

## CLINICAL CALORIMETRY

SIXTEENTH PAPER

### THE BASAL METABOLISM OF PATIENTS WITH CARDIAC AND RENAL DISEASE \*

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The literature contains extremely few reports of observations on the metabolism of patients with heart disease. The work most frequently referred to is a monograph of Kraus.<sup>1</sup> This study of the effect of fatigue in various pathologic conditions contains observations on the gaseous metabolism of three cardiac patients while at rest and while working on an ergograph, together with analyses of the oxygen and carbon dioxid content of the venous blood in seven cases. The metabolism experiments were made with the Zuntz apparatus. One of the most striking results is the extraordinarily low value obtained in all cases for the respiratory quotient. In the two milder cases the quotients for experiments with the subjects at rest and fasting were 0.743 and 0.603, while three similar observations in the more severe case gave as respiratory quotients 0.574, 0.534 and 0.614. Exercise brought about a rise of the quotient. In the last case exhausting work raised the quotient to 0.933 and 0.923. The blood-gas analyses showed an increase over the normal carbon dioxid content of the venous blood both at rest and during work. Kraus believed that the low respiratory quotients and the high blood carbon dioxid were best explained by assuming that one of the essential factors of the dyspnea of cardiac patients is that the lung has lost its ability to excrete carbon dioxid and take up oxygen normally, either on account of a disturbance of its glandular function (Bohr), or because of pathologic changes in the lining epithelium or the pulmonary vessels.

Grafe<sup>2</sup> reports observations made with the "Kopfrepirationsapparat" on the metabolism of seven patients with cardiac disease. The

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\* Submitted for publication Feb. 4, 1916.

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1. Kraus: Die Ermüdung als ein Mass der Constitution, Bibliotheca Medica, Abt. D<sup>1</sup>, Hefte 3, Cassel, T. G. Fisher & Co., 1897.

2. Grafe: Gaswechseluntersuchungen bei fortgeschrittenen Erkrankungen der Lungen an der Zirkulationsorgane, Deutsch. Arch. f. Klin. Med., 1909, xcv, 543.

method is open to criticism. The respiratory quotient was 0.885 in a case of congenital heart disease, 0.733 in one with Pick's cirrhosis, and 0.764 in a case of arteriosclerosis with myocarditis, but in the four other cardiac patients the quotients were remarkably low: 0.638, 0.632, 0.619 and 0.586. These instances with low respiratory quotients showed comparatively normal oxygen consumption, but low carbon dioxid production. Grafe demonstrates by calculations that it is quite impossible to accept the theory of Kraus, which accounts for the low quotients on the basis of carbon dioxid retention, as the amounts of carbon dioxid stored up in the body would be too enormous. He believes that the low respiratory quotients signify a qualitatively altered metabolism with incomplete oxidations, and suggests that the accumulation of carbon dioxid, which Kraus demonstrated by blood-gas analysis, may have injured the body protoplasm so that the chemical changes pursue an abnormal course. There seemed to be no relation between respiratory rate and increase of oxygen consumption.

While some of the respiratory quotients obtained by Grafe are so low that it is almost impossible not to suspect their accuracy, nevertheless his theory as to an altered metabolism finds some confirmation in the work of other authors who have shown that acidosis is frequently associated with cardiac disease. Thus, according to Beddard and Pembrey,<sup>3</sup> the alveolar carbon dioxid tension is very low in cases of decompensated cardiac disease. French, Pembrey and Ryffel<sup>4</sup> found it low in cases of congenital heart disease with cyanosis. Fitzgerald<sup>5</sup> obtained normal values for the alveolar carbon dioxid in the majority of cardiac cases, but low values in a case of mitral stenosis, and extremely low figures in a case of congenital heart disease. Porges, Leimdörfer and Markovici<sup>6</sup> studied a considerable series of patients with heart disease, and found that in general the carbon dioxid tension of the alveolar air is normal in those which were without dyspnea, but that it tended to be below normal in the dyspneic patients. The lowest tensions in compensated patients without dyspnea occurred in two cases of congenital heart disease, both of which probably had open ductus Botalli. Lewis<sup>7</sup> and his associates have shown by investigations on the blood and alveolar air that the attacks of dyspnea so commonly seen in elderly patients with renal disease or advanced arteriosclerosis are accompanied by an acidosis which they believe to be the cause of the disturbance of respiration. In cases of pure valvular

3. Beddard and Pembrey: *Brit. Med. Jour.*, 1908, ii, 580.

4. French, Pembrey and Ryffel: *Jour. Physiol.*, 1909, xxix, Proc., p. 9.

5. Fitzgerald: *Jour. Path. and Bacteriol.*, 1910, xiv, 328.

6. Porges, Leimdörfer and Markovici: *Ztschr. f. klin. Med.*, 1913, lxxvii, 446.

7. Lewis, Ryffel, Wolf, Cotton and Barcroft: *Heart*, 1913, v, 45. Lewis and Barcroft: *Quart. Jour. Med.*, 1915, vii, 97.

disease with cyanosis, they found no evidence of acidosis, but that there may be an acidosis in severely decompensated cases, which disappears as compensation is regained, is shown by the observations of Porges, Leimdörfer and Markovici.<sup>6</sup> It is, however, particularly in the type of case which may be conveniently grouped under the heading of "cardiorenal" disease that the factor of acidosis assumes a more permanent and thus a more important part. The association of acidosis with chronic nephritis has been carefully discussed by Sellards<sup>8</sup> and by Palmer,<sup>9</sup> and its relation to the course of the disease has been studied by Peabody.<sup>10</sup> The significance of acidosis in investigations on metabolism was first suggested by Benedict and Joslin,<sup>11</sup> who showed that in two normal subjects an acidosis resulting from the administration of a carbohydrate-free diet was accompanied by an increase in the total metabolism. This observation has since been confirmed by Higgins, Fitz and Peabody.<sup>12</sup> Lusk believes that this increase is due to the increased protein metabolism of the carbohydrate-free periods.

#### METHODS USED

It is thus quite evident that in studying the metabolism of patients with heart disease it is of the utmost importance to know whether or not there is an acidosis. On account of its direct bearing on the subject of acidosis, and also on account of any other possible, but as yet unknown effects which a nephritis may exert on the metabolism, it is also of importance to know as much as possible about the functional capacity of the kidneys. At the time when the earlier of the cases reported here were investigated, renal function tests were not in general use, but the later cases were, whenever possible, studied with these points in mind. As an index of acidosis, the carbon dioxide tension of the alveolar air was determined. This was done by the Higgins modification of the method of Plesch, which has proved very satisfactory for clinical work. The normal alveolar carbon dioxide tension by this method is approximately 40 to 45 mm. In some instances the alkali tolerance test of Sellards<sup>8</sup> was used. The determination of the part played by the kidneys in cases of cardiac or cardiorenal disease is, of course, proverbially difficult and unsatisfactory. In general we have relied on the history, physical examination, urine examination, blood

8. Sellards: Johns Hopkins Hosp. Bull., 1912, xxiii, 289; *ibid.*, 1914, xxv, 141.

9. Palmer: Med. Communicat., Mass. Med. Soc., 1913, xxiv, 133.

10. Peabody, F. W.: Studies on Acidosis and Dyspnea in Renal and Cardiac Disease, *THE ARCHIVES INT. MED.*, 1914, xiv, 236; Clinical Studies on the Respiration, II, The Acidosis of Chronic Nephritis, *ibid.*, 1915, xvi, 955.

11. Benedict and Joslin: Publications of the Carnegie Institution of Washington, 1912, Pub. 176.

12. Higgins, Fitz and Peabody: Unpublished.

pressure and phenolsulphonephthalein test to aid us in differentiating the pure cardiac from the renal or cardiorenal cases.

The patients were all from the medical wards of Bellevue Hospital, but during the period of study they were kept in the special metabolism ward. The general method of conducting the observations was similar to that described in the third and fourth paper of this series.<sup>13</sup> The patients were usually put into the calorimeter for a short period in the afternoon, in order that they might become accustomed to the new surroundings, and then put in again for the actual experiment on the following day. As one of the chief points which we wished to investigate was the influence of dyspnea on the metabolism, quite a number of the decompensated patients were put into the calorimeter. In spite of their comparatively serious condition, however, no patient was in any way injured by his stay in it. The majority said they felt better when they came out, and, indeed, the period of absolute quiet seemed to have only a beneficial effect. The construction of the chair described in the eleventh paper made it possible to study the metabolism of patients with orthopnea. The respirations were counted by watching the patient through the glass window in the side of the calorimeter, but the graphic records registered by the spirometer on a kymograph for the five minutes at the end of each period were of help, particularly in drawing attention to periodic breathing.

#### DISCUSSION OF RESULTS

The total number of patients investigated was sixteen. One of these (Case 3, Fred D.) was examined first when he was decompensated and dyspneic (3a), and later when he was compensated (3b). Six cases (11, William S., 12, George M., 13, Marcus R., 14, David K., 15, William A., 16, Theodore S.) were studied for purposes not directly connected with the present investigations so that the details on them are not complete, but they are included since they serve as controls of the more severely ill patients, and contribute information about various special points. Seven cases (2, Armon W., 3, Fred D., 4, Edward M., 9, Burrell P., 11, William S., 15, William A., 16, Theodore S.) were instances of pure cardiac disease; two were cases of nephritis (12, George M., 14, David K.) and six (1, Arthur V., 5, Charles L., 7, Edward W., 8, Henry R., 10, August F., 13, Marcus R.) were mixed cases belonging to the "cardiorenal disease" group. At the time when they were in the calorimeter, five patients (1, Arthur V., 3a, Fred D., 4, Edward M., 8, Henry R., 10, August F.) had moderately severe dyspnea; seven had slight dyspnea (2, Armon W., 5,

13. Gephart, F. C., and DuBois, E. F.: The Organization of a Small Metabolism Ward, *THE ARCHIVES INT. MED.*, 1915, xv, 829; The Determination of the Basal Metabolism of Normal Men and the Effect of Food, *ibid.*, 1915, xv, 835.

TABLE 1.—SUMMARY OF CALORIMETER EXPERIMENTS; INDIRECT CALORIMETRY: AVERAGES PER HOUR

Case No. and Name	Date	Age	Sex*	Indirect Calorimetry			Average per Hour		Average Normal Basal Calories per Sq. M.		Remarks
				Average Calories Per Kg.	Per Sq. M., Meeh	Per Cent. Divergence from Average Normal Basal, Meeh	Per Sq. M., Linear Formula	Per Cent. Divergence from Average Normal Basal Linear	Accord- ing to Meeh's Formula	Accord- ing to Linear Formula	
1. Arthur V. . . . .	2/19/15	40	♂	1.57	54.4	+42	58.7	+48	34.7	39.7	Restless
2. Arnon W. . . . .	2/19/15	33	♂	1.21	38.6	+11	47.7	+19	34.7	39.7	Quiet
3. Fred D. . . . .	2/15/15 2/23/15	17	♂	1.51 1.41	45.1 38.5	+17 0	58.8 42.1	+28 +2	38.5 38.5	42.0 42.0	Very quiet Very quiet
4. Edward M. . . . .	2/17/15	37	♂	1.18	39.5	+15	....	....	34.7	....	Restless
5. Charles L. . . . .	2/19/15	54	♂	1.08	38.7	+26	....	....	30.8	....	Quiet
6. Annie T. . . . .	2/20/15	14	♀	1.75	42.2	+10 (?)	48.9	-5 (?)	38.5 (?)	46.4 (?)	Slightly restless
7. Edward W. . . . .	2/24/15	37	♂	1.68	51.8	+49	....	....	34.7	....	Slightly restless
8. Henry R. . . . .	2/26/15	40	♂	1.05	36.0	+4	45.7†	+16†	34.7	39.7	Quiet
9. Burrell P. . . . .	3/24/15	41	♂	1.20	37.3	+7	48.9	+23	34.7	39.7	Restless
10. August F. . . . .	5/ 1/15	62	♂	1.04	31.7	+3	36.9	+5	30.8	35.2	Quiet
11. William S. . . . .	2/10/15	48	♂	1.06	34.8	-2	41.7	+8	34.7	39.7	Fairly quiet
12. George M. . . . .	4/ 7/13 4/14/13 3/24/14 4/ 4/14	56	♂	1.08 1.01 1.03 1.03	33.1 31.7 31.1 31.0	+8 +3 +1 +1	.... .... .... ....	.... .... .... ....	30.8 30.8 30.8 30.8	.... .... .... ....	Restless Quiet Quiet Quiet
13. Marcus R. . . . .	4/ 9/13	51	♂	1.34	45.5	+41	....	....	30.8	....	Very quiet
14. David K. . . . .	3/21/13 3/24/13	54	♂	1.22 1.14	39.3 37.0	+28 +20	.... ....	.... ....	30.8 30.8	.... ....	Restless
15. William A. . . . .	1/25/15 1/27/15	24	♂	1.13 1.17	36.3 37.9	+5 +9	39.5 41.2	0 +4	34.7 34.7	39.7 39.7	Fairly quiet Quiet
16. Theodore S. . . . .	1/28/14 1/30/14 2/ 5/14 2/ 9/14 2/18/14	32	♂	1.17 1.10 1.15 1.08 1.13	37.1 34.8 36.7 33.0 36.4	+9 +2 +7 -4 +7	45.1 38.5 39.9 37.1 41.1	+4 -2 0 -7 +3	34.7 34.7 34.7 34.7 34.7	39.7 39.7 39.7 39.7 39.7	Very quiet Very quiet Very quiet Very quiet Very quiet

\* In this column, ♂ denotes male, and ♀ female.

† In Case 8 (Henry R.) there was some error in the measurements of the height or of the surface. The three measurements of the linear formula L, O and R added together give a total length of 150 cm. from soles of feet to suprasternal notch. His height was recorded as 153 cm. According to the linear formula measurement, his surface area was 1.958 sq. m. or only 13 per cent. below the figure of 2.215 obtained by Meeh's formula. With fat individuals of his body shape the true surface is usually about 20 per cent. below the estimate according to Meeh. This would make his surface about 1.77 sq. m. According to new height-weight chart it would be 1.73. His metabolism per square meter per hour on this new basis would be about 15 per cent. above the average, or 45.70 calories per square meter.

Charles L., 6, Annie T., 7, Edward W., 9, Burrell P., 11, William S., 13, Marcus R.), and five had normal respiration (3b, Fred D., 12, George M., 14, David K., 15, William A., 16, Theodore S.).

*Respiratory Quotients.*—In striking contrast to the results of Kraus and Grafe, which have been described above, all of the respiratory quotients in this series of cases fell within comparatively normal limits. Our lowest quotient was 0.73 (Case 4, Edward M.). Of the ten cases reported by Kraus and Grafe, only four had respiratory quotients equal or above our lowest figure, while in the other six the results had to be explained as being caused by a qualitative alteration in metabolism. On the basis of the respiratory quotients, as obtained by us, there is no need to assume any change in the type of metabolism from the normal. In general there is a distinct tendency for the lowest quotients to be found in the cases with most dyspnea. Five patients, classed as having moderately severe dyspnea, gave as quotients: 0.74, 0.75, 0.73, 0.75 and 0.82. In seven patients with slight dyspnea the quotients were 0.79, 0.76, 0.81, 0.79, 0.84, 0.82 and 0.78, while the patients without dyspnea showed the following quotients: 0.88, from 0.80 to 0.83, from 0.74 to 0.75, from 0.81 to 0.85 and from 0.80 to 0.85 (Table 2).

#### DIRECT AND INDIRECT CALORIMETRY

In the previous papers of this series the close agreement between the methods of direct and indirect calorimetry with normal subjects has been demonstrated. In disease, owing to certain technical difficulties, there is a tendency for the method of direct calorimetry to average from 1 to 2 per cent. lower, particularly if short periods are used. In the group of cardiac and nephritic patients here presented, the total of the calories measured by indirect calorimetry is 4,297.67, by direct calorimetry 4,214.53, or 1.93 per cent. lower. This is remarkably good agreement, considering the technical difficulties, and indicates that there is no profound change in the metabolism which would upset calculations based on the method of indirect calorimetry.

#### TOTAL METABOLISM

The total metabolism is compared with the normal in terms of the heat production per square meter of surface area per hour. After the linear formula was devised, it was possible to measure most of the patients in this manner and use the results as a basis of the calculations. In all other cases it has been necessary to use Meeh's formula, which is fairly satisfactory with these subjects, since they all happened to be of about the normal body shape.

Of the five patients with moderately severe dyspnea, all but one (Case 10, August F.) showed a distinct increase in metabolism. Of

TABLE 2.—CLINICAL FINDINGS AND—

Case No. and Name	Age	Date in Calorimeter	Diagnosis	Blood Pressure	Pulse Rate	Phthalein Per Cent.
1. Arthur V. ....	40	2/12/15	Chronic nephritis, chronic myocarditis with decompensation	110-70	99	2/15=32% 2/27=63%
2. Armon W. ....	33	2/13/15	Double mitral disease, auricular fibrillation	110-70	77	—
3a. Fred D. ....	17	2/15/15	Double mitral disease, decompensation	—	105	—
3b. Fred D. ....	..	2/23/15	Compensated .....	95-70	86	—
4. Edward M. ....	37	2/17/15	Mitral insufficiency, auricular fibrillation, decompensation	120-85	78	—
5. Charles L. ....	54	2/19/15	Aortic and mitral insufficiency, chronic nephritis, emphysema	180-90	71	30%
6. Annie T. ....	14	2/20/15	Congenital heart disease, open ventricular septum, dextrocardia	95	102	—
7. Edward W. ....	37	2/24/15	Chronic nephritis, cardiac dilatation, syphilis	190-100	112	10%
8. Henry R. ....	40	2/26/15	Chronic myocarditis, emphysema, chronic nephritis	160-120	116	48%
9. Burrell P. ....	41	3/24/15	Aortic stenosis and insufficiency, mitral and tricuspid insufficiency, aneurysm of aorta	—	66	—
10. August F. ....	62	5/ 1/15	Chronic nephritis, auricular fibrillation	170-110(?)	77	24%
11. William S. ....	48	2/10/15	Adherent pericardium .....	110-80(?)	91	—
12. George M. ....	56	4/ 7/13 4/14/13 3/24/14 4/ 4/14	Chronic nephritis, cardiac hypertrophy	170-95 170-55 195-115 160-102	64 ..... 59 60	..... ..... ..... .....
13. Marcus R. ....	57	4/ 9/13	Chronic nephritis, mitral insufficiency, arteriosclerosis	310-160	81	.....
14. David K. ....	54	3/21/13 3/24/13	Chronic nephritis, arteriosclerosis, inguinal hernia	195-110	..... .....	..... .....
15. William A. ....	24	1/25/15 1/27/15	Aortic insufficiency .....	140	61 66	..... .....
16. Theodore S. ....	32	1/28/14 1/30/14 2/ 5/14 2/ 9/14 2/13/14	Mitral stenosis, auricular fibrillation....	..... ..... ..... ..... 145-85	50 53 49 48 55	..... ..... ..... ..... .....

—CALORIMETER RESULTS COMPARED

Arterio-sclerosis (radial)	Resp. Rate	Dyspnea	Orthopnea	Periodic Resp.	Cyano-sis	Edema	Alveolar CO <sub>2</sub> Tension, mm.	R. Q.	Metab. % Deviation from Av. Norm.	
0	36	+	+	+	Slight	0	2/12=23.9 2/16=30.9 2/27=41.6	0.739	+48	
0	26-28	Slight	..	0	Slight	....	2/13=44.2	0.791	+19	
0	27-25	+	+	0	Slight	+	2/15=27.8 2/16=33.7	0.753	+23	
0	22-18	0	0	0	Slight	0	2/18=35.5 2/23=37.1	0.876	+ 2	
0	30-24	+	+	0	+	Slight	2/16=38.6	0.733	+15	
0	28-26	Slight	..	+	0	0	2/19=39.4	0.766	+26	
0	20-18	+	0	0	++	0	2/18=25.2	0.907	- 5	
+	23-21	Moderate	+	+	Slight	Slight	2/24=38.9 2/27=40.0	0.789	+49	Died, April 17, 1915
0	39-33	++	+	Slightly	-	Slight	2/25=41.1 2/26=39.9	0.747	+15	
+	25-22	Slight	+	0	-	....	-	0.837	+23	
+	28-27	+	++	+	Slight	+	-	0.815	+ 5	
..	19-18	Slight	+	0	+	....	-	0.817	+ 8	
Slight	.....	Slight	.....	.....	.....	±	.....	0.819	+ 8	
.....	.....	Slight	.....	.....	.....	+	.....	0.796	+ 3	
.....	24-18	Slight	.....	.....	.....	+	.....	0.827	+ 1	
.....	.....	Slight	.....	.....	.....	+	.....	0.815	+ 1	
++	20-18	Slight	.....	.....	0	0	.....	0.781	+41	
+	.....	0	0	.....	0	0	.....	0.746	+28	
+	.....	0	0	.....	.....	.....	.....	0.744	+20	
.....	.....	0	0	.....	.....	.....	.....	0.852	± 0	Lying flat on back
.....	.....	0	0	.....	.....	.....	.....	0.814	+ 4	Steamer chair
0	.....	0	0	.....	+	0	.....	0.822	+ 9	Flat on back
.....	.....	0	0	.....	+	0	.....	0.831	+ 2	Sitting in bed at angle of 30°
.....	.....	0	0	.....	+	0	.....	0.803	+ 7	Lying flat on back
.....	.....	0	0	.....	+	0	.....	0.842	- 4	Sitting up at angle of 50°
.....	.....	0	0	.....	+	0	.....	0.854	+ 7	Lying flat on back



the seven with slight dyspnea, all showed an increase except the under-developed girl with congenital heart disease. Of the five with no dyspnea, the only one with increased metabolism was the restless and unsatisfactory alcoholic, David K. (Case 14).

Dyspneic patients must do an increased amount of muscular work in their labored breathing, but it is doubtful if this would account for an increase of 10 per cent. Some of the dyspneic patients were rest-

TABLE 3.—PATIENTS WITH MODERATELY SEVERE DYSPNEA, SLIGHT DYSPNEA AND NO DYSPNEA

Subject	Case No.	Pulse	R. Q.	Per Cent. Increase of Metabolism above the Normal	Alveolar CO <sub>2</sub> Tension, mm.
<b>Patients with moderately severe dyspnea</b>					
Arthur V. ....	1	99	0.739	+48	23.9
Fred D. ....	3a	105	0.753	+28	27.8
Edward M. ....	4	78	0.733	+15	38.6
Henry R. ....	8	116	0.747	+15?	39.9
August F. ....	10	77	0.815	+ 5	....
<b>Patients with slight dyspnea</b>					
Armon W. ....	2	77	0.791	+19	44.2
Charles L. ....	5	71	0.766	+26	39.4
Annie T. ....	6	102	0.807	— 5 ?	21.7
Edward W. ....	7	112	0.789	+49	38.9
Burrell P. ....	9	66	0.837	+23	....
William S. ....	11	91	0.817	+ 8	....
Marcus R. ....	13	81	0.781	+41	....
<b>Patients with no dyspnea</b>					
Fred D.* ....	3b	105	0.753	+ 2	37.1
George M. ....	12	59-64	0.80-0.83	+ 1 to + 8	....
David K. ....	14	.....	0.74-0.75	+20 to +28	....
William A. ....	15	61	0.81-0.85	0 to + 4	....
Theodore S. ....	16	48-55	0.80-0.85	— 7 to + 4	....

\* Compensated.

less while in the calorimeter, but a similar degree of restlessness in other patients does not increase the metabolism more than about 10 per cent. This factor may be of some importance in the cases of Arthur V. (Case 1), Edward M. (Case 4), Edward W. (Case 7), Burrell P. (Case 9) and David K. (Case 14), but other patients with high metabolism for example, Armon W. (Case 2), Fred D. (Case 3), Charles L. (Case 5), Henry R. (Case 8) and Marcus R. (Case 13) were as quiet as the normal controls. It is evident that most dyspneic

patients show a metabolism increased from some cause other than muscular activity.

An analysis of the relation between increase of metabolism in these cases and acidosis is of considerable interest. It is unfortunate that the carbon dioxid tension of the alveolar air was not determined in all the patients. The lowest carbon dioxid was found in Case 6 (Annie T.), but it is quite possible that in such a case of congenital heart disease the decreased alveolar carbon dioxid might not be accurate evidence of the change in the reaction of the blood. Excluding this patient, the two with the lowest carbon dioxid, Arthur V. (Case 1) and Fred D. (Case 3) showed marked increase in metabolism. Still there were two others with high metabolism (Edward W., Case 7, and Charles L. Case 5) whose alveolar carbon dioxid was very slightly depressed.

It is interesting to note that patients with low excretion of phenol-sulphonephthalein, Arthur V. (Case 1), Charles L. (Case 5) and Edward W. (Case 7), showed marked increase in metabolism; but one, August F. (Case 10), whose phenolsulphonephthalein was low, showed no increase.

Six patients gave systolic blood pressure readings of 170 mm. or over. Of these four, Charles L. (Case 5), Edward W. (Case 7), Marcus R. (Case 13) and David K. (Case 14) had high metabolism, while two, August F. (Case 10) and George M. (Case 12), had low metabolism.

It is evident that in so complex a group of subjects as the sixteen cardiacs and nephritics, there are many factors at work. At present it would seem as if no one factor would account for the definite increase in metabolism found in the dyspneic patients. The studies in this subject are being continued.

It is of interest to note that patients with compensated cardiac lesions or with mild nephritis show a metabolism within the normal limits.

#### SUMMARY AND CONCLUSIONS

Sixteen patients with cardiac and cardiorenal disease have been studied, and for the first time the methods of direct and indirect calorimetry have been compared. In this group of cases the two methods have been found to agree within 1.9 per cent.

The respiratory quotient in all cases was within normal limits (0.73 or above). This is opposed to the findings of Kraus and Grafe. The normal quotients and the very close agreement of the direct and indirect calorimetry prove that there is no profound change in the intermediary metabolism.

TABLE 4.—

Subject, Date, Weight, Surface Area, Linear Formula	Period	End of Period	Carbon Dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.
Case 1 (Arthur V.) 2/12/15 58.26 Kg. 1.556 Sq. M.	Prelim.	11:19	.....	.....	.....	.....	.....	.....	.....
	1*	12:22	30.05	29.35	0.75	49.92	0.331	96.62	94.96
	2†	1:19	26.41	26.26	0.73	48.47	0.331	85.99 182.61	88.82
Case 2 (Armon W.) 2/13/15 60.77 Kg. 1.550 Sq. M.	Prelim.	11:25	.....	.....	.....	.....	.....	.....	.....
	1	12:25	24.11	21.73	0.81	27.78	0.266	72.69	72.61
	2	1:25	23.85	22.37	0.78	28.32	0.266	74.15 146.84	71.81
Case 3 (Fred D.)... 2/15/15 49.75 Kg. 1.394 Sq. M.	Prelim.	11:34	.....	.....	.....	.....	.....	.....	.....
	1	12:34	23.37	22.54	0.75	36.61	0.579	73.75	76.63
	2	1:34	24.07	23.30	0.75	37.44	0.579	76.27 150.02	78.63
Fred D. .... 2/23/15 39.68 Kg. 1.291 Sq. M.	Prelim.	11:19	.....	.....	.....	.....	.....	.....	.....
	1	12:19	19.07	14.77	0.94	24.00	0.331	50.76	56.63
	2	1:19	20.53	16.90	0.88	25.27	0.331	57.38	60.43
	3§	1:49	9.82	8.87	0.81	12.48	0.331	29.56 137.70	29.00
Case 4 (Edw. M.).. 2/17/15 68.88 Kg.	Prelim.	11:30	.....	.....	.....	.....	.....	.....	.....
	1	12:30	23.35	23.41	0.76	36.73	0.399	76.37	89.58
	2	1:30	26.37	26.37	0.74	36.51	0.399	86.49 162.86	90.02
Case 5 (Chas. L.) 2/19/15 85.84 Kg.	Prelim.	11:25	.....	.....	.....	.....	.....	.....	.....
	1	12:25	28.50	27.18	0.76	35.43	0.287	89.96	89.41
	2	1:25	30.50	28.84	0.77	39.05	0.287	95.71 185.67	93.28
Case 6 (Annie T.).. 2/20/15 26.27 Kg. 1.046 Sq. M.	Prelim.	10:57	.....	.....	.....	.....	.....	.....	.....
	1	11:57	15.29	13.69	0.81	20.09	0.150	45.33	43.83
	2	12:57	15.20	13.78	0.80	20.78	0.150	46.02 91.85	43.80
Case 7 (Edw. W.).. 2/24/15 54.35 Kg.	Prelim.	11:18	.....	.....	.....	.....	.....	.....	.....
	1	12:18	28.90	26.69	0.79	47.27	0.357	88.64	89.31
	2	1:18	30.78	28.29	0.79	47.66	0.357	94.21 182.85	94.88
Case 8 (Henry R.) 2/26/15 75.49 Kg. 1.73(?) Sq. M.	Prelim.	11:32	.....	.....	.....	.....	.....	.....	.....
	1	12:32	24.62	24.07	0.74	38.36	0.303	79.21	77.35
	2	1:32	24.75	23.98	0.75	40.81	0.303	78.91 158.12	80.88

\* 63 min. † 57 min. § 30 min.

—CALORIMETER EXPERIMENTS

Direct Calorimetry (Rectal Temp.), Cal.	Rectal Temp., C.	Average Pulse	Work-Adder, Cm.	Non-protein R. Q.	Per Cent. Calories from			Calories per Hour		Remarks
					Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M.	
.....	37.61									
94.15	37.60	100	37.2	0.74	9	80	11	1.66	52.23	Restless period 63 min. Restless period 57 min.
81.51	37.46	97	45.0	0.72	10	86	4	1.48	46.48	
175.66										
.....	36.99									
72.78	37.00	76	14.2	0.81	10	58	32	1.20	38.19	Quiet; reading 40 min. Quiet; reading 5 min.
71.50	37.00	78	30.3	0.77	10	71	20	1.22	38.96	
144.28										
.....	38.17									
74.63	38.15	104	5.0	0.74	21	70	9	1.48	44.29	Very quiet
76.00	38.11	105	14.0	0.74	20	71	9	1.53	45.81	Very quiet
150.63										
.....	36.33									
56.41	36.83	86	5.0	0.97	17	8	74	1.28	35.45	Asleep 40 min.
55.16	36.68	81	7.0	0.90	15	29	56	1.45	40.07	Very quiet
29.54	36.70	91	4.0	0.81	15	55	30	1.49	41.28	Very quiet
141.11										
.....	36.99									
80.00	36.83	80	41.5	0.71	14	85	1	1.11	37.08	Very restless
92.59	36.88	76	38.0	0.73	12	81	7	1.26	42.00	Restless
172.59										
.....	37.15									
86.23	37.11	70	23.6	0.76	8	75	17	1.05	37.55	Quiet, dozing and reading Quiet, reading
96.41	37.16	71	25.0	0.77	8	72	20	1.12	39.95	
182.64										
.....	37.16									
42.07	37.09	102	24.0	0.81	9	59	32	1.74	42.12	Restless
44.23	37.12	102	16.0	0.80	9	62	29	1.75	42.30	Fairly quiet
86.30										
.....	37.55									
80.94	37.37	111	25.0	0.79	11	66	23	1.63	50.19	Fairly quiet; dozing Slightly restless
97.28	37.46	112	32.0	0.79	10	64	26	1.73	53.35	
178.22										
.....	37.40									
76.49	37.39	117	21.0	0.74	10	79	10	1.05	36.02	Quiet
75.94	37.32	115	13.0	0.74	10	79	10	1.05	35.88	Quiet
152.43										

TABLE 4.—CALORIMETER—

Subject, Date, Weight, Surface Area, Linear Formula	Period	End of Period	Carbon Dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calorimetry, Cal.	Heat Eliminated, Cal.
Case 9 (Burrell P.) 3/24/15 70.81 Kg. 1.739 Sq. M.	Prelim.	11:10	.....	.....	.....	.....	.....	.....	.....
	1	12:10	30.31	27.06	0.82	33.75	0.544	90.29	88.94
	2	1:10	27.96	23.67	0.86	29.89	0.544	79.67	86.20
								169.96	
Case 10 (Aug. F.) 5/1/15 52.61 Kg. 1.487 Sq. M.	Prelim.	12:00	.....	.....	.....	.....	.....	.....	.....
	1	1:00	18.26	15.49	0.86	25.98	.....	Approx. 52.50	49.62
	2	2:00	18.38	17.29	0.77	25.55	.....	57.27	51.67
								109.77	
Case 11 (Wm. S.) 2/10/15 65.02 Kg. 1.62 Sq. M.	Prelim.	11:29	.....	.....	.....	.....	.....	.....	.....
	1	12:29	22.68	19.76	0.84	22.48	0.515	65.97	65.29
	2	1:29	23.75	21.83	0.80	24.97	0.515	72.40	71.41
								138.37	
Case 12 (Geo. M.) 4/7/13 54.29 Kg.	Prelim.	10:00	.....	.....	.....	.....	.....	.....	.....
	1	12:00	40.20	34.52	0.85	45.15	0.392	115.92	104.16
	2	2:00	38.76	35.64	0.79	49.34	0.392	118.02	115.02
								233.94	
George M. .... 4/14/13 57.18 Kg.	Prelim.	10:00	.....	.....	.....	.....	.....	.....	.....
	1	12:00	36.23	32.33	0.82	46.23	0.311	107.87	101.38
	2	2:00	39.98	37.36	0.78	49.48	0.311	123.66	112.01
								231.53	
George M. .... 3/24/14 58.82 Kg.	Prelim.	11:36	.....	.....	.....	.....	.....	.....	.....
	1	12:36	19.31	16.27	0.86	23.14	0.385	54.85	61.59
	2	1:36	20.08	18.44	0.79	25.03	0.385	61.10	65.68
								115.95	
George M. .... 4/4/14 58.98 Kg.	Prelim.	11:40	.....	.....	.....	.....	.....	.....	.....
	1	12:50	22.70	21.12	0.78	26.32	0.402	69.74	63.87
	2	1:40	16.14	13.84	0.85	18.94	0.402	46.44	46.38
								116.18	
Case 13 (Marcus R.) 4/9/19 63.43 Kg.	Prelim.	10:00	.....	.....	.....	.....	.....	.....	.....
	1	12:00	55.21	52.33	0.77	68.56	0.456	172.64	148.96
	2	2:00	55.27	50.59	0.80	74.22	0.456	168.03	162.03
								340.67	
Case 14 (David K.) 3/21/13 62.66 Kg.	Prelim.	9:40	.....	.....	.....	.....	.....	.....	.....
	1	10:40	25.86	25.55	0.74	32.26	0.323	83.84	79.94
	2	11:40	21.78	20.91	0.76	28.71	0.323	68.89	66.49
									152.73
	3	12:40	27.13	26.95	0.73	32.44	0.323	88.36	82.37
	4	1:40	29.35	27.43	0.78	32.74	0.323	91.04	84.88
	5	2:40	25.50	23.78	0.78	30.95	0.323	78.89	80.54
6	3:40	23.74	23.61	0.73	30.16	0.323	77.32	79.79	
								488.34	

—EXPERIMENTS—(Continued)

Direct Calorimetry (Rectal Temp.), Cal.	Rectal Temp., C.	Average Pulse	Work-Adder, Cm.	Non-protein R. Q.	Per Cent. Calories from			Calories per Hour		Remarks
					Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M. (Meeh)	
.....	37.87									
79.78	37.72	68	36.0	0.82	16	51	33	1.30	39.67	Restless
81.04	37.64	64	35.0	0.87	18	36	46	1.13	35.01	Restless
160.82										
.....	38.18									
45.76	38.10	78	12.0	....	..	..	..	....	.....	Very quiet; asleep 15 min. Quiet
51.43	38.10	76	7.0	....	..	..	..	....	.....	
97.19										
.....	36.79									
59.13	36.68	85	3.0	0.84	21	43	36	1.02	33.13	Very quiet
71.16	36.71	98	27.6	0.80	19	55	26	1.11	36.36	Restless
130.29										
.....	36.52									
112.80	36.72	64	....	0.86	18	40	42	1.07	32.84	Restless
117.72	36.79	...	....	0.79	18	59	23	1.09	33.43	Restless
230.52										
.....	36.78									
96.08	36.66	...	....	0.82	15	53	32	0.94	29.52	Asleep
115.88	36.76	...	....	0.77	13	67	20	1.08	33.34	Slightly restless
211.91										
.....	36.68									
50.97	36.47	58	14.9	0.88	19	34	47	1.02	29.46	Asleep 30 min.
63.66	36.47	60	21.3	0.79	17	59	24	1.04	32.81	Asleep 10 min.
114.63										
.....	36.53									
64.04	36.54	59	29.8	0.78	18	62	20	1.01	32.04	
50.94	36.64	60	9.0	0.86	19	39	42	0.94	29.37	
114.98										
.....	37.24									
165.91	37.57	...	....	0.76	14	70	16	1.36	44.09	Very quiet
163.27	37.60	...	....	0.79	14	61	25	1.32	42.91	Very quiet
329.18										
.....	36.97									
82.17	37.02	...	....	0.73	10	83	7	1.34	43.26	Restless
69.16	37.06	...	....	0.75	12	75	13	1.10	35.47	Restless
151.33										
.....	37.01	...	....	0.72	10	84	6	1.41	45.49	At 11:40 a. m., oatmeal
.....	36.97	...	....	0.78	9	70	21	1.45	46.87	
.....	37.09	...	....	0.78	11	67	22	1.26	40.62	
.....	37.01	...	....	0.72	11	84	5	1.23	39.81	
153.33										

TABLE 4.—CALORIMETER—

Subject, Date, Weight, Surface Area, Linear Formula†	Period	End of Period	Carbon Dioxid, Gm.	Oxygen, Gm.	R. Q.	Water, Gm.	Urine N per Hour, Gm.	Indirect Calo- rimetry, Cal.	Heat Elimi- nated, Cal.
David K. .... 3/24/13 64.26 Kg.	Prelim.	9:21	.....	.....	.....	.....	.....	.....	.....
	1	10:21	22.91	22.75	0.73	27.51	0.391	74.39	68.85
	2	11:21	22.66	21.78	0.76	27.73	0.391	71.65	67.05
								146.04	
Case 15 (Wm. A.).. 1/25/15 63.44 Kg. 1.795 Sq. M.	Prelim.	11:13	.....	.....	.....	.....	.....	.....	.....
	1	12:13	25.32	20.31	0.91	34.45	0.282	69.44	72.58
	2	1:13	24.08	20.86	0.84	32.15	0.382	70.14	73.06
	3	2:13	24.45	22.02	0.81	31.11	0.382	73.44	73.48
								213.02	
William A. .... 1/27/15 63.00 Kg. 1.790 Sq. M.	Prelim.	10:40	.....	.....	.....	.....	.....	.....	.....
	1	11:40	24.37	21.08	0.84	32.50	0.390	70.86	73.83
	2	12:40	25.01	22.17	0.82	32.37	0.390	74.09	75.33
	3	1:40	24.75	23.05	0.78	33.53	0.390	76.38	78.06
								221.33	
Case 16 (Theo. S.) 1/28/14 59.52 Kg. 1.68 Sq. M.	Prelim.	11:10	.....	.....	.....	.....	.....	.....	.....
	1	12:10	23.13	20.30	0.83	39.03	0.454	67.86	77.23
	2	1:10	23.93	21.43	0.81	38.26	0.454	71.40	76.66
								139.26	
Theodore S. .... 1/30/14 59.44 Kg. 1.68 Sq. M.	Prelim.	11:15	.....	.....	.....	.....	.....	.....	.....
	1	12:15	21.66	18.76	0.84	36.00	0.385	62.97	73.11
	2	1:15	22.80	20.18	0.82	37.75	0.385	67.48	73.83
								130.45	
Theodore S. .... 2/5/14 60.23 Kg. 1.69 Sq. M.	Prelim.	11:46	.....	.....	.....	.....	.....	.....	.....
	1*	1:16	34.63	31.59	0.80	50.61	0.538	105.10	118.65
	2	2:16	22.82	20.53	0.81	32.00	0.350	68.47	72.40
								173.57	
Theodore S. .... 2/9/14 61.15 Kg. 1.70 Sq. M.	Prelim.	11:50	.....	.....	.....	.....	.....	.....	.....
	1	12:50	21.11	18.41	0.83	21.14	0.394	61.66	56.93
	2	1:50	22.34	19.11	0.85	22.55	0.394	64.30	60.88
								135.96	
Theodore S. .... 2/13/14 61.99 Kg. 1.71 Sq. M.	Prelim.	11:10	.....	.....	.....	.....	.....	.....	.....
	1	12:10	24.54	20.49	0.87	26.73	0.391	69.38	70.40
	2	1:10	24.35	21.15	0.84	33.09	0.391	71.02	75.79
								140.40	

\* 1½ hours.

† In the case of Theodore S. the height-weight formula.

—EXPERIMENTS—(Continued)

Direct Calorimetry (Rectal Temp.), Cal.	Rectal Temp., C.	Average Pulse	Work-Adder, Cm.	Non-protein R. Q.	Per Cent. Calories from			Calories per Hour		Remarks
					Protein	Fat	Carbohyd.	Per Kg.	Per Sq. M. (Meeh)	
.....	36.96									
76.52	37.11	...	....	0.72	14	82	4	1.16	37.66	
66.14	37.10	...	....	0.75	14	73	13	1.11	36.27	
142.66										
.....	36.96	..	....	....	..	..	..	....	.....	Basal; flat in bed
62.29	36.77	62	20.2	0.93	15	20	65	1.10	35.47	Restless
69.48	36.71	60	10.5	0.85	14	68	18	1.11	35.82	Fairly quiet
70.55	36.66	62	10.0	0.81	14	62	24	1.16	37.51	Quiet
202.82										
.....	36.89	..	....	....	..	..	..	....	.....	In steamer chair
66.72	36.76	66	10.0	0.85	15	44	42	1.13	36.36	Quiet
72.33	36.71	66	10.5	0.82	14	53	33	1.18	38.01	Quiet
73.06	36.62	..	20.6	0.78	14	65	22	1.21	39.19	Fairly quiet
212.11										
.....	37.14	..	....	....	..	..	..	....	.....	Basal; flat in bed
89.22	36.94	49	21.0	0.84	18	46	36	1.14	36.14	
71.30	36.93	50	23.2	0.82	17	52	31	1.19	38.03	
160.52										
.....	37.10	..	....	....	..	..	..	....	.....	[ Sitting up with backrest at angle of about 30 deg.
70.46	37.05	53	1.9	0.85	16	44	40	1.06	33.58	
75.61	37.13	52	0.9	0.83	15	51	34	1.14	35.99	
146.07										
.....	37.03	..	....	....	..	..	..	....	.....	Basal; flat in bed
86.70	36.87	50	10.0	0.80	14	60	26	1.16	37.09	
65.32	36.94	47	0.6	0.81	14	56	30	1.14	36.26	
152.02										
.....	37.06	..	....	....	..	..	..	....	.....	[ Sitting up with backrest at angle of about 50 deg.
64.71	36.83	49	6.7	0.84	17	45	38	1.01	32.28	
67.15	36.86	46	3.7	0.86	16	40	44	1.05	33.67	
131.86										
.....	37.01	..	....	....	..	..	..	....	.....	Basal; flat in bed
66.94	36.95	54	3.5	0.88	15	34	51	1.12	35.99	
75.32	36.95	55	5.5	0.84	15	45	40	1.15	36.84	
142.26										



TABLE 5.—CLINICAL DATA

Case No., Name and Date	Total Calories	Protein, Gm.	Fat, Gm.	Carb., Gm.	Food N	Urine N	Excreta N†	N Balance	NaCl Gm.	Urine Vol., c.c.	Body Weight, Kg.
Case 15, William A. Jan. 7-8, 1915	2,753	94.1	126.0	29.15	15.05	13.86	15.37	-0.32	.....	1,255	62.38
Jan. 8-9, 1915	3,075	112.2	152.9	291.4	17.95	13.82	15.62	+2.33	.....	1,230	.....
Jan. 9-10, 1915	3,207	97.4	131.9	385.5	15.58	14.54	16.06	-0.48	.....	1,530	.....
Jan. 25-26, 1915	1,756	72.0	99.0	131.6	11.52	9.52	10.67	+0.85	.....	1,232	63.44
Jan. 26-27, 1915	2,588	76.4	102.8	321.7	12.55	.....	.....	.....	.....	.....	.....
Jan. 27-28, 1915	2,063	58.3	87.1	247.4	9.32	10.30	11.23	-1.91	.....	1,135	63.00
Case 5, Charles L. Feb. 19-20, 1915	1,514	33.3	69.8	177.3	5.33	8.55	9.08	-3.75	.....	685	85.84
Case 8, Henry R. Feb. 26-27, 1915	1,085	18.2	33.1	158.8	2.91	7.12	7.41	-4.50	.....	417	74.59
Case 3, Fred D. Feb. 15-16, 1915	820	31.6	39.3	79.0	5.06	12.61	13.12	-8.06	.....	913	49.75
Feb. 16-17, 1915	514	24.5	28.0	37.6	3.92	14.28	14.67	-10.75	.....	2,850	.....
Feb. 17-18, 1915	882	35.3	39.2	78.6	5.65	11.09	12.26	-6.61	26.95	4,800	.....
Feb. 18-19, 1915	1,155	34.4	46.5	137.4	5.50	7.90	8.45	-2.95	20.48	1,880	.....
Bartolo D. Mar. 11-12, 1915	2,836	85.9	147.7	246.9	13.74	6.28	7.65	+6.09	.....	1,220	.....
Mar. 12-13, 1915	2,922	100.8	131.5	313.7	16.13	5.32	6.96	+9.17	.....	1,960	43.78
Mar. 13-14, 1915	3,498	96.9	192.1	320.6	15.50	7.17	8.72	+6.78	.....	1,820	43.88
Mar. 14-15, 1915	2,983	91.8	157.6	278.2	14.69	6.89	8.36	+6.33	.....	1,700	43.33
Mar. 15-16, 1915	2,315	78.3	119.0	216.4	12.53	6.49	7.74	+4.79	.....	1,259	41.80
Morris S. Dec. 17-18, 1914	1,930	56.6	75.0	244.2	9.06	11.69	12.60	-3.54	.....	1,775	61.21
Dec. 11-18, 1914	558 Protein meal	62.1	11.8	47.1	9.98	6.24 Cal. Spec.	.....	.....	.....	875	62.81
Case 9, Burrell P. Mar. 24-25, 1915	2,306	71.1	124.0	210.0	11.38	12.37	13.51	-2.13	.....	1,035	70.81
Case 11, William S. Feb. 10-11, 1915	1,726	40.0	95.3	164.9	6.40	10.61	11.25	-4.85	.....	2,235	65.02
Feb. 11-12, 1915	2,444	59.9	117.4	269.7	9.60	.....	.....	.....	.....	1,695	.....
Case 7, Edward W. Feb. 24-25, 1915	1,423	44.2	58.8	169.6	7.07	7.26	7.98	-0.91	.....	1,254	54.35
Case 16, Theodore S. Jan. 28, 1914	2,021	88.4	94.8	189.5	14.1	.....	.....	.....	.....	800+	59.55
Jan. 29, 1914	2,034	96.3	87.3	201.7	15.4	.....	.....	.....	.....	1,025	60.10
Jan. 30, 1914	2,065	95.4	94.4	191.4	15.3	.....	.....	.....	.....	930	59.48

† Urine N + 10% of food N.

Patients with compensated cardiac lesions or with mild nephritis showed no increase in the metabolism. Of twelve patients with dyspnea, nine showed a distinct rise in metabolism, and in five of these the increase was from 25 to 50 per cent. above the average normal. Two out of the five gave evidence of marked acidosis in the low content of carbon dioxide in the alveolar air. In two others, whose metabolism was just as high, there was no significant depression of the alveolar carbon dioxide.

697 Huntington Avenue, Boston—477 First Avenue, New York.

#### REPORT OF CASES

CASE 1.—Arthur V., aged 40, Italian, admitted Feb. 10, 1915, discharged March 3, 1915. Service of Dr. Nammack.

Diagnosis: Chronic nephritis, chronic myocarditis with decompensation.

Complaint: Dyspnea and cough.

Past History: Never sick before except for an attack of bronchitis three months ago. No history of venereal disease.

Present Illness: Has been "feeling poorly" for one month. For twelve days has had shortness of breath.

Physical Examination (February 12): The patient is a well built and fairly well developed man. Height 155 cm. Skin is slightly yellowish. Sclerae clear. He is dyspneic and orthopneic. There is a slight cyanotic tinge to his lips and ears. Respiration is rapid and shallow; rate 30. Pneumographic tracings show respiration to be periodic in type. Heart: Dulness extends from 16 cm. to the left of the midsternum in the fifth space to 5 cm. to the right in the third space. The action is regular. At the apex there is a weak first sound with a faint systolic murmur and a weak second sound. Gallop rhythm at the apex. Pulmonic second sound is louder than the aortic second sound. No murmurs at the base. Radial artery not palpable. Lungs: Slight dulness at extreme right base posteriorly. Large moist râles at both bases. Abdomen, negative. Liver: Dulness extends 3 cm. below the costal margin. Edge indistinctly felt. No edema.

Pulse: Varied in rate from 72 to 116 between February 10 and February 18.

Temperature: Between February 10 and February 18 varied between 97.8 and 101 F. except on February 13, when it reached 103 F. (rectal), February 16, when it was 102.2 F. (rectal), and February 17, when it was 102.4 F. (rectal).

Urine: February 10, specific gravity, 1.026; albumin, very faint trace. One hyaline cast.

February 14, specific gravity, 1.020; albumin, cloud. Few casts.

February 23, specific gravity, 1.020; albumin, faint trace. No casts.

Blood Pressure: February 15, systolic, 110 mm.; diastolic, 70 mm.

February 16, systolic, 120 mm.; diastolic, 75 mm.

February 24, systolic, 120 mm.; diastolic, 60 mm.

Phenolsulphonaphthalein Test: February 15, first hour, 20 per cent.; second hour, 12 per cent.; total, 32 per cent.

February 27, first hour, 50 per cent.; second hour, 13 per cent.; total, 63 per cent.

March 2, 1915: Roentgenoscopy does not reveal evidence of aneurysm or dilatation of the aorta. Cardiac shadow is triangular in shape with enlargement of the right heart. Cardiophrenic angle is obtuse.

Medication: Patient was on a "soft special" diet, consisting chiefly of milk, cream, bread, butter and eggs. Strophanthin, 0.5 mg., intramuscularly, on February 10. Digitalis from February 13 to February 22, inclusive.

## DIET CHART SUMMARY

Date	Food Calories	Food N, Gm.	Urine Vol., C.c.	Urine N, Gm.
2/12/13	1,246	7.28	560	10.27

Alveolar Air (Plesch-Higgins method): February 12, 23.9 mm.; February 16, 30.8 mm.; February 27, 41.0 mm.

Electrocardiogram: February 26, "R" waves small in all leads, directed down in lead 3. "P" waves larger in all leads.

In the ten days following the observations in the calorimeter, the patient's condition showed little change. His dyspnea, though of only moderate grade while he was at rest, improved but little. Physical examination remained practically unchanged.

In calorimeter, Feb. 12, 1915, No. 189.

February 13, the dyspnea is somewhat less marked. The pulse is a little smaller and the heart action not quite so strong.

February 26, seems improved. Much less dyspneic. Pulse suggestive of a Corrigan.

CASE 2.—Armon W., aged 33, pedler, born in Hungary, admitted Feb. 9, 1915, discharged Feb. 18, 1915. Service of Dr. Nammack.

Diagnosis: Mitral stenosis and insufficiency. Auricular fibrillation.

Complaint: Pain in heart and right side.

Past History: Was never sick up to six months ago. Has been in hospitals twice during last six months on account of dyspnea and swollen feet. No history of rheumatism or syphilis.

Present Illness: No improvement since discharged from Beth Israel Hospital.

Physical Examination (February 13): Patient is a fairly well built young man. Height 161 cm. Respiration, 28 per minute. Slight cyanosis. Heart dullness extends from 12 cm. to left of the midsternum in the fifth interspace to the right sternal border of the sternum. First sound at apex is loud and is followed by a rumbling systolic murmur. Second sound is loud and is followed by a rumbling diastolic murmur which extends through the short diastoles but is followed by a pause before the first sound in the longer diastoles. Both second sounds are normal at the base. Action absolutely irregular. Practically all the beats reach the wrist.

Temperature: Normal.

Pulse: From 156 to 72.

Respiration: From 26 to 28. During last three days it was from 20 to 24.

Medication: Special diet. Infusion of digitalis, every four hours from February 9 to 10.

Wassermann (Feb. 10, 1915): + + +.

Blood Pressure (February 18): Systolic, 110; diastolic, 70.

Urine: February 10, specific gravity, 1.022; albumin, 0; no casts.

February 17, specific gravity, 1.030; albumin, faint cloud; no casts.

Alveolar Air (Plesch method): February 13, carbon dioxid tension 44.2 mm.

In calorimeter Feb. 13, 1915.

CASE 3.—Fred D., aged 17, clerk, admitted Feb. 13, 1915, discharged March 19, 1915. Service of Dr. Nammack.

Diagnosis: Mitral stenosis and insufficiency.

Complaint: "Shortness of breath."

Past History: First attack of rheumatism at the age of 6 years. He made a complete recovery and was well until a second attack of rheumatism at 11 years of age. Since then he has been perfectly well up to the present illness.

Present Illness: Began three weeks ago with pain in the abdomen. He stopped work for one week but after that went back to work for two weeks. During the week before admission to the hospital he was troubled with marked shortness of breath. Edema of feet began on the day before admission. He has had a cough for three days.

Physical Examination (February 16): The patient is 157 cm. tall. He is slightly cyanotic and orthopneic. No clubbing of fingers. Heart: Apex impulse is in the fifth space 9 cm. to the left of the midsternal line. Cardiac dullness extends from 12 cm. to left of midsternum in the sixth space to 5 cm. to the right in the fourth space. Action regular. At the apex the first sound is followed by a blowing systolic murmur; the second sound is distant and followed by a long rumbling murmur which extends through diastole. The pulmonic second sound is accentuated. There is a loud systolic murmur in the fourth and fifth spaces just to the left of the sternum and transmitted to the right. The lungs are negative except for scattered râles and dullness at the extreme left base. Liver not felt. Abdomen negative. Slight edema of legs.

Urine: Specific gravity, 1.030; heavy cloud of albumin; many casts.

Temperature has ranged from 100 to 102 since admission.

Pulse has varied between 96 and 112; respirations from 24 to 32.

The patient was in the calorimeter, February 15, the day preceding the foregoing physical examination, and on February 23.

February 19: The patient is now almost completely compensated at rest. Respiration less rapid and less labored. Slight cyanosis persists. Heart dullness extends from 10 cm. to the left in the fifth space to 3.5 cm. to the right in the fourth space. Action regular. Sounds and murmurs are unchanged. He has been passing large quantities of water.

Date	Food Cal.	Food N.	Urine N.	Urine NaCl	Urine Vol., C.c.
2/15-16			12.61		913
2/16-17	518	3.92	14.28		2,430
2/17-18			11.69	26.95	4,800
2/18-19	1,139	4.90	7.90	20.48	1,880

February 24: Blood pressure: systolic, 95; diastolic, 70.

February 17-24, temperature varied between 98.4 and 99.8 (rectal).

February 20: Urine: Albumin negative, no casts.

The patient was on the Karrell diet and received digitalis from February 14 to February 17, inclusive.

February 24: Blood culture sterile. Wassermann negative.

March 13: Up and about.

Alveolar Carbon Dioxid (Plesch-Higgins method): February 15, average 27.7 mm.; February 16, average 33.7 mm.; February 18, average 36.7 mm.; February 23, average 37.2 mm.

Medication: Digitalin, 10 minims every four hours (8, 12, 4) the night before going into the calorimeter (Feb. 15, 1915). Also digitalin, 10 minims, every four hours (8, 2, 6) on the day of the calorimeter (Feb. 15, 1915).

No electrocardiogram.

CASE 4.—Edward M., aged 37, chauffeur, born in the United States, admitted Feb. 15, 1915, discharged Feb. 27, 1915. Service of Dr. Coleman.

Diagnosis: Mitral insufficiency and auricular fibrillation.

Complaint: Dyspnea and edema of the legs.

Family History: Negative.

Past History: Had rheumatism in 1908. The attack lasted about one year, and affected all the joints of his limbs. He was in bed off and on. Four years ago he was refused life insurance. He has had dyspnea, palpitation, edema of the feet and vertigo for several years. During the last year these symptoms have been severe. This is his third admission to the hospital since last May. No history of venereal disease.

Present Illness: Legs have been more swollen during the last week. Dyspnea and cough are more severe, so he has returned to the hospital.

Physical Examination (Feb. 17, 1915): The patient is a large, well developed man. He is orthopneic and distinctly cyanotic, but his respiration is

slower and not so labored as it was yesterday. He coughs occasionally but raises little sputum. Heart: Dulness extends from 14 cm. to the left of the midsternum in the fifth space to 4 cm. to the right in the fourth space. Pulse 86, irregular in force and rhythm. No pulse deficit. At the apex the first sound is poor in quality, and is followed by a blowing systolic murmur which is transmitted to the left. No murmurs at the base. Pulmonic second sound is louder than the aortic. Radial artery not palpable. Lungs: Slight dulness at the left base posteriorly. Numerous sibilant and sonorous râles throughout the chest. Liver: Edge indistinctly made out 5 cm. below the costal margin in the right mammary line. No fluid in the abdomen. Slight edema of the back and legs.

Pulse, between February 16 and February 20, ranged from 56 to 108. It was 120 once, and 140 once.

Temperature reached 102 F. (rectal), February 16. From then to February 20 it was below 99.8 F. (rectal).

Respiration varied from 24 to 30 on the first three days in the hospital, and was subsequently 20 or less.

Blood Pressure: February 16, systolic, 120; diastolic, 85.

Urine: February 16, specific gravity, 1.025; trace of albumin; no casts.

Medication: Soft diet. Digitalis from February 16 to February 19, infusion of digitalis, 20 minims, the night before and on the day he was in the calorimeter.

Alveolar Air (Plesch method): February 16, carbon dioxid tension, 38.3 mm.

Electrocardiogram shows auricular fibrillation. "T" waves directed down

in the second and third leads.

Patient regained compensation rapidly, and on February 24 was beginning to get up in a chair.

In calorimeter, Feb. 17, 1915.

Discharged, Feb. 27, 1915. General condition very good. Cyanosis much improved. Walks around without shortness of breath. Pulse still irregular.

CASE 5.—Charles L., aged 54, laborer, born in the United States, admitted February 16, 1915, discharged Feb. 24, 1915. Service of Dr. Lambert.

Diagnosis: Chronic nephritis with hypertension. Cardiac hypertrophy with aortic insufficiency and mitral insufficiency. Emphysema.

Complaint: Shortness of breath.

Family History: Negative.

Past History: Three years ago he was sick for nine weeks with rheumatism. He had erysipelas following a fracture of the skull six years ago. He drinks a considerable amount of beer. There is no history of syphilis.

Present Illness: He has noticed dyspnea for about a month when he went upstairs. For two weeks this has been much worse and he has been unable to sleep at night.

Physical Examination (February 19): The patient is a rather large, strong man. His skin has slight yellowish tinge. Lips and mucous membranes are of fair color. There is no definite cyanosis. Respiration is quiet but somewhat rapid. Respiration is periodic in type, but without intervals of complete apnea. The chest is large, almost barrel-shaped. Heart: Dulness extends from 14 cm. in the fifth space to the left of the midsternum to the right sternal margin. No area of absolute cardiac dulness. Action regular. At the apex the first sound is rather faint and it is followed by a blowing systolic murmur. The second sound at the apex is also faint; it is followed by a blowing diastolic murmur. Both systolic and diastolic murmurs are well heard in the axilla and over the precordium. They are also audible in the first and second spaces to the right of the sternum. The murmurs are loudest in the first space to the right and in the second space to the left of the sternum. The pulse is of good size, high tension, and distinctly collapsing in type. Artery wall not palpable. Lungs: Emphysematous. Scattered râles in both sides of back. Fairly frequent cough, but little expectoration. Dulness with absent breath sounds at extreme right base posteriorly. Abdomen negative except for slight tenderness in region of the liver. Liver not felt. No edema.

Temperature: Varied between 98 and 100 F. (rectal).  
 Pulse: Varied between 64 and 100.  
 Respiration: Ran between 28 and 36 on the first two days—later between 20 and 28.  
 Wassermann Reaction: Negative.  
 Blood Pressure: February 17, systolic, 180; diastolic, 90.  
 Phenolsulphonephthalein Test: February 20, first hour, 10 per cent.; second hour, 20 per cent.; total, 30 per cent.  
 Urine: February 16, specific gravity, 1.020; albumin, heavy cloud; many casts.  
 February 21, specific gravity, 1.018; albumin, strong trace; many casts.

SUMMARY OF DIET CHART

Date	Food Cal.	Food N.	Urine Vol., C.c.	Urine N.	Urine NaCl
2/19-20	1,524	5.82	685	8.55	12.17

Medication: Special diet. Restricted fluids. Infusion of digitalis every four hours from February 18 to February 20. Infusion of digitalis just before going into calorimeter.

Alveolar Air (Plesch method): February 19, carbon dioxid tension, 39.4 mm. at 3:30 p. m.

In calorimeter, Feb. 19, 1915.

CASE 6.—Annie T., aged 14, born in the United States, admitted Jan. 14, 1915, discharged March 25, 1915. Service of Dr. Lambert.

Diagnosis: Congenital heart disease. Open ventricular septum. Dextrocardia. Complaint: Heart trouble, headache and trembling.

Family History: Negative.

Past History: Negative except for the dyspnea associated with her cardiac condition.

Present Illness: Comes to hospital on account of a severe attack of headache, with palpitation of the heart, and stomach ache. Has had similar attacks before.

Physical Examination: Height 137 cm. The patient is a small, rather underdeveloped girl, dull mentally. She lies flat on her back breathing quietly but slightly rapidly. There is a high degree of cyanosis of lips, tongue, nose, hands and feet. There is marked clubbing of the fingers and toes. The chest is asymmetrical. Right side more prominent than left. Heart: Apex impulse is in the fifth space 9 cm. to the right of the midsternal line. The dulness extends from 11 cm. to the right in the fifth space to 4 cm. to the left of the midsternum in the fourth space. No thrills are felt. At the apex, just below and outside the right nipple, the first sound is scarcely audible, and there is a loud blowing systolic murmur. The second sound is weak. There is a loud systolic murmur heard all over the precordium and to the left of the sternum. Its maximum intensity is in the fifth space just to the right of the sternum. There is a loud, low pitched systolic murmur in the second space just to the left of the sternum, and also in the second space to the right of the sternum. Lungs: Negative on auscultation and percussion. Abdomen, liver and spleen negative. Skin harsh and dry.

Roentgenoscopy reveals transposition of heart and colon. Stomach and liver are in normal position.

Temperature: Ranges between 98.4 and 101 F. (rectal).

Pulse: Usually varies between 86 and 108.

Respiration: Now from 20 to 24.

Blood Pressure: January 27, systolic, 95 mm.

Urine: January 15, specific gravity, 1.025; albumin, cloud; granular casts.

Alveolar Air (Plesch method): February 18, carbon dioxid tension, 25.2 mm. at 4 p. m.

Blood: Jan. 28, 1915, leukocytes, 14,000; polymorphonuclears, 63; transitionals, 1; lymphocytes, 28; large mononuclears, 8; mast cells, 0.

Feb. 9, 1915, leukocytes, 15,200; polymorphonuclears, 56; transitionals, 4; lymphocytes, 28; large mononuclears, 7; mast cells, 5.

Electrocardiogram, Jan. 16, 1915, shows an inverted "T" wave in the first lead; very large "P" and "T" waves in the second lead, and very large "P" and "T" waves in the last lead, with a splitting of the "T" waves.

Electrocardiogram: Jan. 19, 1915, right and left arm terminals were normal. Shows right heart preponderance; inverted "P" and very large "T" waves in Lead 1; "P-R" interval prolonged.

In calorimeter, Feb. 20, 1915.

CASE 7.—Edward W., aged 37, born in the United States, bath attendant, admitted Feb. 22, 1915, discharged March 7, 1915. Service of Dr. Meara.

Diagnosis: Chronic interstitial nephritis. Cardiac dilatation.

Complaint: Shortness of breath; swelling of feet.

Past History: Has had frequent attacks of sore throat. Syphilis twelve years ago. Has been a heavy drinker during the last three months.

Present Illness: Five days before admission he began to be troubled with palpitation and dyspnea on exertion. Dyspnea has been much worse at night. Edema of feet for the last few days.

Physical Examination (February 24): The patient is a fairly well developed young man. His lips, ears and finger tips are slightly dusky. Definite exophthalmos. Thyroid not enlarged. Respiration is periodic, but without intervals of complete apnea. Breath urinous. Orthopnea marked. Patient says he is breathing much more easily than during the night. Heart: Dulness extends from 11 cm. to the left of the midsternum in the fifth space to 3.5 cm. to the right of the midsternum in the fourth space. At the apex the first sound is loud, followed by a soft, blowing systolic murmur and a ringing second sound. Aortic second is ringing but not accentuated. Gallop rhythm is heard all over the precordium, most marked just below the left nipple. Pulse is regular; high tension. Wall of radial artery is easily palpable. Vessels tortuous. Lungs: Negative except for scattered râles, which are most numerous at the left base. Abdomen negative. Liver negative. Very slight edema of the dependent parts of the thighs.

Pulse: From February 22 to February 25, has averaged from 86 to 116 per minute.

Respirations: From February 22 to February 25, have averaged from 20 to 32 per minute.

Temperature: From February 22 to February 25, has varied from 98.4 to 99.8 F. (rectal).

Blood Pressure: February 23, systolic, 190; diastolic, 100 mm.

Urine: February 23, specific gravity, 1.018; albumin, +++; no casts seen.

Medication: Soft diet. Tincture of digitalis, 15 minims, every four hours from February 22 to 28.

#### SUMMARY OF DIET CHART

Date	Food	Urine		
	Cal.	Food N.	Vol., C.c.	Urine N.
2/24-25	1,226	3.36	1,254	7.26

Alveolar Air (Plesch method): February 24, carbon dioxid tension, 38.9 mm.

Wassermann, Feb. 28, 1915, positive, 17 units.

Alkali Tolerance Test: After 20 gm. sodium bicarbonate, given in 5 gm. doses every hour, the urine became neutral. After 25 gm. it was still neutral. Not tested later.

Phenolsulphonephthalein Test: February 27, first hour, 6 per cent.; second hour, 4 per cent.; total, 10 per cent.

February 27: The patient has Cheyne-Stokes respiration—periods of apnea and periods of intense dyspnea. He is very uncomfortable with his breathlessness. His condition appears to be much worse.

In calorimeter, Feb. 24, 1915.

March 7, 1915: Patient has improved very little. Fairly comfortable during the day, but each night suffers from shortness of breath and great restlessness. Heart action is rapid, and there is a gallop rhythm in spite of digitalis. Respiration is of Cheyne-Stokes type. Left hospital against advice in a serious condition. Died April 17, 1915.

CASE 8.—Henry R., aged 40, born in the United States, waiter, admitted to hospital, Jan. 22, 1915, died March 20, 1915. Necropsy not obtained. Service of Dr. Nammack.

Diagnosis: Chronic myocarditis. Emphysema. Chronic nephritis (?).

Complaint: Shortness of breath.

Past History: Syphilis three years ago. Was in Bellevue Hospital in May, 1914, with lobar pneumonia. Has been in hospital since then with diagnosis of chronic myocarditis the first time, and chronic cardiac valvular disease the second time. Drinks two or three whiskies a day.

Present Illness: Comes into the hospital again because of increase of dyspnea since catching cold. On admission the clinical picture was that of an acutely decompensated heart. February 6, he began to run an irregular temperature, reaching sometimes 103, rectal. The diagnosis of bronchopneumonia was considered. February 21, the temperature fell to normal. Since then the highest temperature has been 101, rectal. General condition has not improved essentially.

Physical Examination (February 26): The patient is a big strong negro 153 cm. tall. Respiration is very rapid and shallow; rate, 40. There is orthopnea. Tongue and conjunctiva are rather pale. Eyes are prominent. Chest is very large. Heart: Dulness extends from 12.5 cm. to the left of the midsternum in the fifth space to 3 cm. to the right in the fourth space. The action is regular and rapid. Sounds are of fair quality. No murmurs are heard. There is a well marked protodiastolic gallop rhythm, heard best just below and outside the left nipple. Aortic second sound is slightly accentuated and ringing. Pulse is of fair quality; rate, 116 per minute. Artery wall not palpable. Lungs: Marked emphysema. Slight dulness at extreme right base posteriorly. A few scattered râles throughout both lungs. Many moist râles at the right base behind. Abdomen, negative. Liver: Edge easily felt about 3 cm. below the costal margin in the right nipple line. Slight tenderness over the liver. Very slight edema of the feet and lower legs.

Urine: Clear, amber, 1.022 specific gravity, acid, heavy cloud of albumin, many hyaline and coarsely granular casts, many leukocytes.

Blood Pressure: February 18, systolic, 138; diastolic, 105.

February 27, systolic, 160; diastolic, 120.

Phenolsulphonephthalein: Feb. 27, 1915, first hour, 30 per cent.; second hour, 18 per cent.; total, 48 per cent.

Wassermann, January 30, double positive, 12 units.

Alveolar Air (Plesch-Higgins method): February 25, carbon dioxid tension, 41.1 mm. at 5 p. m. February 26, carbon dioxid tension, 39.9 mm. at 4:30 p. m. Medication: Soft diet. Morphine. Infusion of digitalis. Tincture digitalis. Codein  $\frac{1}{4}$  grain, the night before and the morning before going into calorimeter.

Temperature: January 22 to Jan. 28, 1915, 99 to 101. January 28 to Feb. 1, 1915, 99. February 2 to Feb. 7, 1915, rose to 103.5 once. February 8 to Feb. 12, 1915, 100 to 101.5. February 12 to Feb. 16, 1915, 100 to 104. Remainder of time, 99 to 101.

In calorimeter, Feb. 26, 1915.

CASE 9.—Burrell P., aged 41, laborer, admitted March 18, 1915, discharged April 5, 1915. Service of Dr. Nammack.



Diagnoses: Aortic regurgitation and stenosis. Mitral regurgitation. Tricuspid regurgitation. Aneurysmal dilatation of the aorta.

Chief Complaint: Shortness of breath.

Past History: Measles and whooping cough as child. Pneumonia twenty years ago.

Present Illness: Duration for past year. Ten weeks ago found that he could not work properly on account of shortness of breath. Has had hoarseness and sore throat. Nocturia rather frequent. Occasional headaches. Marked dyspnea, especially after work. Has had no swelling of ankles or legs at any time. Coughs frequently and has marked night sweats.

Physical Examination (March 23, 1915): Patient is a dark negro of muscular development. Is 169 cm. (5 feet 7 inches) tall. Orthopneic and dyspneic, breathing 26 to the minute. Not prostrated nor in much distress. An occasional unproductive cough. Heart: Apex beat in sixth space, 15 cm. to the left. Action is regular, not rapid; forceful. At the apex there is a blowing systolic murmur transmitted to the left, and a waterfall, diminuendo diastolic murmur heard with maximum intensity to the left of the sternum, but audible over the whole precordium. In the third left space there is a short presystolic murmur (Flint?). Over the aortic region there is a harsh systolic and a soft diastolic murmur. Pulse: Large excursion, quick rise and fall. Artery wall moderately thickened. Lungs: No dulness; many sibilant and sonorous râles. Cervical, axillary, epitrochlear, inguinal glands considerably enlarged.

March 19, 1915: Electrocardiogram shows a large "P" wave and the "T" wave is directed upward in each lead. There is marked left sided preponderance.

April 1, 1915: Some dyspnea. Complains of precordial pain. Heart not much changed.

Urine: Negative.

Blood: No data.

Temperature ran to 101.5 F., March 18, 1915; below 100 F. the rest of the time.

Pulse: March 18, 1915, from 104 to 112; March 19, 1915, from 70 to 80.

Respiration: March 18, 1915, from 20 to 32.

In the calorimeter, March 24, 1915.

March 18, 1915: Pupils unequal. React sluggishly. Aortic arch is dilated and heart is greatly enlarged down and to the left, also to the right of the midsternal line. Systolic thrill palpable over the aortic area. Apical impulse is forceful. Systolic and diastolic murmur is heard at the apex. Aortic second sound is accentuated. A systolic murmur is heard over the tricuspid area. There is an extracardiac sound heard which appears to be a pericardial rub. The pulse is of a typical Corrigan type.

March 22, 1915: Condition improved. Rhythm regular. Rate slow. Pericardial scratch persists. Seems much better compensated.

Medication: Digitalin, 15 minims, every four hours, the day before going into the calorimeter. Also  $\frac{1}{4}$  grain codein, the night before going into the calorimeter.

CASE 10.—August F., aged 62, tailor, married, admitted April 26, 1915, died May 20, 1915.

Diagnosis: Chronic interstitial nephritis and auricular fibrillation.

Complaint: Shortness of breath. Swelling of feet. Pain in chest.

Past History: There is a family history of cardiac disease. He was told that he had albumin in the urine many years ago. He had pneumonia long ago. Has had no rheumatism. Three months ago fluid was removed from his chest.

Present Illness: Began three years ago with a feeling of fatigue and shortness of breath. He has had remissions ever since. Also occasional headaches and night sweats. He feels very weak.

Physical Examination: The patient is 159 cm. tall. He is very orthopneic and in considerable distress. His lips are dry and cyanotic. Teeth are bad.

There are many râles over both bases of the lungs. Heart: Right border 3 cm. from the midsternal line. Upper border at the third rib. Left border 14 cm. and the apex 13 cm. from the midsternal line. There is a faint systolic blow heard over the apex. The sounds are of poor muscular quality. There is a harsh systolic murmur heard over the aortic area. The pulse is somewhat irregular. Walls palpable.

April 27: Pulse slower after strophanthin and digitalis.

April 29: A rough, hard systolic murmur is heard over the base of the heart, loudest in the third left space. The second sound is also loudest in this site. There is a moderate amount of fluid in the abdomen. Edema of the extremities.

May 1: Dulness at both bases posteriorly. Breath sounds diminished in intensity at the bases, where one hears an occasional râle. The cardiac impulse is less pronounced than on admission. The heart is still much dilated. There is a rough blow at the mitral area. The aortic second sound is slightly prolonged. The heart impulse is in the fifth space, 12 cm. to the left of the midline. The left limit of dulness is in the sixth space, 12.5 cm. to the left of the midline. Right limit of dulness is in the fourth space, 4 cm. to the right of the midline. There is a systolic murmur of maximum intensity to the right of the sternum. The patient has very scant beard. Pubic hair of female type. The patient is very orthopneic: distinctly dyspneic and shows marked Cheyne-Stokes breathing when asleep or quiet. He is slightly cyanotic. There is distinct edema of the flanks and legs. The breath is slightly urinous.

Urine: Cloudy, amber colored, specific gravity, 1.010, trace of albumin, hyaline and granular casts, leukocytes, erythrocytes.

Blood Pressure: Systolic, 170; diastolic, 110 (?), May 1, 1915.

Blood: Leukocytes, 15,600; polymorphonuclears, 68 per cent.; transitionals, 3 per cent.; lymphocytes, 25 per cent.; large mononuclears, 4 per cent.

Temperature: April 27 to May 12, from normal to 100; May 13 to May 19, 103.

Respiration: During high temperature, from 24 to 32.

Pulse: During high temperature, from 104 to 120.

Electrocardiogram: May 3, shows auricular fibrillation and left hypertrophy.

Phenolsulphonephthalein Test: May 8, first hour, 13 per cent.; second hour, 11 per cent.; total, 24 per cent.

The patient grew more and more orthopneic and dyspneic until death. Breath became more urinous.

CASE 11.—William S., aged 48, longshoreman, admitted Dec. 22, 1914, discharged March 1, 1915. Service of Dr. Coleman.

Diagnosis: Adherent pericardium and auricular fibrillation.

Complaint: Shortness of breath. Pain in lumbar region.

Past History: Healthy until 1913, when he had pneumonia and was in Ward B2 of the Bellevue Hospital. After discharge he was weak and dyspneic for two months and was unable to work. Since then he has had a productive cough. He has lost weight and has had hemoptysis. There is a positive history of syphilis and gonorrhoea.

Present Illness: Dec. 22, 1914, while unloading heavy lumber, he became suddenly short of breath. He rested but obtained no relief.

Physical Examination: The patient is 171 cm. tall, a moderately well nourished man, propped up in bed, markedly dyspneic and somewhat cyanotic. Pupils are sluggish. He is breathing rapidly and shallowly. There is diffuse systolic impulse over a broad area at the apex. The area of absolute cardiac dulness is very much enlarged. The sounds are of poor quality. There are no murmurs. The abdomen is distended and somewhat tender. The liver is felt at the umbilicus. Heart: Right border is 10 cm. to the right of the midline; left border, 14 cm. to the left of the midline. A triangular area of dulness.

Wassermann: Anticomplementary.

Jan. 2, 1915: General condition much improved. Broadbent's sign present.

Jan. 27, 1915: Patient sat up for two hours without any ill effect.

Feb. 3, 1915: Three days ago the patient developed shortness of breath; precordial pain; edema of the extremities.

Feb. 10, 1915: Dyspnea less marked. Cyanosis persists. Heart action very irregular, sounds faint, no distinct murmurs. Regurgitant wave in the jugulars. Few moist râles at bases.

Feb. 28, 1915: Distention of abdomen relieved by catharsis. Dyspnea continues. Heart irregular. Condition improved slightly.

Urine: Dec. 23, 1914, clear, pale amber, specific gravity 1.020, acid, faint trace of albumin, few hyaline casts.

Blood: Dec. 24, 1914, leukocytes, 4,800; polymorphonuclears, 73 per cent.; transitionals, 5 per cent.; lymphocytes, 12 per cent.; large mononuclears, 8 per cent.; eosinophils, 1 per cent.

Temperature: December 23 to December 25, from 101 to 103 F. December 26 to Feb. 28, 1915, from normal to 99 F.

Pulse: In the beginning from 100 to 146; later, from 60 to 80; then from 80 to 95.

Respiration: In the beginning, from 28 to 36; later, from 24 to 28.

Blood Pressure: Dec. 26, 1914, systolic, 110; diastolic, 80 (?).

Electrocardiogram: December 28, auricular fibrillation; "T" waves directed down in all leads.

Roentgenoscopy: December 30, moderate enlargement to the right and left; marked irregularity in the outline of the right diaphragm suggesting extensive adhesions.

In calorimeter, Feb. 10, 1915.

CASE 12.—George M., aged 56, saloonkeeper, watchman, porter, admitted Jan. 19, 1914, discharged April 29, 1914. Service of Dr. Meara.

Diagnosis: Chronic interstitial nephritis and cardiac hypertrophy.

Complaint: Shortness of breath. Swelling of the feet.

Past History: Alcoholic. Had measles when a child. Gonorrhœa thirty-four years ago.

Present Illness: In December, 1911, he first noticed shortness of breath on exertion and swelling of feet after work. Had to stop work about the 10th of June, 1911, because of the shortness of breath and edema of feet. His abdomen then began to increase in size and he became yellowish in color. His scrotum and penis began to swell. Frequent micturition. Oct. 23, 1912, he was taken with shortness of breath again, cough and swelling of the legs. Aug. 5, 1913, his legs began to swell, and he became very dyspneic on walking. His sputum became bloody. He could not lie down in bed on account of dyspnea. His abdomen increased in size.

Physical Examination (Jan. 19, 1914): The patient is a well nourished man propped up in bed showing considerable dyspnea. His face is flushed and somewhat edematous. Chest symmetrical and emphysematous. Sibilant and sonorous râles anteriorly and posteriorly. Heart: Right border 7 cm. to the right; left border 13 cm. to the left; cardiac impulse 12.5 cm. from the midsternal line. It extends to the third rib above. The sounds at the apex are of poor muscular quality. There are extrasystoles, some of which are not felt at the wrist. At the base the sounds are distant. No murmurs can be definitely made out. The pulse is irregular in force and rhythm. The vessel walls are slightly thickened. Liver dulness extends 2 cm. below the costal margin. Extremities edematous.

Jan. 22, 1914: Left lung shows dulness to flatness from the angle of the scapular to the base with a pleuritic rub. Heart: Left border 13 cm. from the midsternal line in the fourth-fifth interspace; right border 7 cm. from the midsternal line in the third-fourth interspace. Extends to third rib above.

Feb. 23, 1914: Doing well. No edema. Heart regular. Patient has a pulsus alternans.

March 14, 1914: Looks very well. On sodium chlorid has incomplete elimination with formation of an edema and increased blood pressure. On potassium chlorid the elimination is complete, associated with diuresis and fall of blood pressure.

April 28, 1914: General condition excellent. Heart as noticed above. Discharged.

Urine: Nov. 10, 1912, cloudy, amber, specific gravity 1.022, acid, faint trace of albumin, finely granular casts, leukocytes +, erythrocytes +.

Blood: Dec. 6, 1912, leukocytes, 11,000; polymorphonuclears, 73 per cent.; transitionals, 7 per cent.; lymphocytes, 15 per cent.; large mononuclears, 8 per cent.; hemoglobin, 90 per cent.; reds, 4,504,000.

Blood Pressure: March 24, 1914, systolic, 195; diastolic, 115. April 4, 1914, systolic, 160; diastolic, 102.

Pulse: March 24, 1914, from 72 to 90; April 4, 1914, from 72 to 80.

Respiration: March 24, 1914, from 18 to 24; April 4, 1914, from 20 to 24.

Temperature: March 24, 1914, subnormal; April 4, 1914, subnormal.

Wassermann: Dec. 8, 1913, positive.

Phenolsulphonephthalein: Jan. 27, 1914, 55 per cent. in two hours.

CASE 13.—Marcus R., aged 51, Hebrew, tinsmith, admitted March 10, 1913, discharged April 12, 1913. Service of Dr. Thompson.

Diagnosis: Chronic interstitial nephritis, arteriosclerosis, mitral insufficiency.

Past History: He had malaria at the age of 17 to 20 years. Had pneumonia in 1877. He is a moderate user of alcohol; occasionally took whisky before breakfast.

Present Illness: In January, 1912, his legs began to swell. Since then he has been short of breath and has not been able to walk. He has been very thirsty and gets up once or twice at night to pass water. Three weeks ago he caught cold.

Physical Examination: The patient is of medium stature and heavy build. He is slightly dyspneic. The apex is in the fifth space, 14 cm. from the midline. The sounds are booming. There is a loud systolic murmur at the apex. The aortic second sound is very much accentuated. The artery wall is very thick, and there is a question of calcification. Tension is high. Pulse is regular. Many crackling and moist râles over the lungs. Liver edge is felt one hand's breadth below the costal margin. The surface is hard and nodular. There is shifting fluid in the flanks.

Urine: March 10, from 600 to 1,400 c.c.

Blood Pressure: March 10, systolic, from 300 to 320; diastolic, from 140 to 180. March 16-31, systolic, 300 to 310; diastolic, 115 to 150. April 1-9, systolic, 300 to 320; diastolic, 150 to 170.

Temperature: March 10, from 98 to 100 F. March 16-31, normal. April 1-9, normal.

Pulse: March 10, from 88 to 100. March 16-31, 72 to 80. April 1-9, 78 to 84.

Respiration: March 10, from 20 to 30. March 16-31, 18 to 20. April 1-9, 18 to 20.

Weight: March 10, 149½ pounds. March 16-31, from 140 to 137 pounds.

CASE 14.—David K., aged 54, architect in reduced circumstances, admitted Feb. 21, 1913, discharged March 26, 1913. Service of Dr. Hartwell.

Diagnosis: Chronic interstitial nephritis. Arteriosclerosis. Inguinal hernia.

Past History: Three years previous to admission he noticed a small lump in his left groin. There was little discomfort until two years later when it became painful. Is very alcoholic.

March 21, 1913: Four weeks ago the patient was operated on for inguinal hernia. He now seems absolutely normal. He was out on a pass yesterday and returned at 7 p. m. For breakfast he had a cup of coffee without sugar or milk.

March 26, 1913: Heart: apex neither visible nor palpable. Left limit of dullness in the fifth space, 12.5 cm. to the left of the midline. Over the aortic area there is a rough systolic impurity of the first sound. The second aortic sound is loud and ringing. There is no enlargement to the right of the sternum. The radials are palpable.

March 26, 1913: Patient discharged.

Urine: Trace albumin.

Blood Pressure: March 26, systolic, 195; diastolic, 110.

CASE 15.—William A., aged 24, laborer, admitted Dec. 28, 1914, discharged Jan. 30, 1915. Service of Dr. Coleman.

Diagnosis: Aortic regurgitation.

Complaint: Pain in right side of chest. Difficulty of breathing when lying down.

Past History: Has had measles, pneumonia and rheumatism. Has had gonorrhoea. Tonsils have given him trouble. Tonsils are enlarged.

Present Illness: Dec. 25, 1914, he was taken with a very sharp pain in his side. The following night he could not lie down. He felt his heart beating. He now feels weak and coughs a good deal.

Physical Examination: The patient is a well developed and well nourished young man 180 cm. tall. His tonsils are swollen and congested. The cardiac impulse is seen in a diffuse area around the nipple and is forcible. The upper border is in the third interspace; right border 4 cm. from the midsternal line; left border 13 cm. from the midsternal line. There is a Flint murmur at the apex, and also a diastolic murmur. Corrigan pulse.

January 11, 1915: Lungs are normal. Patient is comfortable except for a slight cough. The diastolic and Flint murmurs still continued. There is a short systolic murmur at the apex.

January 15: There is a blowing systolic murmur at the aortic region, transmitted along the vessels of the neck and arm.

January 26: The patient has been in a chair all day without fatigue. He was examined upright in the chair. The cardiac impulse was forceful, maximum in the fifth space. The left limit of dullness in the fifth space, 13.5 cm. from the midline, in the fourth space 11.5 cm. from the midline; right limit of dullness at the sternal margin. In the aortic region there is a systolic murmur transmitted upward and a blowing diastolic murmur transmitted downward. At the apex there is a short systolic murmur and a rumbling murmur in diastole. Pulse of Corrigan type.

Blood Pressure: Systolic 140.

Urine: Clear, amber, specific gravity 1.030.

Temperature: Dec. 31, 1914, to Jan. 2, 1915, from 99 to 101 F. Jan. 6, 1915, varied slightly around the normal.

Respiration: From 18 to 20.

Pulse: From 65 to 80.

Electrocardiogram: "T" waves directed downward in the second and third leads. In the calorimeter, Jan. 25 and 27, 1915.

CASE 16.—Theodore S., aged 32, coachman, single, admitted Jan. 17, 1914, discharged Feb. 22, 1914.

Diagnosis: Chronic cardiac valvular disease. Cardiac hypertrophy and dilatation.

Past History: He had pneumonia at the age of 6 years. In 1906 he had typhoid fever. He has had no rheumatism. At 8 years of age he was operated on for some abdominal condition. He was a moderate user of beer, but for the last two or three years he has used none. He stopped working one year ago. In Sweden he did rough carpenter work one year. Last year he was a driver.

Present Illness: For four or five years he has been short of breath, especially on exertion. At times he has had a pain in his left side. For one month he has had a short, sharp, hacking cough. He sleeps well. He was obliged to take an

easy job three years ago, as the doctor said he had heart trouble. Eight months ago he could carry a trunk upstairs. For two weeks he has been confined to the house.

Physical Examination: The patient is of medium build, 169 cm. tall, a well developed and well nourished man. Arteries are palpable. Sibilant râles at both bases.

Jan. 19, 1914: Patient is quite comfortable, not dyspneic, slight cyanosis of the lips.

January 26: Condition excellent. Slight cough, no dyspnea, no orthopnea. Sat up in chair without fatigue. Apex beat in the fifth space, 12 cm. from the midline; left limit of dullness in the fifth space 14.5 cm. from the midline, in the fourth space 12.5 cm. from the midline; right limit of dullness in the third space 3 cm. from the midline, in the fourth space 4 cm. from the midline. Heart action very slow, heavy, irregular in force and rate. Tracings show absence of the "A" wave, typical auricular fibrillation. At the apex the first sound is sharp and short. The second sound is faint. There is a loud, rough, rumbling murmur starting almost immediately after the second sound and diminishing in intensity during diastole, lasting throughout the short diastolic pauses, but stopping before the end of the long diastoles. At the base of the heart the pulmonary second sound is very much accentuated. The radial pulse corresponds with the apex impulse. The beats vary in size. Wall not palpable. There are a few sibilant and sonorous sounds in the lungs. No edema. Mucous membranes are deep red and slightly cyanotic.

February 10: The patient is up and about. He can walk up one and a half flights of steps.

February 11: The patient was given 1/120 grain atrophin, repeated after twenty-one minutes. Five minutes after the second dose the pulse rate increased from 48 to 55; the apex rate increased up to 96, and there was a large pulse deficit. At the apex the rate became almost regular, but not so regular in force. Throat dry, pupils dilated. The patient felt bad the next day, "As if he had been on a debauch."

February 15: The patient is sitting in a chair. Pulse 49; blood pressure, large beats, systolic, 145; diastolic, 85. After climbing stairs, pulse, 46, diastolic blood pressure, 150; systolic, 85.

February 21: Sounds as before. Wassermann negative.

Temperature: January 17-27, from 98 to 100 F. From January 28 on, the temperature was normal.

Roentgenogram of heart:

	Upright	Horizontal
Left .....	11.3	12.85
Right .....	8.35	7.8
	<hr/>	<hr/>
	19.65	20.65

No medication.

The patient caught cold at home and was readmitted, March 4, 1914, with bronchopneumonia. Heart sounds the same. Discharged March 27, 1914.