Schmid and Bessan[3] for purine nitrogen of fresh tissues are transferred to our desiccated products the kidney powder would contain 0.48%, the liver powder 0.47%, and the thymus powder 1.98% purine nitrogen. The relationship of these figures is the same as the influence of the respective dried tissues on the rate of growth.

The rats with kidney and those with thymus added to their diets had (Table I) abnormally heavy kidneys and hearts. Grossly, they were normal. All of the dried tissues when fed caused the adrenals to become heavier. This increased weight was apparently due to cortical enlargement.

Conclusions. The addition of a significant amount of desiccated beef liver or kidney to the diet of the albino rat impairs slightly the rate of growth. The deleterious influence of desiccated beef thymus is more pronounced. These effects are probably due to the nuclear material in these tissues for their influence is related to their content of purine nitrogen.

8073 C

Extracellular and Intracellular Water Loss during Suprarenal Insufficiency in the Dog.

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In the cycle of cortical deficiency and recovery which may be induced in the suprarenalectomized dog by the withdrawal and subsequent readministration of suprarenal cortical hormone, two periods of diuresis may be discerned in balance experiments, in which the animal is offered an approximately constant food, fluid and sodium chloride intake. The first period of diuresis follows the withdrawal of the cortical extract and is associated with increased urinary excretion of sodium and of chloride. This important effect of suprarenal deficiency was first reported by Loeb and his coworkers, following suprarenalectomy in the dog.[1] The sodium

[3] Quoted by Brugsch, J., Gicht, in Kraus and Brugsch: *Specielle Pathologie und Therapie der innere Krankheiten*, Berlin, 1913, p. 228.

[1] Loeb, R. F., Atchley, D. W., Benedict, E. M., and Leland, J., *J. Exp. Med.*, 1933, **57**, 775.

diuresis is associated with an excretion of extracellular water. During the period of insufficiency there may be no substantial alteration in the potassium, nitrogen, and phosphate balance, but the increased concentration of these substances in the blood plasma, coincidental with the fall in sodium and chloride, is usually well marked, and indicates a renal retention. To a certain extent, this increased concentration of phosphate and potassium in the plasma makes good the loss of osmotic pressure which would otherwise attend the fall in concentration of sodium and of chloride.

When the animal is revived from a condition of insufficiency by injections of cortical hormone, a second period of diuresis immediately takes place which is quantitatively much larger than the first. The body weight also continues to drop for a time after the cortical extract injections are resumed, even though the condition of the animal obviously is improving greatly and food is being taken eagerly. This second period of diuresis is associated with a marked increase in the urinary excretion of potassium, urea, and phosphates and with a diminished excretion of sodium.[2] Not only is the excretion of potassium augmented severalfold in amount as a result of the increased fluid excretion, but the urinary concentration of this ion is also raised. Coincidental with this urinary excretion of potassium, nitrogen, and phosphates, the concentration of plasma potassium, urea, and inorganic phosphate falls, and the concentration of plasma sodium and chloride rises to normal levels. The augmented urinary excretion of potassium and of nitrogen will account for the fall in concentration in the extracellular fluid, assuming the latter to approximate in volume of water 20% of the body weight, with subsequent contraction.

The potassium diuresis represents primarily an excretion of intracellular water, in part due to cell destruction and in part due to cell shrinkage, as shown by the quantities of potassium and of nitrogen excreted with respect to the associated water loss. The diuresis may reflect the effects of an alteration in cellular permeability taking place as a consequence of the contraction in volume of the extracellular water, with the resulting disturbance of normal cell metabolism. It must be regarded not as due directly to lack of the cortical hormone, but as a consequence of the disordered renal excretion of sodium with the simultaneous displacement of a large moiety of the extracellular water. It is noteworthy that the first consequence of the resumption of extract injections is an increased renal excretion

[2] Harrop, G. A., Soffer, L. J., Ellsworth, R., and Trescher, J. H., *J. Exp. Med.*, 1933, **58**, 17.

TABLE I.

Balance Experiment Showing Effect of Withdrawal and Subsequent Readministration of Suprarenal Cortical Hormone on a Bilaterally Suprarenalectomized Dog. Dog 132. Ground raw meat diet* with 300 cc. distilled water† and 1 gm. sodium chloride per day.†

Date 1935 Mar.	Weight kg.	Food Intake gm.	Extract cc.	Water‡ Balance cc.	Sodium Balance m.-eq.	Chloride Balance m.-eq.	Potassium Balance m.-eq.	Nitrogen Balance gm.	Urine Volume cc.
5-8	10.6	450	8	—	— 1.0	— 0.6	+ 1.6	— 0.1	455
				Extract injections stopped.					
8-9	10.5	450	0	—263	—66.0	—50.7	+18.3	+ 0.3	710
9-10	10.2	450	0	+ 52	— 5.3	+ 1.6	+12.6	+ 2.9	395
10-11	10.2	380	0	+ 35	— 3.7	—10.9	+ 7.2	+ 5.8	360
				Insufficiency. Extract resumed.					
11-12	10.1	0	50	—510	— 2.2	— 9.2	—56.4	—14.5	670
12-13	9.6	100	50	— 65	+16.0	+ 8.5	—15.9	— 5.1	250
13-14	9.7	150	15	+ 62	+16.1	+15.1	— 1.2	— 1.2	175
14-15	9.7	270	15	+182	+23.3	+18.3	+16.5	+ 2.2	235
15-16	9.7	390	10	+118	+20.5	+11.4	+11.8	+ 1.3	345
16-18	9.9	450	10	+ 22	—10.0	+ 6.2	+ 7.8	+ 0.1	435
18	10.1	450							

*The meat was ground, mixed for the entire period, a sample taken for chemical analysis, and the remainder weighed out into oiled paper parcels and preserved by refrigeration until used. The food was consumed within an hour after it was offered.

†Administered by stomach tube.

‡Represents the difference between intake (including water derived from food and extract) and output, considering the period March 5-8 as representing proper fluid balance.

The dog was catheterized daily. For details concerning conduct of metabolism experiments see Reference 2.

TABLE II.

Dog 132. Observations on the Blood and Heparinized Plasma (Arterial).

Date 1935 Mar.	Non-protein nitrogen mg. per 100 cc.	Urea mg. per 100 cc.	Sugar mg. per 100 cc.	Sodium m.-eq. per liter	Chloride m.-eq. per liter	Potassium m.eq. per liter	Carbon dioxide content m.-eq. per liter	Proteins gm. %	Plasma (hematocrit) %	
5	36	20	73	144.8	111.1	4.3	30.1	6.0	62.2	
				Extract withdrawn March 8.						
11	180	140	95	133.0	101.5	10.6	17.4	6.9	46.5	T. 99, P. 34, stagger gait
				Extract resumed March 11.						
18	32	16	74	140.5	107.4	4.9	26.9	6.4	60.8	

of potassium and nitrogen, and that the retention of sodium and chlorides follows this primary effect, in most experiments.

Summary. The initial hemoconcentration which is observed in suprarenal insufficiency in the dog is due at least in part to a renal loss of extracellular fluid. It is followed during the early stage of repair by a further loss of water, primarily intracellular in origin, a reflection of cellular damage which is not made manifest until this

renal excretion takes place during the recovery phase. The first effect of the cortical hormone upon the animal in suprarenal insufficiency is to produce an increased urinary excretion of potassium, nitrogen, and phosphates, followed by retention of sodium and of chlorides.

The ultimate effect of the hormone is the restoration and maintenance of the proper plasma concentrations of potassium and sodium through regulation of their renal excretion. Hence, it plays a predominant rôle in the stabilization of a proper volume of extracellular fluid.

8074 C

Respiratory Exchange of Oxygen and Carbon Dioxide During Rebreathing from a Rubber Bag.

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During rebreathing from a rubber bag, the nose being compressed with a spring clip so that the lungs and bag form a closed system, O_2 and CO_2 diffuse across the pulmonary epithelium, the direction and rate of diffusion depending on the relative tensions of these gases in the blood and alveolar air. This process has been studied in 18 experiments in 2 normal young men. After the subject had sat in a chair for 10 minutes, the metabolic rate was determined. The subject then expired through a side tube to residual air (an alveolar sample being taken) and then rebreathed from the rubber bag 9 times in 22.2 seconds, being guided by spoken directions from an accurately timed phonograph record. Each inspiration emptied the bag and each expiration was as deep as possible. During the rebreathing alveolar samples were drawn into evacuated tubes at the end of breath No. 3, 6, and 9, dividing each experiment into 3 intervals of 8.0, 7.0, and 7.2 seconds in the order named.

The results of the experiments are presented in tabular form. The contents of the rebreathing bag are noted. The initial volume of the lung-bag system is obtained by adding the gas volume of the bag and the residual lung volume of the subject. In most experi-

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