were calculated by means of the normal ratios for the relative lung volumes (100 — 62 — 24.7 and 75.3) previously published. This mode of calculation was adopted on account of the diminished range of chest movement and because we have every reason to believe that the maximum inspiratory expansion is normal in these cases. However, the lung volumes based on all the normal ratios did usually not differ materially from those reported in Table II. In Table II the directly observed lung volumes are given in percentage of the calculated normal figures. The information gained in this way gives quite another picture than the (so to speak distorted) one we get by using the relative values. The total capacity is either normal (mild cases) or decreased (more advanced cases). The middle capacity follows as a whole the total capacity. The residual air is decreased in patients in the decompensated stage, but increased in the compensated. The vital capacity is in all instances decreased but through a different mechanism in the two types. This observation makes us understand the mechanism of the lung involvment in stasis. In the mild cases an emphysematic condition takes place, probably on account of stiffness of the pulmonary vessels through increased blood pressure in the lungs. (Cf. v. Basch's experiments.) In the advanced cases some of the space for the residual air is taken up by overloading of the lungs with blood and edematous fluid, the residual air is therefore diminished. Figure I gives our conception of the condition. A is the calculated normal volume for Patient No. 1. B and C give the observed volume. The conditions found are, in our opinion, brought about not by the mechanism shown in B, but as shown in C, where the black area indicates the space in the chest taken up by (1) increased size of heart, (2) increase in amount of blood

in lungs, (3) increase in amount of lung tissue, including possible intraalveolar and intrapleural exudate and (4) increased size of abdominal organs, causing diminished downward movement of diaphragm.

TABLE I.

Observed lung volumes given as relative values based on total capacity.

Number of patients.	Total capacity.	Middle capacity.	Residual air.	Vital capacity.	Remarks.
1	100	105	122	92	Patients with incompensated heart failure.
2	100	99	143	85	
3	100	90	118	94	
4	100	9.5	145	85	
5	100	87	146	84	
6	100	142	156	81	
7	100	....	215	62	Patients with compensated heart failure.
8	100	103	170	77	
9	100	101	136	88	
10	100	95	135	88	
11	100	125	187	71	

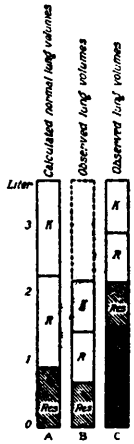
Normal ratio for thorax excursion 74.7. See paper V of this series.

TABLE II.

Observed values of different lung volumes in per cent. of normal value. Calculated from the size of the chest wall.

Number of patients.	Total capacity.	Middle capacity.	Residual air.	Vital capacity.	Excursion of thorax.	Remarks.
	per cent.	*per cent.*	*per cent.*	*per cent.*	$\frac{C_r}{C_t}$	
1	60	63	73	56	86.4	Patients with incompensated heart failure.
2	52	51	73	45	84.7	
3	54	49	64	52	82.5	
4	78	78	112	67	83.0	
5	100	87	145	86	79.2	
6	71	100	109	58	80.3	Patients with compensated heart failure.
7	81	.....	172	50.5	82.0	
8	85	87	142.5	65	81.5	
9	102	103	132	94	80.9	
10	107	102	142	96	84.3	
11	89	112	164	61	85.3	

Normal ratio for thorax excursion 74.7. See paper V of this series.



1. Diagram showing mode of production of changes in total lung volumes in heart patients. From Patient No. 1. Res. = residual air. R = reserve air. K = complementary air.

75 (2035)

Studies on lung volume. IX. Patients with lung emphysema pulmonum.

By CHRISTEN LUNDSGAARD and KNUD SCHIERBECK.

[*From the Medical Clinic of the University of Copenhagen, Denmark.*]

Twelve patients suffering from chronic emphysema of the lungs were studied. All of them except Nos. 5 and 11 have also asthma but no determinations were made within 24 hours after an attack of asthma. Except in No. 5 no fine rales were present in the lungs. The technique was as described in previous papers. In the diluting experiments, full mixture was secured by constructing "mixtures curves" (see paper No. 4 of this series). All figures in this and previous papers are given at room temperature and observed pressure. The size of chest was determined as described by Lundsgaard and Van Slyke. The normal total lung volume was calculated as $\frac{54}{100} \times$ observed "chest volume" in maximum