coming in periodic direct content with the lining serves naturally to aid in maintaining the lining in sound condition.

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11925

Effect of Adrenalectomy on Intestinal Absorption Involving Osmotic Work in Rats.

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The abnormalities of the mineral metabolism of adrenalectomized animals are common knowledge, and have been the subject of several comprehensive reviews (*e. g.*, Kendall[1]). In the kidney it has been possible to study the course of interference with the normal sodium and potassium balance in some detail. Further analyses in the kidney are however confronted with great difficulties. Fortunately, disturbances of reabsorption by the kidney tubuli can often be demonstrated by analogous experiments with the small intestine. Phloridzin interference with sugar reabsorption in proximal parts of the tubuli can be seen for example in the inhibitory effect of phloridzin on active sugar absorption in the intestine (Wertheimer[2]). Visscher and coworkers[3] in a series of investigations have shown that an active transport of ions in a direction opposite to that of the concentration gradient can regularly be demonstrated in the small intestine under specified conditions. This finding seems to be of general physiological significance; a similar transport of ions against the direction of the gradient has been shown to exist in plant roots by Lundegardh[4] and in several freshwater animals by Krogh.[5] In this connection mention may also be made of the papers of Steward[6] and Keys.[7] It seemed of some importance in view of these results to ascertain whether an active transport of ions against the direction

1 Kendall, E. Z., Congress Bericht 1, 16 Intern. Physiol. Congr., August, 1938, Zurich, p. 47.

2 Wertheimer, E. *Pflüger's Arch.*, 1933, **233**, 514.

3 Ingraham, R. C., and Visscher, M. B., *Am. J. Physiol.*, 1938, **121**, 771.

4 Lundegardh, H., *Biochem. Z.*, 1937, **290**, 104.

5 Krogh, A., *Scand. Arch. Physiol.*, 1937, **76**, 60.

6 Steward, F. C., *Trans. Farraday Soc.*, 1937, **33**, 1006.

7 Keys, A., *Trans. Farraday Soc.*, 1937, **33**, 930, 972.

of the gradient could be demonstrated also in the small intestine of adrenalectomized animals. Fifty-four animal experiments testing this question have been carried out by us. Our earlier experiments were carried out according to the procedure used by Wilbrand and Laszt[8] for the study of active sugar absorption in the rat intestine.

Considerable differences in total sodium and chlorine absorption between normal and adrenalectomized rats were found. (In 12 experiments absorption of NaCl in adrenalectomized rats during a time interval of 40-80 min. was nil, whereas in normal rats absorption during the same interval varied in extent from 20 to 80%.) Ionic migration against the gradient, as shown by Visscher, was, however, difficult to demonstrate by this method. Active sugar absorption on the other hand, was clearly evident. This finding shows that active ion absorption by the small intestine is distinct from active sugar absorption, being of a far greater lability and to be ascribed to a distinct energetic process.

In our later experiments the method of Visscher and his coworkers[9] was applied. This differs from Laszt's method only in that for cleaning, gentle stroking of the intestine is replaced by rinsing. With this technic results obtained using normal rats were in full accord with the findings of Visscher.

The adrenalectomized rats were maintained on a diet relatively rich in common salt but poor in potassium. Rubin-Krick solution was given to drink. In addition, the animals received injections of NaCl and sodium bicarbonate solution, as in the experiments of Laszt.[10] All animals used were in good health. They were maintained throughout the course of the absorption experiments on an electrically heated table at 38°C. The external behavior of adrenalectomized and normal rats was similar. Shock phenomena (*e. g.*, temperature drop) were not observed. Typical experiments are shown in Table I.

The experiments show that NaCl resorption in the small intestine of adrenalectomized, but otherwise healthy, rats is markedly retarded and that in such rats resorption against the direction of the concentration gradient is no longer possible. The inability of adrenalectomized rats to effect an active ion transport is already evident two days after operation. By administration of desoxycorticosterone, on the other hand, normal resorption of Cl may be reëstablished. Rats maintained on vitamin B-free diet do not suffer from interference with the normal active resorption of ions despite marked

8 Wilbrand, W., and Laszt, L., *Biochem. Z.*, 1933, **259**, 398.

9 Lifson, N., *Am. J. Physiol.*, 1940, **128**, 607.

10 Laszt, L., *Nature*, 1939, **144**, 244.

TABLE I.
Absorption of $NaCl$-Na_2SO_4 in Small Intestine Following the Method of Visscher.

Body wt, g	Time, min.	Volume, cc		Chloride, mM/L			Sodium, mM/L			Notes
		Begin	End	Intro.	Found	% Abs.	Intro.	Found	% Abs.	
170	80	5.0	0.7	78.5	33.0	94.0	191.0	243.0	81	(1)
141	80	4.0	1.0	78.5	33.2	90.0	191.0	191.0	76	(2)
140	40	4.0	1.0	78.5	66.3	79.0	191.0	184.0	70	(3)
181	80	5.0	5.0	78.5	107.8	—	191.0	159.0	20	(4)
193	80	5.0	3.9	78.5	91.3	10.6	191.0	174.0	41	(5)
187	80	5.0	1.4	78.5	45.2	81.0	191.0	143.6	80	(6)
158	70	4.0	2.1	78.5	79.0	47.4	178.5	163.2	55	(7)

Notes:
(1) Semi-adrenalectomized.
(2) Maintained 4 weeks on vitamin B-free diet; loss in body weight 20 %.
(3) Thyroidin admin. for 14 days in daily dose of 10 mg.
(4) 20 days after adrenalectomy.
(5) 2 " " "
(6) 7 " " " , 1 mg desoxycorticosterone 3 days before exp.
(7) Addition of 1/10,000 parts monoiodoacetate.

loss of weight. For the ultimate identification of the energy-yielding reaction it is of interest to note that a 1/10,000 solution of monoiodoacetate completely inhibited all ion resorption against the direction of the gradient. Thyreotoxic animals do not show clearcut deviations from normal in regard to resorption.

At this stage of our investigations, the study of Dennis and Wood[11] which reports experiments with adrenalectomized dogs in both the acute and chronic condition and yielded results similar to those obtained by us was published. We are, therefore, able to offer full confirmation of the results obtained by these authors.

11926 P

Production of Azoospermia in Man from the Use of α-Estradiol Benzoate (Progynon-B).*

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This preliminary report deals with the effect of α-estradiol benzoate upon spermatogenesis in a 72-year-old man, who has been

[11] Dennis and Wood, *Am. J. Physiol.*, 1940, **129**, 182.

* α-Estradiol Benzoate was generously supplied by the Schering Corporation under the trade name of "progynon-B."