

ON ALTERATIONS IN THE COMPOSITION OF THE
BLOOD RESULTING FROM EXPERIMENTAL
DOUBLE NEPHRECTOMY.

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Although the alterations in the composition of the blood which follow uncomplicated experimental double nephrectomy are of much interest in relation to the pathology of human uræmic states, the literature relating to the subject is exceedingly limited, and it is certain that investigators have not given it the attention of which it is worthy. It is the aim of this paper to present concisely the results of experimental work relating chiefly to the chemical changes that occur in the blood as the result of double nephrectomy. In most instances dogs were employed as the subjects of these observations, and both kidneys were removed at one operation. The chief symptoms following the removal of both kidneys in dogs are as follows: lowering of the temperature, loss of appetite, drowsiness, vomiting, diarrhœa.

In a few instances the second kidney was removed several days after the removal of the first. In a smaller series of cases studies were made of the blood after both ureters had been tied just below the pelves of the kidneys. In almost all cases the animals were carefully watched, and were bled to death as soon as there were indications that life was not likely to be prolonged for many hours. This method of procedure is of importance, because there is reason to think that the composition of the blood undergoes alterations in certain respects by contact post mortem with the tissues.*

Thus v. Limbeck obtained the following results:

	NaCl.		KCl.		HNa ₂ PO ₄	
	During life.	48 hours post mort.	During life.	48 hours post mort.	During life.	48 hours post mort.
Blood.....	.1643	.1642	.0279	.0567	.0247	.0327
Muscle.....	.0193	0.198	.3261	.2271	.3286	.2721

* v. Limbeck, *Arch. f. exp. Path. u. Pharm.*, 1892, xxx, 195.

Our observations have reference to the reaction of the blood and to its content of urea, of uric acid, of alcoholic and ethereal extractive substances, of ethereal extractive substances, of total proteids, of fibrin, of ash, of sodium and potassium, and of phosphoric acid.

*Reaction of the blood.**—Reference to Table I shows that the alkalinity of the blood was distinctly increased as the result of double nephrectomy. Thus the average alkalinity in six normal dogs was .0043 gm. NaOH (1 cc. blood), while that of six nephrectomized dogs was .0095 gm. NaOH. In the case of two dogs whose ureters had been tied, the alkalinity gave an average of .0138 gm. NaOH, but these results do not of course justify the conclusion that a higher grade of alkalinity is to be regularly expected after ligation of the ureters than after nephrectomy.

TABLE I.—ALKALINITY OF BLOOD.

No.	Nature of experiment.	No. of hours.	1 cc. blood in terms of cc. of $\frac{1}{10}$ normal tartaric acid sol.	1 cc. blood in terms of grammes of NaOH.	NORMAL DOG'S BLOOD.	
					1 cc. blood in terms of cc. of $\frac{1}{10}$ normal tartaric acid sol.	1 cc. blood in terms of grammes of NaOH.
1	Double Nephrectomy.	48	4.10 cc.	.0164 grms.	.940	.0037 grms.
2	"	52	1.65 "	.0066 "	.950	.0038 "
3	"	52	2.91 "	.0116 "	.940	.0037 "
4	"	52	2.21 "	.0088 "	.730	.0029 "
5	"	72	1.44 "	.0057 "	1.05	.0042 "
6	"	72	1.93 "	.0077 "	1.90	.0076 "
7	Both ureters ligated.	48	3.10 "	.0124 "		
8	"	52	3.80 "	.0152 "		
Average of results, Nos. (1-6) = 2.37 cc. = .0095.						
" " " " (7-8) = 3.45 cc. = .0138.						
" " " " (1-8) = 2.64 cc. = .0106.						
" " " " Normal = 1.08 cc. = .0043.						

This increased alkalinity after nephrectomy is especially noteworthy, as it contrasts with the well-known results of von Jaksch in

* *Method:* To a given amount of freshly drawn blood a tenth normal solution of tartaric acid containing sodium sulphate is added. The point of neutralization is determined by the use of litmus paper. For the details of the process see Hoppe-Seyler's Handbuch d. physiol.- u. path.-chem. Analyse, p. 399, Berlin, 1893. The method for absolute values is far from accurate on account of the difficulties involved in determining the neutral point, but is probably sufficiently accurate to render relative results trustworthy.

human uræmia.† It is very doubtful if it can be ascribed entirely to loss of water, as the increase in the specific gravity of the blood is inconsiderable.

*Urea.**—The increase in the percentage of urea in the blood is perhaps the most striking alteration in the composition of the blood after double nephrectomy (Table II). Twenty-eight observations on the blood of normal dogs give an average percentage of .037. Eighteen observations on nephrectomized dogs (which lived from 22 to 82 hours) yield an average of .315 per cent, while six observations on the blood of dogs whose ureters were tied give an average of .301 per cent. The increase in the percentage of urea thus amounts to nearly 10 times the average normal percentage in the course of 82 hours or less. The highest individual percentage in the blood was .458, or nearly .5 per cent. A similar increase in the urea of the blood has been observed by us in several cases of uræmia. It is noteworthy that the average normal percentage of urea in human blood is about the same as that of dogs, and that the highest percentages of urea which have been found in human uræmia are comparable with the highest noted after nephrectomy.

The urea which is stored in the blood after removal of the kidneys is derived from the waste of proteid tissue, and perhaps in a measure directly from proteid food in the digestive tract at the time of opera-

† v. Jaksch. *Zeitschr. f. klin. Med.*, xiii, 350. Further work is certainly needed to determine whether the diminished alkalescence of the blood observed by von Jaksch is actually a feature of the blood in human uræmia.

* *Method*: A given quantity of blood is treated with four or five times its volume of absolute alcohol and allowed to stand 24 hours. The filtrate and washings are evaporated to dryness at a moderate temperature, and the residue is taken up in absolute alcohol and filtered. The filtrate and washings are again evaporated to dryness, and the residue dissolved in a little water. This solution is subjected to the action of sodium hypobromite, and from the volume of nitrogen evolved is calculated the percentage of urea. Other nitrogenous alcoholic extractives of blood, as creatin and lecithin, are partly decomposed with liberation of nitrogen in this process, and herein lies the inaccuracy of the method. Urea, however, is by far the most abundant of the nitrogenous extractives, and the only one which is wholly broken up by the action of sodium hypobromite. The results obtained by this method are looked upon as sufficiently accurate for the purposes of this investigation.

tion.* After operation the animals seldom eat, and the formation of urea is probably little greater than in a state of starvation. The waste in starvation is, however, considerable. A dog weighing 12 kilos, and possessing, say, one kilo of blood, would produce enough urea to cause an accumulation of .5 per cent of urea in the blood in the course of three days, supposing the formation of urea to be even less than 2 grammes daily and further supposing the blood to be entirely free from urea at the time of operation. The daily formation of urea in a starving dog weighing 12 kilos is, however, considerably greater than 2 grammes daily. If all the urea formed were stored in the blood, the percentage would probably rise to 1 in three days. The discrepancy between the amount which should theoretically be found and the amount actually stored in the blood can probably be explained wholly by the fact that after nephrectomy urea

TABLE II.—UREA IN THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage of urea.	Normal dog's blood. Percentage of urea.	No.	Nature of experiment	No. of hours.	Percentage of urea.	Normal dog's blood. Percentage of urea.
1	Double nephrectomy	22	.394	.049	19	Both ureters ligated	48	.260	.027
2	"	26	.256	.040	20	"	36	.342	.058
3	"	36	.103	.035	21	"	45	.200	.021
4	"	40	.121	.023	22	"	48	.323	.063
5	"	48	.350	.023	23	"	52	.302	.022
6	"	48	.395	.026	24	"	72	.377	.011
7	"	48	.276	.021	25	Left kidney removed, right ureter ligated.	24	.254	.013
8	"	48	.184	.034					
9	"	48	.347	.070					
10	"	52	.259	.036					
11	"	52	.366	.079	26	Right ureter ligated, left renal ligated.	36	.247	.056
12	"	52	.286	.073					
13	"	60	.431	.042					
14	"	60	.386	.025					
15	"	72	.458	.031	27	Both renals ligated.	36	.330	.027
16	"	72	.456	.045					
17	"	72	.220	.027	28	Both renals ligated, both ureters ligated.	36	.310	.027
18	"	82	.377	.049					

Average of results: Nos. (1-18) = .315.

" " " (19-24) = .301.

" " " (1-28) = .308.

" " Normal = .037.

* Chittenden, *On Digestive Proteolysis*, p. 105, New Haven, 1895.

accumulates in the muscles, brain, and other tissues and organs. A similar storage in the tissues is noticeable both in human uræmia and after the experimental intravenous injection of a solution of pure urea in dogs, and makes the percentage of urea in the blood lower than it would be were all the urea retained in the blood.

*Uric acid.**—The few observations upon uric acid recorded in Table III indicate that the salts of uric acid are not increased after nephrectomy—the observations, however, are too few to be conclusive.

If it be a fact that uric acid occurs in minute quantities in normal blood and that it is not increased after nephrectomy, this is of considerable physiological interest. Speculations on the possible reasons for the absence of an increase are of little interest until the fact itself is established.

TABLE III.—URIC ACID IN THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage of uric acid.	Remarks.	Normal dog's blood. Percentage of uric acid.	Remarks.
1	Double nephrectomy.	48	.0016	Residue did not respond to murexide test.	.0022	Residue did not respond to murexide test.
2	Both ureters ligated.	48	.0025	“ “	.0014	“ “
3	“ “ “	52	.0024	“ “		

Average of results: Nos. (1 to 3) = .0022.

“ “ “ Normal = .0018.

Alcoholic and ethereal extractives.†—A moderate increase in the alcoholic and ethereal extractives appears to be a feature of the blood after removal of both kidneys. Thus the average of fourteen determinations on the blood of nephrectomized dogs gives 1.29 per cent, while the average of thirteen results obtained from the study of

* *Method:* After the removal of the proteids in the well-diluted blood by heat and acetic acid, the method employed was essentially that of Salkowski modified by von Schroeder. See Hoppe-Seyler's *Handbuch d. physiol.-u. path.-chem. Analyse*, p. 398, Berlin, 1893.

† *Method:* A given quantity of blood is treated with a large excess of alcohol and allowed to stand. The precipitate is washed with hot absolute alcohol, and afterwards extracted with ether. The alcoholic filtrate and washings are evaporated and the residue extracted and washed with cold and hot absolute alcohol. The combined alcoholic and ethereal residues are dried at 105° C. and the ash deducted.

normal dog's blood gives .95 per cent (Table IV). A similar moderate increase is often observed in the blood of fully developed human uræmia, and also in the blood in some infectious conditions which do not give the typical clinical evidences of uræmia. The alcoholic and ethereal extractives include in larger or smaller quantities fats, cholesterin, lecithin, creatin, urea and salts of hippuric acid, sarco-lactic acid and carbamic acid, sugar and xanthin bodies.

TABLE IV.—ALCOHOLIC AND ETHEREAL EXTRACTIVES OF THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage alcoholic and ethereal extractives.	Normal dog's blood. Percent. alc. and eth. extractives.
1	Double nephrectomy.	36	1.02	1.11
2	“ “	40	1.33	1.10
3	“ “	48	1.13	1.33
4	“ “	48	1.41	1.03
5	“ “	48	.97	.88
6	“ “	48	1.13	.83
7	“ “	48	1.31	.98
8	“ “	52	1.26	.85
9	“ “	52	1.54	.82
10	“ “	52	1.00	.88
11	“ “	60	1.72	.80
12	“ “	72	1.13	.80
13	“ “	72	1.31	.94
14	“ “	82	1.76	
15	Both renals ligated.	36	1.76	
16	Both ureters ligated.	45	1.10	

Average of results: Nos. (1-14) = 1.29.
 “ “ “ (1-16) = 1.30.
 “ “ Normal. = .95.

*Ethereal extractives.**—The percentage of increase in the ethereal extractives is greater than that of the combined alcoholic and ethereal extract. It is seen in Table V that the average of eight results obtained from the blood of dogs whose kidneys had been removed or ureters tied is .299, which is more than double the average result obtained from the study of the blood of six normal dogs. The

* *Method:* A known weight of blood is dried and a given quantity of the finely powdered residue is thoroughly extracted in Soxhlet's extraction apparatus. The extract is dried at 105° C. and weighed and the ash deducted.

etheral extractives of blood include neutral fats and cholesterol, as well as lecithin and salts of hippuric acid, and possibly of sarcolactic and carbamic acids.

TABLE V.—ETHEREAL EXTRACTIVES OF THE BLOOD.

No.	Nature of experiment.	No. of Hours.	Percentage of ethereal extractives.	Normal dog's blood. Percentage of ethereal extractives.
1	Double neprectomy.	40	.378	.206
2	“ “	48	.308	.104
3	“ “	52	.295	.144
4	“ “	52	.320	.180
5	“ “	72	.358	.090
6	“ “	72	.130	.100
7	Both ureters ligated.	48	.270	
8	“ “ “	52	.330	

Average of results: Nos. (1-6) = .298.

“ “ “ “ (1-8) = .299.

“ “ “ Normal = .137.

*Total proteids.**—The total proteids of the blood in six normal dogs yielded an average of 6.95 per cent of the constituents of the blood (Table VI). The average percentage of the total proteids in seven

TABLE VI.—TOTAL PROTEIDS OF THE BLOOD.

No.	Nature of experiment	No. of hours.	Percentage of total proteids.	Normal dog's blood Percentage of total proteids.
1	Double neprectomy.	26	6.49	7.07
2	“ “	48	9.54	7.44
3	“ “	52	6.61	6.90
4	“ “	52	8.82	5.10
5	“ “	52	7.40	7.11
6	“ “	72	7.38	8.09
7	“ “	72	7.39	
8	Both ureters ligated.	45	6.55	
9	“ “ “	48	8.19	
10	“ “ “	52	6.40	

Average of results: Nos. (1-7) = 7.66.

“ “ “ (8-10) = 7.05.

“ “ “ (1-10) = 7.48.

“ “ Normal = 6.95.

* *Method:* The proteids are precipitated in large excess of alcohol. After standing they are brought upon a weighed filter paper, washed with hot alcohol and ether, dried, weighed and the ash deducted.

cases of double nephrectomy was 7.66 per cent and 7.05 per cent in the case of three dogs in which double ligation of the ureters was practised. The inference seems proper that the percentage of the total proteids remains unaltered both after double nephrectomy and after double ligation of the ureters.

*Fibrin.**—The average fibrin yield of the blood of eleven normal dogs was .246 per cent. The average yield from seven nephrectomized dogs was .513 per cent. The average yield from three dogs in which the ureters had been tied was .483 per cent (Table VII). It is not possible at present to account satisfactorily for this apparently constant increase in the fibrin content of the blood after double nephrectomy. At first the possibility suggested itself that the increase might be the result of the simple elimination of the renal functions, but control observations have failed to establish this idea. In some of our operations there was moderate hemorrhage. It is known that considerable hemorrhage is followed by an increase in the fibrin content of the blood, and the question arose whether the increase of fibrin after nephrectomy might not depend on hemorrhage. Several operations were then done with great care to avoid hemorrhage. The fibrin content of the blood in these cases was as high as in the case of the dogs previously nephrectomized. As various infections are associated with an increase of fibrin, and as streptococcus infection occurred in some of our dogs, it seemed possible that our high fibrin results were due to infection. But this explanation would hold true of only a few of our cases; the fibrin content of the blood was increased even in cases where infection could be excluded. It was further found that if both hind legs of rabbits were removed at the knee, the fibrin of the blood was distinctly increased on the third day, even when hemorrhage and infection were absent. Thus from one experiment of this nature the fibrin yield was .702 per cent, and from another .744 per cent, while the average fibrin yield of the blood of eight normal rabbits was .255 per cent. On the other hand a simple

* *Method:* The fibrin estimations were made by the method of Hoppe-Seyler, see Handbuch, p. 410. The fibrin, separated by beating the freshly drawn blood, is thoroughly washed with a dilute solution of sodium chloride, then with water, and finally with boiling alcohol. It is dried at 105° C. and weighed. Duplicate analyses gave uniformly concordant results.

laparotomy on a dog was not followed by any change from the average fibrin content. On the whole it seems more likely that the increase in the fibrin of the blood after nephrectomy is in some obscure way connected with the operation to which the animal is subjected rather than to the elimination of the renal functions *per se*.

TABLE VII.—FIBRIN FROM THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage of fibrin.	Normal dog's blood. Percentage of fibrin.
1	Double nephrectomy.	48	.457	.201
2	" "	48	.430	.162
3	" "	52	.585	.221
4	" "	52	.450	.375
5	" "	52	.491	.320
6	" "	72	.690	.320
7	" "	72	.490	.185
8	Both ureters ligated.	45	.600	.200
9	" " "	48	.530	.279
10	" " "	52	.320	.240
				.200

Average of results: Nos. (1-7) = .513.

" " " (8-10) = .483.

" " " (1-10) = .504.

" " " Normal = .246.

*Ash.**—By referring to Table VIII it is seen that the average of eight estimations of the ash from the blood of nephrectomized dogs

TABLE VIII.—ASH OF THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage of ash	Normal dog's blood. Percentage of ash.
1	Double nephrectomy.	40	.74	.93
2	" "	48	.91	.83
3	" "	48	.90	.94
4	" "	52	.96	.48
5	" "	52	.93	.92
6	" "	52	.72	.64
7	" "	72	.84	
8	" "	72	1.02	
9	Both ureters ligated.	45	1.09	
10	" " "	48	.99	

Average of results: Nos. (1-8) = .88.

" " " " (9-10) = 1.04.

" " " " (1-10) = .91.

" " " " Normal = .79.

* *Method*: A given quantity of blood is dried and decarbonized with access of air over a Bunsen burner; the residue is weighed.

is .88 per cent, while the average of six estimations from the blood of normal dogs is .79 per cent. These results would seem to indicate an increase of the non-volatile products of the blood in the case of nephrectomized animals. The difference, however, is so slight, and the observations so few, that one is not justified in attaching much importance to the suggestion.

TABLE IX.—SODIUM AND POTASSIUM IN THE BLOOD.

No.	Nature of Experiment.	No. of Hours.	Percentage of Na ₂ O.	Normal dog's blood Percentage of Na ₂ O.	No.	Nature of experiment.	No. of hours.	Percentage of K ₂ O.	Normal dog's blood Percentage of K ₂ O.
1	Double nephrectomy.	36	.324	.280	1	Double nephrectomy.	36	.067	.015
2	" "	40	.156	.273	2	" "	40	.028	.026
3	" "	48	.213	.273	3	" "	48	.028	.020
4	" "	48	.345	.240	4	" "	48	.027	.036
5	" "	52	.330	.284	5	" "	48	.028	.022
6	" "	52	.365		6	" "	48	.034	.015
7	" "	52	.260		7	" "	52	.021	.017
8	" "	60	.181		8	" "	52	.031	.029
9	" "	72	.305		9	" "	52	.033	.027
10	" "	72	.285		10	" "	60	.030	
11	Both ureters ligated.	45	.396		11	" "	72	.032	
12	" "	48	.392		12	" "	72	.035	
13	" "	52	.418		13	" "	72	.031	
					14	Both ureters ligated.	45	.029	
					15	" "	48	.036	
					16	" "	52	.038	
					17	" "	48	.027	

Average of results: Na₂O, Nos. (1-10) = .276.

" " " Na₂O, " (11-13) = .401.

" " " Na₂O, " (1-13) = .305.

" " " Normal, Na₂O = .270.

" " " K₂O, Nos. (1-13) = .033.

" " " K₂O, " (14-17) = .033.

" " " K₂O, " (1-17) = .033.

" " " Normal, K₂O = .023.

*Sodium and potassium.**—The blood from ten nephrectomized dogs gave an average of .276 per cent Na₂O, and three dogs whose ureters had been tied yielded an average of .401 per cent Na₂O (Table IX). Estimations on the blood of five normal dogs showed

* *Method:* A given quantity of blood is carbonized in presence of (NH₄)₂SO₄. The residue is extracted with water, and a mixture of BaCl₂ and Ba(OH)₂ added. The barium is thrown out of the filtrate with (NH₄)₂CO₃. The method of procedure is as usual. The weight of the combined chlorides of sodium and potassium is obtained, and the potassium alone is weighed as K₂PtCl₆.

an average of .270 per cent Na_2O . It is thus seen that the sodium content of the blood of nephrectomized dogs is about the same as that found in normal animals. The percentage of sodium in the blood of animals whose ureters had been tied is seen to be considerably higher than the normal, but more observations are needed to determine whether this is regularly the case.

As regards the potassium content of the blood, there is found a slight increase in the case of dogs whose kidneys have been removed or ureters ligated. Thus the average yield from the study of the blood of thirteen nephrectomized dogs is found to be .033 per cent K_2O , and from four dogs whose ureters had been tied the value is the same. The blood of nine normal dogs yielded an average of .023 per cent K_2O .

TABLE X.—PHOSPHORIC ACID IN THE BLOOD.

No.	Nature of experiment.	No. of hours.	Percentage of P_2O_5 .	Normal dog's blood. Percentage P_2O_5 .
1	Double nephrectomy.	48	.100	.111
2	“ “	52	.134	.068
3	“ “	52	.144	.064
4	“ “	72	.115	.063
5	“ “	72	.145	
6	Both ureters ligated.	45	.066	
7	“ “ “	48	.081	
8	“ “ “	52	.077	

Average of results; Nos. (1-5) = .128.

“ “ “ (6-8) = .075.

“ “ “ (1-8) = .106.

“ “ Normal = .076.

*Phosphoric acid.**—The study of the blood of five nephrectomized dogs yielded an average of .128 per cent P_2O_5 . From three dogs whose ureters had been tied an average of .075 per cent P_2O_5 was obtained. The average from the study of the blood of four normal dogs was found to be .076 per cent P_2O_5 (Table X). These results

* *Method:* A weighed amount of blood is decarbonized by aid of HNO_3 . The phosphates in HNO_3 are precipitated with molybdic acid mixture. The precipitate is filtered off and washed and dissolved in $(\text{NH}_4)\text{OH}$. The phosphates are again precipitated with “Magnesia Mixture,” and finally weighed as $\text{Mg}_2\text{P}_2\text{O}_7$.

suggest an increase of the salts of phosphoric acid in the blood of nephrectomized dogs—a suggestion borne out by the study of the potassium content of the blood, as well as the ash, before and after nephrectomy.

Muscle, liver and brain.—The results recorded in Table XI represent the percentage of nitrogen obtained by the action of sodium hypobromite in alkaline solution upon the alcoholic extractives of the various organs.*

In the case of the muscle it is seen from the average of a number of observations that the nitrogen evolved by the action of sodium hypobromite upon the alcoholic extractives after nephrectomy is four to five times as great as that obtained from the alcoholic extractives of normal dog's muscle. A still greater increase is noticeable in the case of the liver. Thus the alcoholic extractives of the liver after nephrectomy liberate about nine times as much nitrogen as the alcoholic extractive of the normal liver. The few observations on the brain show the same marked increase.

While no attempt was made to establish the identity of the substance or substances which contribute to the increased liberation of nitrogen after nephrectomy, it is fair to suppose that the increase was due to the accumulation of urea. This view is borne out by the following experiment. Into the femoral vein of a dog weighing 43 pounds, whose kidneys had been removed, 220 cc. of a 25 per cent urea solution were injected at the rate of 20 cc. per minute. The animal was bled to death immediately after injection and the muscle, freed from blood, gave .066 per cent N when the alcoholic extract was acted upon by sodium hypobromite. Muscle cut from the animal before injection gave .036 per cent N. The increase here is clearly due to urea, since the other muscle extractives during the short time involved would remain fairly constant.†

* The method of obtaining the alcoholic extractives preparatory to the action of sodium hypobromite was similar to that pursued in the estimation of urea in blood. (See foot-note, p. 119.)

† In another case where a similar experiment was made, but in which the rate of infusion was much slower (2 cc. per minute), the urea rose to .648 per cent in the muscles, to .808 per cent in the liver and to .593 per cent in the brain.

TABLE XI.—NITROGEN, BY ACTION OF SOD. HYPOBROMITE UPON ALCOHOLIC EXTRACTIVES, OF MUSCLE, LIVER AND BRAIN.

No.	Nature of experiment.	MUSCLE.			LIVER.			BRAIN.				
		No. of hours.	Percentage of nitrogen by action of sod. hypobromite upon alcoholic extractives.	Normal dog's muscle. Percentage of nitrogen by action of sod. hypobromite upon alcoholic extractives.	Nature of experiment.	No. of hours.	Percentage of hydrogen by action of sod. hypobromite upon alcoholic extractives.	Normal dog's liver. Percentage of nitrogen by action of sod. hypobromite upon alcoholic extractives.	Nature of experiment.	No. of hours.	Percentage of nitrogen by action of sod. hypobromite upon alcoholic extractives.	Normal dog's brain. Percentage of nitrogen by action of sod. hypobromite upon alcoholic extractives.
1	Double nephrectomy.	48	.098	.028	Double nephrectomy.	48	.048	.0075	Double nephrectomy.	48	.125	.048
2	"	48	.087	.029	"	48	.104	.0098	"	60	.132	.030
3	"	48	.125	.019	"	48	.091	.0102	"	60	.138	
4	"	60	.125	.036	"	60	.107	R. ureter tied, L. renal tied.	36	.091	
5	"	60	.158	.035	"	82	.061	Both renals tied.	36	.053	
6	"	82	.230	.033	Both ureters tied.	36	.146					
7	Both ureters tied.	36	.152	.034	Both renals tied.	36	.047					
8	R. ureter tied, L. renal tied.	36	.084									
9	Both renals tied.	36	.020									

Average: Nos. (1-6) muscle = .137 Average: Nos. (1-5) liver = .082 Average: Nos. (1-3) brain = .132
 " Normal " = .031 " Normal " = .0092 " Normal " = .039

The results from the organs of nephrectomized dogs are mainly interesting when compared with the results similarly obtained from the organs of normal dogs. It is doubtful whether the nitrogen derived from the normal organs, especially in the case of the muscle, is due to the presence of urea. Thus Nencki and Kowarski* by employing phosphotungstic acid as a precipitant in the aqueous extract of large quantities of dog's muscle, obtaining an alcoholic extract, and eventually applying a delicate color test by the use of orthonitrobenzaldehyde and phenylhydrazin, arrived at the conclusion that urea is not a normal constituent of the muscle.

Few, if any, of the nitrogenous extractives except urea are wholly decomposed with liberation of nitrogen by the action of alkaline hypobromites, and upon most of the nitrogenous extractives the action of sodium hypobromite with liberation of nitrogen is slight. This favors the view that the increased nitrogen after nephrectomy is due to urea.

* *Arch. f. exp. Path. u. Pharm.*, 1895, xxxvi, 395.