

ON THE OCCURRENCE OF CATALASE IN HUMAN TISSUES AND ITS VARIATIONS IN DISEASES.¹

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Catalase is a ferment which occurs in all vegetable and animal tissues, and is characterized by its power of decomposing hydrogen peroxide with the formation of water and the evolution of oxygen. Schoenbein in his studies on hydrogen peroxide, found that it was decomposed by extracts of animal and plant tissues obtained from the most diverse sources, and he considered that all ferments possessed the property of decomposing hydrogen peroxide, which besides was able to effect their specific activity. His experiments showed not only that some enzymes did not have the power of splitting hydrogen peroxide, but that by the addition of weak acids and other inhibitors, enzymes could be made to lose their power of decomposing hydrogen peroxide without losing their specific action, for example, by heating emulsin or by adding weak acids to it, its action on hydrogen peroxide decreased more rapidly than its action on amygdalin. This was the first indication of the specific nature of the enzyme which catalytically decomposes hydrogen peroxide, namely, catalase.

The property tissue extracts have of producing a blue coloration with tincture of guaiac in the presence of hydrogen peroxide was also thought by Schoenbein to be brought about by the various soluble ferments. He obtained both of the above reactions—the guaiac blueing test in the presence of hydrogen peroxide, and the

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decomposition of hydrogen peroxide into water and oxygen—with a large number of substances, and only in beer yeast was there an exception, the guaiac blueing test not being obtained although the peroxide was readily decomposed. Recently, however, it has been shown that the guaiac blueing reaction is due to a separate enzyme, peroxidase (Spitzer), belonging to the group of oxidases.

Up to the time that Loew published his article on catalase, the property tissues have of decomposing hydrogen-peroxide was supposed to be identical with their power of giving a blue coloration on addition of guaiac in the presence of hydrogen peroxide. Loew definitely proved that these two reactions are distinct, and furthermore that the property of decomposing hydrogen peroxide is likewise due to a specific enzyme of general occurrence. He says, "There is in commerce a kind of diastase, prepared from a fungus (*Aspergillus oryzae*), the so-called taka diastase, which does not give the reaction for peroxidase, but shows the power of decomposing hydrogen peroxide in a very high degree." Since pure diastase does not show this property, as above mentioned, this diastase preparation must then contain an admixture of another active principle. On the other hand, the trypsin of commerce, prepared from the pancreatic gland, often shows the blue reaction for peroxidase without being able to catalyze hydrogen peroxide. It often contains some peroxidase as an impurity. Furthermore, the filtrate of cultures of *Penicillium glaucum* generally yields no blue reaction with guaiac either for oxidase or peroxidase, but has the power of catalyzing hydrogen peroxide in a high degree. The same is true for cultures of various bacteria.

Tobacco samples of commerce also show the power of catalyzing hydrogen peroxide, frequently to a great extent, although they may have lost the original content of oxidase and peroxidase.

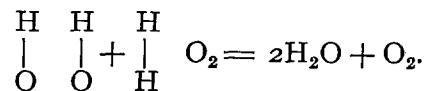
A case where the blue guaiac reactions were obtained in the absence of the power of catalyzing hydrogen peroxide was observed with green tobacco leaves gathered from greenhouse plants in December. The juice was mixed with one-fifth of its volume of absolute alcohol and left for fifteen hours before filtering. Five cubic centimeters of the clear filtrate were mixed with fifteen cubic centimeters of water and five centimeters of hydrogen peroxide,

but no trace of oxygen was given off, while the blue guaiac reactions for oxidase as well as for peroxidase (after killing the oxidase by heating to 70° C.) were obtained with considerable intensity. The property of catalyzing hydrogen peroxide was here observed only with the insoluble parts of the leaf. In the following chapters further instances will be mentioned which prove that these two reactions are produced by different principles.

Since it is clear that the power of catalyzing hydrogen peroxide is not due to any of the known enzymes, it appears justifiable to ascribe this power to a special enzyme. The writers propose to call this, "*catalase*."

It has long been known that colloidal metals have the power of decomposing hydrogen peroxide, but Loevenhart and Kastle have shown that the action of the organic and inorganic catalyzers is entirely different. Various chemical substances destroy or inhibit the ferment in the tissue extracts, but have no effect upon the metallic decomposition.

Wells in his text-book on Chemical Pathology writes: "Just what function catalase performs is at present merely a matter of speculation." The two possibilities which have suggested themselves to the various workers in this field, are dependent upon the character of the oxygen liberated in the decomposition; whether it is in the form of atomic oxygen, an active oxidizing agent, or molecular oxygen, which is relatively inert. The former is the older view, and in 1899 was revived by Bredig and von Berneck. Traube as early as 1893, described the decomposition of hydrogen peroxide as being due to the molecules decomposing each other mutually. He considered that two weakly held hydrogen atoms of one molecule of the peroxide split a second into two hydroxyl groups, with the result that water was produced and molecular or passive oxygen set free. He represents the equation in this way:



Kastle and Loevenhart in 1903, by a series of very interesting experiments, were able to show that liver catalase is unable to effect the oxidation of neutral potassium oxalate in the presence of

hydrogen peroxide, although the latter was being rapidly decomposed. The work of Traube proved that neutral potassium oxalate is oxidized by the oxygen liberated at the anode in electrolysis (active atomic oxygen), therefore Kastle and Loevenhart concluded that the oxygen liberated by the decomposition of hydrogen peroxide by liver catalase is not atomic but molecular oxygen. Schaffer,² in 1905, likewise concluded that when catalase decomposes hydrogen peroxide molecular oxygen is produced. He found that uric acid is oxidized by hydrogen peroxide, but when catalase is present, this oxidation is prevented. According to this, the function of catalase is rather to prevent dangerous forms of oxidation, than to help in normal oxidative processes.

The only work we have been able to find on the catalytic activity of pathological tissues is that of Jolles and Oppenheim. In 1905 they reported a series of cases in which they studied the blood from this point of view. Although they used a very different method from the one here employed, they found, just as we have, that the catalytic activity of the blood is reduced in nephritis and tuberculosis; they found no reduction in diabetes mellitus although one of their cases died in coma, and in this our results are only slightly at variance. By the method they employed only a single observation could be made in each experiment and hence little idea of the velocity of the reaction could be obtained. They allowed the blood to remain in contact with a measured amount of hydrogen peroxide for a definite number of hours; this solution was then acidified with sulphuric acid, and potassium iodide added drop by drop. The hydrogen peroxide which had not been decomposed by the tissue catalase then decomposed the potassium iodide. A known quantity of iodide having been added, the excess was determined by titrating with a solution of sodium hyposulphite of known strength. This, as is readily seen, is a very complex method, but it is still more severely handicapped inasmuch as the rapidity with which the decomposition proceeds cannot be determined. This determination at short intervals seems to be of the greatest possible importance, since in many of our experiments it will be seen, that, although the initial readings were much reduced, at the end of two minutes the maximum reaction had been attained.

² Quoted by Wells, Chemical Pathology.

The following method, which is the same as that used by Kastle and Loevenhart, was adopted in all of our experiments, and seems much more satisfactory. In every case the organs were obtained as fresh as possible from the post-mortem examination rooms of the Johns Hopkins Hospital and Bay View Asylum. Ten grammes of each tissue to be examined were carefully weighed off; each portion was placed in a mortar and ground with thoroughly washed white sand; from twenty to thirty cubic centimeters of distilled water were gradually added and the resulting emulsion strained through clean toweling by pressure. The residue was then turned back into the mortar, again ground, more distilled water added, and again strained. This process was repeated once more and the filtrate diluted to one hundred cubic centimeters with distilled water, thus making a ten per cent. cloudy aqueous extract which was preserved with two cubic centimeters of toluine. One cubic centimeter of the cloudy extract thus obtained was added to four cubic centimeters of distilled water in a low, wide-mouthed bottle with a capacity of about one hundred cubic centimeters. A small phial containing five cubic centimeters of neutralized three per cent. commercial hydrogen peroxide was placed in an upright position in the larger bottle, and the latter then connected with a gas burette. The records of the experiments are expressed in terms of cubic centimeters of oxygen liberated by the decomposition of the hydrogen peroxide, readings being made every fifteen seconds covering a period of two minutes. The small phial was readily overturned at the beginning of each experiment, throughout which the larger bottle was constantly and uniformly shaken, thus allowing a thorough mixing of the hydrogen peroxide and the aqueous tissue extract. Two different varieties of hydrogen peroxide were used, and the fact that lead peroxide rapidly decomposes hydrogen peroxide quantitatively was taken advantage of to standardize the different brands^a of hydrogen peroxide used, as well as to note any change in the activity of a single bottle from time to time. The check was made in much the same manner as the experiments above described. One-half gram of lead peroxide was placed in the larger bottle with five cubic centimeters of water; the phial

^a Dioxygen, Oakland Chemical Co.; Hydrogen Peroxide, Mallinkrodt Chemical Works.

containing five cubic centimeters of the neutralized hydrogen peroxide to be tested was then placed in the larger bottle. This was connected with the gas burette and shaken for a period of two minutes, during which readings were taken every fifteen seconds. The hydrogen peroxide was entirely decomposed during this time. By this means a rapid and sufficiently accurate method of determining the strength of each bottle of hydrogen peroxide, for further correction, was obtained. The hydrogen peroxide employed was of such a strength that 0.5 gram of lead peroxide liberated about fifty-five cubic centimeters of oxygen in two minutes.

Since the determination of the catalytic activity of the various tissues could not be made until a varying number of hours after the death of the subject, it seemed of the utmost importance to determine what, if any, would be the effect of post-mortem changes. For this purpose a dog was killed and the following experiments performed:

Portions of the lung, liver, kidney and spleen were removed immediately after death, ten per cent. aqueous extracts prepared as described above, and their catalytic activity determined.

Readings were made every fifteen seconds in terms of cubic centimeters of oxygen liberated.

Seconds.	15	30	45	60	75	90	105	120
Kidney	24.6	32	37	42.4	46.4	49.8	52	53.2
Lung	8.4	10	11.6	13	14.4	15.8	16.8	17.8
Liver	28.4	37.2	44.4	51.4	52.6	53	53.4	54
Spleen	3.6	4.6	5.4	6	6.6	7.4	8	8.6

After removing the tissues used in the above determinations, the animal was sewed up and placed in the ice box (where the bodies are kept before autopsy), for twenty-seven hours. Then pieces of the same organs taken the previous day were removed, and their catalytic activity determined in a similar manner, with the following result:

Seconds.	15	30	45	60	75	90	105	120
Kidney	26.4	34.2	39.4	43.4	46.6	48.6	49.4	50.8
Lung	7	8.4	9.4	10.4	11.2	12	12.8	13.6
Liver	30.6	39.4	44.2	46.4	48.8	49.4	49.6	49.6
Spleen	2.8	3.6	4.4	4.8	5.2	5.6	6	6.2

By a comparison of the above sets of experiments it will be noted that the enzymic activity of the tissues is somewhat lowered by standing in the ice box. In the case of the liver and kidney, although the first few readings were slightly higher, the reduction of the catalytic power was evident at the end.

It seemed desirable to determine any variation in the activity of the enzyme which might be due to the age of the individual from whom the tissues were obtained, but this must be small and relatively unimportant, while the variations due to pathological conditions have been so marked as to overshadow any other possible slight changes. We have been led to this conclusion concerning the activity of catalase at different ages from the fact that in case No. 3, a still-born infant which showed no pathological lesion, the tissues had a relatively high catalytic activity, while in several old subjects, in spite of some slight pathological condition, which would tend to lower the catalytic activity, there was no appreciable decrease. Case No. 17 is an illustration of this statement.

There are in this series thirty-one cases to be reported. These are divided into several groups. At the beginning of each group is a short abstract of the clinical history and the post-mortem findings of each case. When such data could be obtained, the number of red blood cells, the percentage of hæmoglobin, the condition of the urine, and a few brief important points in the anatomical diagnosis are included.

NEPHRITIS.

Case No. 1.—Autopsy No. 2971. White male, 33 yrs. Died 8 A. M., Dec. 8. Autopsy 9.30 A. M., Dec. 8, 1908.

Clinical Diagnosis—Chronic nephritis, uræmia, tuberculosis, albuminuric retinitis.

R. B. C.—3,800,000; W. B. C.—10,000; Hb.—58 per cent.

Urine—Sp. gr. 1015. Reaction—acid. Albumin—3.8 gm. per L.

Microscopical Examination—R. B. C., W. B. C., granular and waxy casts.

Blood Pressure—200 to 210.

Anatomical Diagnosis—Chronic diffuse nephritis, pale granular kidneys; chronic pulmonary tuberculosis; anæmia and emaciation. In the lungs a few small caseous nodules are found which show microscopically an exudate into the surrounding alveoli. Spleen is congested; the venules show slightly thickened walls. *Kidneys* weigh 250 gm.; they show a marked increase of fibrous tissue and extensive epithelial changes.

Case No. 7.—Autopsy No. 2977. Colored male, 75 yrs. Died 4 P. M., Dec. 15. Autopsy 10 A. M., Dec. 16.

Clinical Diagnosis—Chronic nephritis, arterio-sclerosis, emphysema.

R. B. C.—3,500,000; W. B. C.—10,380; Hb. 60 per cent.

Urine—Sp. gr. 1012. Reaction—acid. Albumin—trace.

Microscopical Examination—Finely granular casts, epithelial cells.

Anatomical Diagnosis—Chronic diffuse nephritis; arterio-sclerosis; senile

spleen; emphysema. Liver shows a slight amount of fatty degeneration and jaundice. *Kidneys* weigh 260 gm; there is only a slight amount of interstitial change, but extensive parenchymatous degeneration.

Case No. 9.—Autopsy No. 2991. White female, 25 yrs. Died 2 A. M., Jan. 8. Autopsy 11 A. M., Jan. 8.

Clinical Diagnosis—Chronic nephritis; uræmia; broncho-pneumonia.

R. B. C.—3,896,000; W. B. C.—10,600; Hb. 75 per cent; blood pressure 210 to 240.

Urine—Sp. gr. 1010. Reaction—acid. Albumin—1 gm. per L.

Microscopical Examination—Hyaline and granular casts.

Anatomical Diagnosis—Chronic diffuse nephritis, small granular kidneys; cerebral hæmorrhage; broncho-pneumonia; chronic splenic tumor; emaciation. *Kidneys* weigh 120 gm.; the cortex measures 2–4 mm. in thickness, and is broken up by coarse bands of fibrous tissue.

Case No. 10.—Autopsy No. 2992. White male, 60 yrs. Died 6 P. M., Jan. 12. Autopsy 11 A. M., Jan. 13.

Clinical Diagnosis—Acute exacerbation of chronic nephritis; arterio-sclerosis.

R. B. C.—4,100,000; W. B. C.—10,000; Hb. 94 per cent.

Urine—Sp. gr. 1013. Reaction—acid. Albumin—2 gm. per L.

Blood Pressure—240.

Anatomical Diagnosis—Acute and chronic diffuse nephritis; broncho-pneumonia; pulmonary œdema and emphysema; chronic passive congestion of spleen. *Kidneys* weight 320 gm.; the capsule is thickened and strips with difficulty, leaving a granular surface; the striations are irregular and obscured, and there are many small hæmorrhages in the cortex. Microscopically there are red blood cells and polymorphonuclear leucocytes in the tubules, the epithelial elements are degenerated, and the glomeruli are changed into fibrous bodies.

Case No. 11.—Autopsy No. 2996. Colored female, 46 yrs. Died 11 P. M., Jan. 16. Autopsy 11 A. M., Jan. 17.

Clinical Diagnosis—Acute lobar pneumonia; acute endocarditis; cerebral thrombosis; multiple infarcts in brain, lungs, etc.; pulmonary abscess; chronic nephritis; aortic insufficiency.

R. B. C.—3,744,000; W. B. C.—21,600; Hb. 90 per cent.

Urine—Sp. gr. 1010. Reaction—acid. Albumin—1.2 gm. per L.

Microscopical Examination—Granular and hyaline casts; R. B. C.

Blood Pressure—100 to 150.

Anatomical Diagnosis—Puriform softening of auricular thrombus; infarction of brain, spleen, kidney, and lung; lobar pneumonia with gangrene; chronic diffuse nephritis. *Kidneys* weigh 320 gm. and show extensive degenerative changes.

Case No. 13.—Autopsy No. 2999. White male, 25 yrs. Died 12 noon, Jan. 21. Autopsy 2 P. M., Jan. 21.

Clinical Diagnosis—Chronic interstitial nephritis; cirrhosis of liver; uræmia.

R. B. C.—6,430,000; W. B. C.—14,000; Hb. 58 per cent.

Urine—Sp. gr. 1013. Reaction—acid. Albumin—3 gm. per L.

Microscopical Examination—Hyaline, waxy and granular casts, R. B. C., W. B. C. and renal epithelial cells.

Blood Pressure—220.

Anatomical Diagnosis—Chronic diffuse nephritis; broncho-pneumonia; diffuse cirrhosis of the liver, with enlargement of the spleen. *Kidneys* weigh 220 gm.; the cortex varies from 2 to 4 mm. in thickness; there is an increase in cellular connective tissue and a marked degeneration of the parenchyma.

Case No. 14.—Autopsy No. 3002. Colored male 45 yrs. Died 2 A. M., Jan. 25. Autopsy 10 A. M., Jan. 25.

Clinical Diagnosis—Chronic nephritis, arterio-sclerosis.

R. B. C.—4,500,000; W. B. C.—8,750; Hb. 53 per cent.

Urine—Sp. gr. 1015. Reaction—acid. Albumin 0.75 gm. per L.

Microscopical Examination—Granular, hyaline, and epithelial casts, and W. B. C.

Anatomical Diagnosis—Chronic diffuse nephritis; broncho-pneumonia; pulmonary oedema; infarcts of lung and spleen; thrombi in right auricular appendage, and in apex of left ventricle; emphysema. *Kidneys* weigh 300 gm.; the cortex measures 4 mm., the striations are obscured by dense bands of connective tissue, and the epithelium shows extensive degeneration.

Case No. 19.—Autopsy No. 3024. Colored male, 53 yrs. Died 9 P. M., Mar. 11. Autopsy 10 A. M., Mar. 12.

Clinical Diagnosis—Chronic nephritis; arterio-sclerosis.

R. B. C.—4,320,000; W. B. C.—5,400; Hb. 75 per cent.

Urine—Sp. gr. 1010. Reaction—acid. Albumin—1 to 3 gm. per L.

Microscopical Examination—Granular and hyaline casts, epithelial and pus cells.

Blood Pressure—220 to 245.

Anatomical Diagnosis—Chronic diffuse nephritis; arteriosclerosis; chronic passive congestion of lungs and spleen; emphysema. *Kidneys* weigh 340 gm.; the cortex is thin, and the striations distorted.

Case No. 26.—Bay View Autopsy No. 136. White male, 45 yrs. Died 5 P. M., Dec. 10. Autopsy 9 A. M., Dec. 11.

Anatomical Diagnosis—Chronic diffuse nephritis (large pale kidney); lobar pneumonia; diffuse cirrhosis of liver; acute splenic tumor.

Case No. 30.—Bay View Autopsy No. 140. White male, 68 yrs. Died 12 P. M., Dec. 17. Autopsy 11 A. M., Dec. 18.

Anatomical Diagnosis—Chronic diffuse nephritis; chronic splenic tumor; emphysema.

KIDNEY—Readings made every fifteen seconds, expressed in terms of cubic centimeters of oxygen.

Seconds.	15	30	45	60	75	90	105	120
Case No. 1.....	1	1.2	1.7	1.8	2.2	2.4	2.5	2.8
Case No. 7.....	9.6	12	14.2	16	18.4	21.4	23.8	26.6
Case No. 9.....	7.2	8.8	10.2	11.8	12.4	15	16.4	18
Case No. 10.....	10.6	13.8	16.2	18.4	21	24	26.6	28.4
Case No. 13.....	4.4	5.6	7	8.2	9.2	10.4	11.8	13
Case No. 14.....	12.4	16	19.2	23	26.6	30.2	33.8	34
Case No. 19.....	8.8	11.4	13.8	16	18.2	20.6	23	25.4
Case No. 26.....	4.6	5.4	8.8	11	11.6	13.2	14.8	14.8
Case No. 30.....	7	10.6	13.8	16.8	19.6	22	26.8	31.4

In all these cases the nephritis was severe and might be considered as the ultimate cause of death. In Cases Nos. 1, 9 and 13, the clinical diagnosis of uræmia was made, and it will be noted that the readings in these are remarkably low. In all of the other cases the reduction seemed to be in direct proportion to the intensity of the anatomical picture as well as to the clinical findings.

LUNG.

Seconds.	15	30	45	60	75	90	105	120
Case No. 1.....	4.4	5.6	6.6	7.4	8.4	9.4	10.4	11.4
Case No. 7.....	10.8	12.4	14.2	16	18.2	20.4	22.8	25.6
Case No. 9.....	21	25.4	28.4	31.4	34.6	38	41	44.2
Case No. 10.....	7	9	10	12.2	13.6	15	16.8	18.2
Case No. 13.....	11.4	14.8	18.6	21.8	25.4	28.5	32.8	36.2
Case No. 14.....	30	38.8	45.6	50.6	53	53.6	54	54
Case No. 19.....	25.4	32.6	38.4	43.4	47.8	50.8	52.2	53.8
Case No. 26.....	16.8	20	24.4	27	30.8	34.6	37.4	39.4
Case No. 30.....	5.6	7.6	10.2	12.2	14	16.4	18.8	21.4

In Cases Nos. 1, 7 and 30, the lungs were in good condition, and showed neither pneumonia, nor congestion. In these it will be seen that the catalytic activity is low. In the remainder of the cases either pneumonia or congestion was present, and it will be shown later that in these conditions there is an increased catalytic activity. Despite the presence of pneumonia, however, in the cases in which the nephritis is more severe, the activity of the lung is reduced.

LIVER.

Seconds.	15	30	45	60	75	90	105	120
Case No. 7.....	11.2	14.4	16.2	22	26.2	30.4	34.8	39.6
Case No. 9.....	34	43	47.4	50.2	51.2	51.6	51.6	51.8
Case No. 10.....	18	23.8	29.4	34.2	39	44.8	49.8	53
Case No. 13.....	35.4	43	47.2	48.4	48.8	49	49.2	49.4
Case No. 14.....	31	37.8	42.8	45.6	47	47.4	47.6	47.6
Case No. 19.....	30.8	41.6	48.4	52.2	54	54.4	54.6	54.8
Case No. 26.....	7.1	9.4	12.2	14.8	17.6	20.3	23.6	26.6
Case No. 30.....	16.8	26.2	31.6	37.8	44	48	50.2	51.6

Except in Cases No. 7, 10, 26 and 30 there is not a remarkable reduction in the catalytic activity of the liver. Of these, Cases Nos. 10 and 30 reach at the end what might be considered a maximum reading, even though the initial reading is low. It seems possible that in many cases in which the first two or three read-

ings are much reduced, while a maximum decomposition is reached at the end, the inhibiting factor may be overcome during the experiment. The explanation of the extremely low readings in Cases Nos. 7 and 26 is at present not clear.

SPLEEN.

Seconds.	15	30	45	60	75	90	105	120
Case No. 9.....	20.4	25	29.4	32.6	36.4	40.8	44.2	47.4
Case No. 10.....	25	32	38	42.6	46	48.6	50.2	51.2
Case No. 13.....	28.4	35.6	43	49.2	52.6	54	54.6	55
Case No. 14.....	30	37.6	44	49.4	53	54.6	55.4	55.4
Case No. 19.....	50.6	52.4	53	53.2	53.4	53.6	53.8	54
Case No. 26.....	6.7	8.8	10.8	12.8	14.6	16.8	19	21.2
Case No. 30.....	22.8	31	37.2	44	46.4	40.4	51	51

The variations in the readings of the spleen in the above cases seem to be due most probably to the amount of blood in the organ rather than to the severity of the associated nephritis.

BLOOD.

Seconds.	15	30	45	60	75	90	105	120
Case No. 9.....	46	51.4	52.4	52.6	53	53	53	53
Case No. 10.....	32	41	45.4	47.6	49	49.8	50.4	51
Case No. 11.....	38.4	47	50.6	52.2	52.6	52.8	53	53
Case No. 13.....	22	30	37	42	46	47.8	48.2	48.2
Case No. 14.....	26	36.6	46.4	49.6	53.2	54	54.2	54.4
Case No. 26.....	15	18	20.8	23.2	25.8	28.6	31	33.6

With normal blood the maximum reaction is reached at the first reading. The blood in the above cases was obtained in a fluid condition from the large vessels at the time of autopsy. It is very important to obtain the blood before clotting has taken place, because, as Bergengrun has shown, the catalase is carried in the stroma of the red blood cells, and not in the hæmoglobin or in the serum. This has been confirmed by us. The clot would naturally be much more active on account of its greater content of red blood cells, and it is, therefore, most necessary to obtain the blood before any abnormal distribution of its elements has occurred. The readings of the blood from the cases of nephritis show a marked reduction when compared with the other conditions in which the blood was examined.

ECLAMPSIA.

The blood in the experiments to be quoted was obtained from two cases of eclampsia in the Maternity Ward, in which venesection was performed as a therapeutic measure.

Seconds.	15	30	45	60	75	90	105	120
Case A.....	52.6	52.8	52.8	53	53.2	53.4	53.4	53.6
Case B.....	51.2	51.4	51.8	52	52.2	52.4	52.6	52.8

The reaction practically reached the maximum in the first fifteen seconds. It is interesting to compare these determinations with those obtained from the blood in the above series of nephritis for this difference may prove of some value clinically in the differential diagnosis between eclampsia and chronic nephritis. Blood has been obtained from cases of chronic nephritis in the wards and tested for its catalytic activity with the result that in every case it has shown a reduction. We have so far been unable to confirm further the results found in eclampsia since the cases have not been forthcoming. By diluting the blood 1-400 with distilled water, we find that the end reaction is reached much more gradually than when stronger solutions of blood are used, and therefore, the differences between normal and nephritic blood stand out in greater contrast. The contrast is likewise more sharply brought out when readings are made every five seconds during the first fifteen seconds.

In summing up the changes which are apparent in the cases of chronic nephritis studied, it will immediately be seen that the most marked changes, evidenced in the lowering of the catalytic activity, are in the kidney itself. Here the reduction seems to be in direct proportion to the extent of the lesion. In the one example of large pale kidney (Case No. 26) the reduction is so marked not only in the kidney itself, but in the blood and other organs as well, that it seems possible that there is in this type a greater decrease in the catalytic activity than in the small contracted kidney. In all cases of nephritis, however, there is not only a reduction in the catalytic activity of the kidney, blood and other organs, but the acid urine of several nephritics, when used to dilute an active extract of tissue catalase, has shown a much greater inhibiting action than normal acid urine. The following experiment illustrates this statement:

Urine was obtained from Case No. 9, two weeks before death, and was used in connection with a 10 per cent. aqueous extract of a haemorrhagic pulmonary infarct from Case No. 2. Normal urine was used in a check experiment.

1. 1 c.c. of the above 10 per cent. aqueous extract + 4 c.c. water + 5 c.c. hydrogen peroxide.

Seconds.	15	30	45	60	75	90	105	120
	50	50.2	50.6	50.8	51.2	51.4	51.6	51.8

2. 1 c.c. of the above 10 per cent. aqueous extract + 4 c.c. normal urine + 5 c.c. hydrogen peroxide.

Seconds.	15	30	45	60	75	90	105	120
	26	32.8	37.6	40.4	43.6	45.4	46.8	48

3. 1 c.c. of the above 10 per cent. aqueous extract + 4 c.c. nephritic urine + 5 c.c. hydrogen peroxide.

Seconds.	15	30	45	60	75	90	105	120
	4.4	10.4	17.4	26.8	36	47.4	51.8	54

Catalase is much more active in a slightly alkaline medium while in a markedly acid medium its activity is not reduced. The above urines were both acid but the total acidity was not determined. In several subsequent observations with nephritic urine which was alkaline the catalytic activity was greater than with normal urine. It is necessary, therefore, to have some check on the results by a quantitative estimation of the acidity, for it is possible that the reaction of the urine might be responsible for the above results. On the other hand, it has occurred to us that the kidney may not be entirely a passive element in nephritis, but that it may secrete some substance which is harmful to the organism, and which finds its way into the circulation as well as the urine, and manifests itself by a reduction in the catalytic activity.

PNEUMONIA.

Case No. 4.—Autopsy No. 2974. White infant, 2 days old. Died Dec. 9. Autopsy Dec. 11.

Pregnancy and labor were normal.

Anatomical Diagnosis—Broncho-pneumonia; uric acid infarcts of kidney; fatty degeneration of the liver. Microscopically small patches of pneumonia in the stage of red hepatization were seen. The fatty degeneration of the liver was very extensive.

Case No. 5.—Autopsy No. 2975. Colored male, 15 years. Died 8 P. M., Dec. 13. Autopsy 10 P. M., Dec. 13.

Clinical Diagnosis—Tuberculosis of the vertebræ; terminal pneumonia.

Urine—Sp. gr. 122. Reaction acid. Albumin—negative. Sugar—negative. Microscopical Examination—negative.

Anatomical Diagnosis—Broncho-pneumonia; parenchymatous degeneration of liver and kidney; tuberculosis of the vertebræ; emaciation. The left lung showed fresh areas of broncho-pneumonia. The right lung was normal throughout.

Case No. 22.—Bay View Autopsy No. 132. White male, 42 years. Died Dec. 4, 6 A. M. Autopsy Dec. 4, 12 A. M.

Anatomical Diagnosis—Broncho-pneumonia; pulmonary œdema; aortic insufficiency; chronic passive congestion of the liver, spleen and kidneys; fatty degeneration of the liver.

Case No. 8.—Autopsy No. 2979. White male, 46 years. Died 9 A. M., Dec. 19. Autopsy 1 P. M., Dec. 19.

Clinical Diagnosis—Alcoholic cirrhosis of the liver; ascites; acute pleuro-pericarditis.

R. B. C.—4,500,000; W. B. C.—12,000; Hb. 72 per cent.

Urine—Sp. gr. 1020. Reaction acid. Albumin and sugar—negative. Microscopic Examination—negative.

Blood pressure—115.

Anatomical Diagnosis—Acute broncho-pneumonia with abscess formation; cirrhosis of the liver; chronic pancreatitis; chronic splenic tumor. The liver cells show a high degree of fatty change. The pneumonia is in the stage of gray hepatization.

(Refer to Cases 9, 10, 13, 14, 11, 18, 26, 23.)

LUNG.

Seconds.	15	30	45	60	75	90	105	120
Case No. 4....	32.4	40.4	43.8	45.6	46.4	47.4	48.4	49.6
Case No. 5....	39.6	43.4	44.3	45.2	46.2	46.8	48	50 (Pneumon.)
Case No. 5....	15.4	19.4	23.4	27.6	32.2	37.2	40.8	45.6 (Normal.)
Case No. 8....	20.2	25.4	30	34.4	39	42.4	46	48.8 (Gray hep.)
Case No. 8....	27.4	34	41	48	48.8	50.4	50.4	50.4 (Normal.)
Case No. 22....	29.8	39.8	45	47.8	49.2	49.6	48.8	50.4

In every case the pneumonic lung shows an increased catalytic action, which is probably due to the presence of the red blood cells in the exudate. In Case No. 5, the first reading was taken from an extract of the lung which showed an early stage of broncho-pneumonia, the red blood cells being everywhere well preserved, while the second reading was taken from an extract of lung which was everywhere apparently normal, except for a slight anæmia which was present throughout the tissues. The difference is remarkable, the initial reading in the pneumonic lung being 34.6 while in the uninvolved lung the initial reading was only 15.4 and the following ones correspondingly low. An interesting contrast was found in Case No. 8, in which the first reading was made from lung tissue in the stage of late gray hepatization and showed no increased activity, while the second reading was taken from the uninvolved lung which was slightly congested and consequently had a slightly greater activity. Among the cases of nephritis there

were several instances in which the pneumonia was the terminal event. Among these, Cases Nos. 9 and 14 are high in comparison to the readings in those cases where there was nephritis without pneumonia, while they are comparatively low for the cases uncomplicated by nephritis. In Cases Nos. 10, 13 and 26, however, despite the presence of the pneumonia, the readings are low, no doubt due to the marked decrease of activity accompanying the kidney lesion.

In connection with the cases of pneumonia it will be interesting to consider the following case:

Case No. 2.—Autopsy No. 3009. Colored male, 66 yrs. Died 8 A. M., Jan. 31. Autopsy 12 M., Jan. 31.

Anatomical Diagnosis—Thrombosis of the left ventricle; hæmorrhagic infarcts in lungs; anæmic infarcts in spleen and kidneys; chronic passive congestion of lungs and kidneys.

Seconds.	15	30	45	60	75	90	105	120
Blood	53.8	54.4	54.4	54.6	54.6	54.6	54.6	54.6
Lung (2)....	50	50.2	50.6	50.8	51.2	51.4	51.6	51.8 (Infarct)
Lung (1)....	21.6	29.4	34	37.8	41.4	44.8	47.6	50 (Normal)
Kidney	19	27.4	30.4	34.8	37.4	41.4	43.6	46.2

Here lung (1) was apparently normal, and gave readings which correspond with what is considered normal. In lung (2) however, the extract was made from a typical fresh hæmorrhagic infarct, with the result that the reaction practically reached the maximum at the initial reading. This case is cited to give strength to the conclusion that the increased catalytic activity in pneumonia and congestion, is very likely due, for the most part, if not entirely, to the presence of an increased number of intact red blood cells.

LIVER.

Seconds.	15	30	45	60	75	90	105	120
Case No. 4.....	17.6	22.4	28	33.6	38.8	42.4	45	46.2
Case No. 5.....	38.2	43.4	44.6	45.2	45.8	46.2	46.2	47
Case No. 8.....	8.4	11.6	14.4	17.8	21	24.4	27.6	31.2
Case No. 22.....	18.4	22.4	26.4	36.6	33.2	35.8	38.6	41

In Case No. 4 the low reading can probably be attributed to the extensive fatty infiltration and likewise in Case No. 8 there was an old alcoholic cirrhosis, the remaining liver tissue showing marked fatty change. Case No. 22 showed red atrophy, and although there were numerous disintegrated red blood cells about the hepatic vein, these had probably long since lost their catalase.

SPLEEN.

Seconds.	15	30	45	60	75	90	105	120
Case No. 4.....	19.4	25	27.8	36.8	42	45.4	48.6	48.6

KIDNEY.

Seconds.	15	30	45	60	75	90	105	120
Case No. 4.....	9.2	11.8	13.6	16.8	19.4	22.4	25.2	28.2
Case No. 5.....	15.6	20.8	25	29.6	33.8	38.8	43	47.6
Case No. 8.....	18.8	24.2	29.6	34	39.2	44	47	48.8

In Case No. 4 the uric acid infarcts might account for the low reading, while in Case No. 5 there was marked parenchymatous degeneration and anæmia.

BLOOD.

Seconds.	15	30	45	60	75	90	105	120
Case No. 8.....	51.2	—	—	—	—	—	—	51.2

This reading stands out in marked contrast to those of the blood in the cases of nephritis, the decomposition being complete during the first fifteen seconds.

In this series the only results of interest are found in the lungs. Extracts made from the involved areas of broncho-pneumonia in the stage of red hepatization invariably showed an increased catalytic activity, which was evidently due merely to the presence of the well preserved red blood cells in the exudate, for in the stage of gray hepatization there was no increase and in the fresh hæmorrhagic infarct the decomposition reached a maximum in the first fifteen seconds. The blood and other tissues examined showed no increased activity. The conclusion is, therefore, justified that there is no new formation of catalase, and no formation of any substance which would increase the action of the enzyme in the body.

TUBERCULOSIS.

Case No. 16.—Autopsy No. 3006. Colored male, 3 mos.

Anatomical Diagnosis—General miliary tuberculosis; caseous lobar pneumonia; anæmia and emaciation.

Case No. 21.—Bay View Insane. Colored female, 23 yrs. Died 6 P. M., Dec. 7. Autopsy 11 A. M., Dec. 8.

Anatomical Diagnosis—Broncho-pneumonia; tuberculosis of the liver and spleen; congestion of the kidneys. The body was fairly well nourished. There was extensive tuberculosis of the lesser peritoneum with cavities in the liver, and tuberculous ulceration of the stomach.

Case No. 24.—Bay View Autopsy No. 134. White male, 32 yrs. Died 9 P. M., Dec. 8. Autopsy 3 P. M., Dec. 9.

Anatomical Diagnosis—Acute pulmonary miliary tuberculosis; acute splenic tumor; fatty degeneration of the liver (slight); congestion of the kidneys. The lung tissue between the miliary tubercles was deeply congested.

Case No. 27.—Bay View Autopsy No. 137. White male, 73 yrs. Died 7 P. M., Dec. 12. Autopsy 11 A. M., Dec. 13.

Anatomical Diagnosis—Chronic pulmonary tuberculosis with cavity formation; miliary tuberculosis of the spleen and liver; acute splenic tumor; chronic passive congestion of the liver and kidneys; fatty degeneration of the liver.

Case No. 25.—Bay View No. 135. White male, 37 yrs. Died 3 A. M., Dec. 11. Autopsy 12 M., Dec. 11.

Anatomical Diagnosis—Tuberculous caseous pneumonia with cavity formation.

Case No. 28.—Bay View No. 138. White male, 32 yrs. Died 2 A. M., Dec. 13. Autopsy 12 M., Dec. 13.

Anatomical Diagnosis—Chronic pulmonary tuberculosis; chronic diffuse nephritis; emaciation.

Case No. 29.—Bay View No. 139. Colored male, 24 yrs. Died 4 P. M., Dec. 15. Autopsy 4 P. M., Dec. 16.

Anatomical Diagnosis—Acute tuberculous broncho-pneumonia with cavity formation; miliary tuberculosis of the liver and spleen; emaciation.

LUNG.

Seconds.	15	30	45	60	75	90	105	120
Case No. 16.....	13.6	17.4	20.2	22.4	24.6	26.8	29.8	32
Case No. 21.....	7.2	9.2	10.4	11.8	13	14.2	15.6	16.8
Case No. 23.....	16.6	19.8	25.6	30	34	39.2	40.2	43
Case No. 24.....	30	36.8	43.6	44	45.4	46.4	46.8	46.8
Case No. 27.....	12	15.4	18.2	21	24.8	29	32.8	36.6
Case No. 25.....	11.8	15.8	19.6	23.4	26.8	30.4	33.4	38
Case No. 28.....	6.4	7.8	9.2	10	11.4	12.8	14	15.4
Case No. 29.....	5.8	7.2	8.4	9.6	10.8	12.4	13.8	15.8

It will be seen that there is a uniform and marked reduction of the power of the tuberculous lung to decompose hydrogen peroxide. In Case No. 24 the reading is high, but the lung in the gross was voluminous, very deep red on section, and studded everywhere with minute tubercles. Microscopically, the tissue between the tubercles was greatly engorged with well preserved red blood cells.

LIVER.

Seconds.	15	30	45	60	75	90	105	120
Case No. 16.....	23.4	29.6	33.8	37.8	44	45.8	47.8	48.8
Case No. 21.....	21.8	28.8	35.4	38.6	40	43.4	45	46
Case No. 23.....	19.6	27.4	32	36.6	40.8	43.8	45.6	46.2
Case No. 24.....	13.4	15.6	21.2	24.8	28.4	32.2	35.6	39
Case No. 27.....	12	15.4	20.2	25.4	30.6	36	42.2	46.8
Case No. 29.....	15	20.6	26.2	32.6	38.6	42.4	47.6	53.4

In all of the cases there is a slight but definite decrease in the catalytic activity. The liver showed a varying amount of involvement, from microscopic tubercles to cavities.

SPLEEN.

Seconds.	15	30	45	60	75	90	105	120
Case No. 16.....	23	31.4	36.2	40	43.2	46	48	49.6
Case No. 21.....	31.8	38.8	41.6	42.6	43.2	43.6	—	—
Case No. 23.....	22.8	30	34.4	37.4	39.8	41.8	43	44.2
Case No. 27.....	20.8	29.2	36	41.6	45.6	48	49.4	51.2

In comparison with the other diseases the readings of the spleen in tuberculosis are low, except in Case No. 21 where, although there was an extensive involvement, the splenic tissue between these areas was much engorged.

KIDNEY.

Seconds.	15	30	45	60	75	90	105	120
Case No. 16.....	11.8	15.4	18	20	22	24.2	26.2	28.2
Case No. 21.....	10.4	20.4	24.4	27.6	30.8	33.8	37.4	38.4
Case No. 24.....	21	30.2	35.4	39.4	41.4	42.6	43.4	44
Case No. 27.....	13.6	18.2	22.4	26.8	31.4	36.2	41.8	45.6
Case No. 29.....	15	21.8	26	30.4	36.6	42	46.4	49.8

Here also the readings are low, except in Case No. 24, where the kidneys were swollen and congested.

It is seen that in these cases of tuberculosis the catalytic activity of the lungs is most markedly reduced. This is probably in large part due to the absence of blood in the tuberculous areas. On the other hand, the reaction of the liver, spleen, and kidneys is lowered, and it would hardly be possible to attribute this to the presence of tuberculous change in these organs, but rather to the general anæmia which accompanies the process. Whether this is sufficient to account for the reduction, or whether the tuberculous process is the seat of formation of some inhibiting substance has not been determined.

JAUNDICE.

Case No. 17.—Autopsy No. 3021. White male, 59 years. Died 1 A. M., Feb. 23. Autopsy 10 A. M., Feb. 23.

Clinical Diagnosis—Carcinoma of the common bile duct; acute gangrenous cholecystitis. Operation Feb. 11—cholecystostomy followed by diffuse bronchitis and broncho-pneumonia.

R. B. C.—4,362,000; W. B. C.—17,400; Hb. 85 per cent.

Urine—Sp. gr. 1018. Reaction—acid. Albumin—trace. Sugar—negative.

Microscopic Examination—Bile stained granular casts.

Anatomical Diagnosis—Carcinoma of the common bile duct; metastasis to the liver; jaundice; cirrhosis of the liver; broncho-pneumonia; chronic diffuse nephritis.

Kidneys weigh 370 gm. The cortex averages 6 mm. in thickness.

Seconds.	15	30	45	60	75	90	105	120
Kidney	26.6	36	41.6	45.4	48	50	51.2	51.8
Spleen	39	46.8	49.6	50.6	51	51.2	51.4	51.4
Liver	29.6	39.2	44.8	47.4	49.8	50.8	51.2	51.6
Lung	23	28.4	32	35.4	38.2	41.4	44	46.2
Blood	48.4	50	50.4	—	—	—	—	50.4

This case of jaundice is quoted to show that, in spite of a small amount of nephritis, there is no decrease in the catalytic activity as suggested by Jolles and Oppenheim. They report a case of catarrhal jaundice with gall stones in which they found a minimal catalytic activity. It seems probable that the mere jaundice in their case could not have accounted for the low catalytic activity, since in Case No. 17 of our series there was extreme jaundice but no reduction in the catalytic activity.

DIABETES MELLITUS.

Case No. 20.—Autopsy No. 3026. White female 19 yrs. Died 12 M. March 18. Autopsy 3 P. M., March 18.

Clinical Diagnosis—Diabetes mellitus; gangrene of left forearm.

R. B. C.—5,472,000; W. B. C.—21,160; Hb. 101 per cent.

Urine—Sp. gr. 1027. Reaction—acid. Albumin—trace. Sugar—3 per cent.

Microscopical Examination—Hyaline and granular casts; epithelial cells. Blood pressure—120.

Anatomical Diagnosis—Gangrene of arm; fatty liver; epithelial necrosis of kidneys; œdema and hyperæmia of lungs. *Kidneys* weigh 430 gms. Parenchyma is yellow and granular.

Seconds.	15	30	45	60	75	90	105	120
Lung	16.6	20.4	23.4	26.6	29.6	33	36.6	39.4
Kidney	11.4	14.4	17.6	20.6	24	27.4	30.4	37
Liver	48.6	53.2	53.8	54.2	54.4	54.6	54.8	54.8

In this case, the lung and kidney show a definite reduction in their catalytic activity. The kidneys, however, showed extensive epithelial necrosis which might account for their low activity. The liver gives a high reading, even though it showed fatty infiltration. This might be explained by the extensive hyperæmia it showed in places. The pancreas was apparently normal both grossly and microscopically.

TOXÆMIA OF PREGNANCY.

Case No. 18.—Autopsy No. 3023. White female, 27 yrs. Died 8 P. M., March 10. Autopsy 10 A. M., March 11

Clinical Diagnosis—Toxæmia of pregnancy. History of operative labor (low forceps); febrile puerperium.

Urine—Sp. gr. 1028. Reaction—acid. Albumin—heavy precipitate. Sugar—negative.

Microscopical Examination—Hyaline casts.

Anatomical Diagnosis—Broncho-pneumonia; acute splenic tumor; fatty degeneration of the liver, kidney and myocardium; epithelial necrosis of the kidney; pulmonary œdema.

Seconds.	15	30	45	60	75	90	105	120
Lung	23.6	29.6	35	40	45	49.2	50.4	51.8
Liver	44	50.2	51.2	51.4	51.4	51.6	51.8	51.8
Spleen	48	52.4	53.4	53.6	53.8	54	54.2	54.4
Kidney	17	22	27.4	32.2	37	41.4	45.6	48.6

The lungs, though showing early broncho-pneumonia, are only slightly increased in their activity; the urine contained albumin and hyaline casts, and the kidneys showed extensive epithelial degeneration. The high reading of the spleen is probably due to its congestion.

INFANTS.

Case No. 3.—Autopsy No. 2973. White male, still born. Birth 12 M., Dec. 6. Autopsy 12 M., Dec. 9.

Clinical History—Pregnancy complicated by placenta præva. Operative delivery; dilatation of cervix (Harris), version and extraction. Febrile puerperium. Child still-born; macerated.

Anatomical Diagnosis—No cause of death could be found.

Case No. 6.—Autopsy No. 2976. White male, 2 days. Died 7 P. M., Dec. 13. Autopsy 4 P. M., Dec. 14.

Clinical History—Operative delivery, low forceps; febrile puerperium.

Clinical Diagnosis—Congenital syphilis.

Anatomical Diagnosis—Congenital syphilis.

Case No. 12.—Autopsy No. 2998. White male, 8 days. Died 6 A. M., Jan. 19. Autopsy 11 A. M., Jan. 21.

Clinical History—Premature delivery by *accouchment forcé* for eclampsia. Child was taken to mother to nurse perfectly well, and ten minutes later was found dead with its head and face cyanotic.

Anatomical Diagnosis—No cause of death could be found.

CASE NO. 3.

Seconds.	15	30	45	60	75	90	105	120
Lung	26.5	33.4	38.2	41.6	43.8	46.2	47.2	47.8
Liver	19.8	27.6	33.8	39.2	42.2	44.4	46.4	47
Kidney	11.4	15.4	18.2	21.8	25	28	31.6	34.8

CASE No. 6.

Lung	7.6	9.4	11.2	12.4	14.4	16.2	18.4	19.8
Liver	16.8	22	25.8	30.2	34.8	41.4	44.4	46.8
Spleen	22.8	29.4	34.8	40.2	44	47.2	49.2	49.2
Kidney	6.4	7.8	9.2	10.2	11.8	13.4	14.6	15.8

CASE No. 12.

Lung	19	24	29	35	40.8	45.4	49.2	52.2
Liver	23	32.6	39.8	46.2	50.6	53.6	55.4	56.2
Spleen	22.4	28.6	34	39	44	49	52.8	55
Kidney	7.4	11	14.6	18	19.8	24	28.4	32.6
Blood	51	51.4	51.8	52.2				52.4

In the case of congenital syphilis, Case No. 6, the lung, liver, and kidney extracts give a lower catalytic reaction than the corresponding tissue extracts from Cases Nos. 3 and 12. The autopsy in Case No. 6 was done twenty hours after death, that in Case No. 3, three days after death, and in Case No. 12, two days after death. In consideration of the fact that tissues lose, to some extent, their catalytic activity through post-mortem changes, it is probably true, that the difference between Case No. 6 and Cases Nos. 3 and 12, would have been greater had they been done at equal intervals after death. That Case No. 3 was still-born, and showed considerable catalytic activity, is worthy of note.

CARBON MONOXIDE POISONING.

CASE No. 15.

Seconds.	15	30	45	60	75	90	105	120
Blood	22.6	32.6	37.2	40.6	44.4	45.4	46.6	47.6
Serum	2.6	3.6	4	4.4	5	5.6	6	6.4

The blood was obtained from this case post-mortem, though no other tissues were examined, as an autopsy could not be obtained. Jolles and Oppenheim say that there is only a very slight reduction in the enzymic activity of the blood after passing carbon monoxide through it. The reduction is very marked in the one case of carbon monoxide poisoning here reported.

From the above results, it is impossible for us to agree with Jolles and Oppenheim in their theory, that in the group of diseases which are characterized clinically by coma, such as, diabetes mellitus, nephritis, icterus, eclampsia, there is retained in the blood a catalytic inhibiting substance, and that the symptoms are due not

to the retention of specific substances in the blood, but to the lack of oxidation in the tissues. That there is a decreased catalytic activity in the blood in nephritis, is quite evident, but in both their cases of diabetes mellitus and in our one case, and in our cases of eclampsia and jaundice, the catalytic activity was not reduced. Although these diseases may be allied clinically, the determination of their catalytic activity would rather be a point of differentiation between certain members, *i. e.*, eclampsia and nephritis, than a point of resemblance.

CONCLUSIONS.

1. In work along this line it is most important to have a simple method of determining the catalytic activity of tissues. The method must be such that several observations can be made during a single experiment, so that a better idea can be obtained of the velocity of the reaction at various intervals.

2. The catalytic activity of human tissues varies greatly in diseases.

A. *Nephritis*.—The kidney always shows the most marked reduction although the other tissues examined, blood, lung, liver, spleen, likewise show decrease in their power of decomposing hydrogen peroxide. This reduction varies directly with the severity of the pathological lesion in the kidney and the clinical symptoms. The urine also in cases of nephritis shows a much greater inhibiting power than normal urine. This may be accounted for by the reaction of the urine, and subsequent work must prove whether or not the kidney takes any more active part in nephritis and secretes into the blood and urine a substance which manifests itself by a reduction in the catalytic activity.

B. The catalytic activity of the blood in the two cases of eclampsia which we have studied was not reduced. This is the most important fact we have so far obtained, if it can be substantiated, since it can furnish us with a ready ante-mortem means of differentiating eclampsia and nephritis.

C. *Pneumonia*.—The lung in the stage of *red hepatization* has an increased catalytic activity. This increase varies directly with the number of intact red blood cells in the exudate, and in the engorged capillaries. Strength is given to this conclusion by the

fact, that on the one hand, there is no increased activity in *gray hepatization*, while on the other hand, there is an enormously increased activity in the fresh *hemorrhagic infarct*.

D. *Tuberculosis*.—The decreased activity of the lung in tuberculosis is probably due, for the most part, to the lack of blood in the diseased area, while the lowered activity which is present in the other organs is to be explained by the anæmia and emaciation which accompanies the process. Whether there is a specific catalytic inhibiting substance generated by the process, has not been determined.

E. There was no reduction of the catalytic activity in the cases of diabetes mellitus and jaundice studied.

F. In the one case of asphyxiation by illuminating gas, there was decided decrease in the catalytic activity of the blood.

G. The tissues in the one case of congenital syphilis showed a marked lowering of the catalytic activity.

3. There is a slight decrease in the catalytic activity of the tissues due to post-mortem change, but this is so slight that it is hardly to be taken into consideration in the interpretation of the results obtained.

4. There is no marked change in the catalytic activity due to age.

In concluding, we wish to thank Dr. A. S. Loevenhart, at whose suggestion this enzyme was studied, for the unfailing interest with which he has followed the progress of this work, and for the many valuable suggestions he has given us.

BIBLIOGRAPHY.

1. Jolles and Oppenheim, *Virchow's Archiv*, 1905, clxxx, 185.
2. Schoenbein, *Jour. f. prakt. Chem.*, 1863, lxxxix, 1.
3. Loew, U. S. Dep't. of Agriculture, Report No. 68, 1901.
4. Jacobson, *Zeit. f. physiol. Chem.*, 1892, xvi, 340.
5. Spitzer, *Pflüger's Archiv*, 1897, lxvii, 615.
6. Schoenbein, *Zeit. f. Biol.*, 1867, iii, 140.
7. Loevenhart and Kastle, *American Chemical Jour.*, 1903, xxix, 397.
8. Loevenhart and Kastle, *Ibid.*, 1901, xxvi, 539.
9. Wells, *Chemical Pathology*, Philadelphia and London, 1907.
10. Bredig and v. Berneck, *Zeit. f. physiol. Chem.*, 1899, xxxi, 258.