phate in a concentration equivalent to the zinc content of the amount of crystalline insulin which we employed (*circa* 1×10^{-5} M) caused a similar inhibition in the absence of insulin.

Discussion. The *in vitro* inhibition of succino-oxidase activity by insulin is due solely to the zinc content of the insulin sample, and can be duplicated by equivalent amounts of the zinc ion. The possible physiologic significance of these results depends upon whether zinc is an integral part of the insulin molecule as secreted by the pancreas and, if so, whether the zinc moiety exerts a similar effect *in vivo*. The work of Scott and Fischer[6] and of Cohn, *et al.*,[7] indicates that zinc is very closely associated with the insulin molecule. Crystalline insulin has a constant percentage content of zinc, which is not decreased by repeated recrystallizations, and which cannot be separated from the protein by electrodialysis. However, even if it may be assumed, for the time being, that zinc is an integral part of the insulin molecule as secreted, it still remains to be shown that it is effective *in vivo*. Recent work has shown that a number of other enzyme systems may be influenced by very small concentrations of zinc *in vitro*.[8, 9] But evidence is lacking as regards similar *in vivo* actions of zinc, either when associated with insulin or by itself.

11199

Effect of NaCl and Desoxycorticosterone on Body Weight and Carbohydrate Stores of Adrenalectomized Rats.*

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It is well known that additional amounts of sodium chloride will enable adrenalectomized animals to survive a considerable length of time beyond the expected survival period following adrenalectomy. It has been found that adrenalectomized rats given 1% solution of

6 Scott, D. A., and Fischer, A. M., *Biochem. J.*, 1935, **29**, 1048.

7 Cohn, E. J., Ferry, J. D., Lingood, J. J., and Blanchard, M. H., *Science*, 1939, **90**, 183.

8 Thunberg, T., *Skand. Arch. Physiol.*, 1934, **69**, 247.

9 Lohmann, K., and Kossel, A. J., *Naturwis.*, 1939, **27**, 595.

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NaCl in place of tap water to drink *ad libitum,* will excrete sodium and potassium as normal animals in contrast to adrenalectomized rats unsupported by salt which show an increased urinary excretion of sodium and a retention of potassium.[1] It has also been shown that sodium chloride therapy enables adrenalectomized animals to absorb glucose from the intestinal tract like normal animals, in contrast to untreated adrenalectomized animals which have a decreased intestinal absorption of glucose.[2]

This study was undertaken in order to compare the general nutritional status and the carbohydrate levels of the body after glucose feeding in adrenalectomized rats treated with sodium chloride, with that of adrenalectomized rats receiving no treatment, adrenalectomized rats treated with desoxycorticosterone and rats in which the adrenals were intact. Male rats 63 days of age were used. The animals were kept in individual cages in a constant temperature chamber at 28°C for 2 weeks before operation and during the 10-day observation period following operation. A record of the daily intake of food and fluid and of body weight was kept during the entire 24-day period. A summary of these data is given in Table I.

In Group I, consisting of 10 rats, the adrenals were removed and the animals were started immediately on a 1% solution of NaCl to drink *ad libitum.* In Group II, consisting of 10 rats, the same operation was performed and the animals put on a daily dose of 0.5 mg desoxycorticosterone, administered in oil by the subcutaneous route. They received tap water to drink. In Group III, consisting of 8 rats, a "mock adrenalectomy" was performed, that is, the adrenals were dissected free from the surrounding tissue, but were not removed. These animals received no therapy and were given tap water to drink. In Group IV, consisting of 5 rats, the adrenals were removed completely and no therapy given. This group was sacrificed on the 4th day post-adrenalectomy, in contrast to the animals of the other 3 groups which were not sacrificed until the 10th day. During the 10-day post-operative period the NaCl-treated animals each received a daily average of 38 cc of a 1% NaCl solution. In Table I it is shown that the average daily food intake and the increase in body weight were practically the same for the first 3 groups of animals. The corresponding figures for Group IV might well be considered comparable for the shorter period.

The day before sacrificing, the rats were started on a 20-hour fast.

[1] Anderson, E., and Joseph, M., Proc. Soc. Exp. Biol. and Med., 1939, 40, 347.

[2] Althausen, T. L., Anderson, E., and Stockholm, M., Proc. Soc. Exp. Biol. and Med., 1939, 40, 342.

TABLE I.
Intake of Food and Fluid and Changes in Body Weight in Treated Adrenalectomized Rats.

	No. animals	Avg body wt (g)		Avg daily food intake (g)		Avg daily fluid intake (cc)	
		At operation	10th day post op.	Before operation	After operation	Before operation	After operation
Group I							
Adrenalectomized. 1% NaCl	10	194	218	14.9	10.8	29 H_2O	38 1% NaCl
Group II							
Adrenalectomized. 0.5 mg desoxycorticosterone	10	189	212	15.4	10.5	26 H_2O	20 H_2O
Group III (controls)							
"Mock adrenalectomized"	6	191	217	14.4	12.3	26 H_2O	26 H_2O
Group IV (controls)							
Adrenalectomized, untreated	5	172	180*	15.6	14.1	—	—

* 4th day postoperative

TABLE II.
Carbohydrate Stores After Adrenalectomy in Rats Treated with 1% NaCl, and with Desoxycorticosterone. Average.

	No. animals	Body wt, g (20 hr fasting)	Glucose absorbed per 100 g B. wt per hr	Blood sugar, mg %	Liver glycogen		Muscle glycogen mg % of wet tissue
					mg %§	mg per 100 g body wt	
Group I							
Rats adrenalectomized for 10 days, given 1% NaCl	10	207 (180-234)	136 (116-149)	133 (90-305)	1,494 (823-2,271)	47.5 (25.8-78.9)	606* (504-757)
Group II							
Rats adrenalectomized 10 days, given 0.5 mg desoxycorticosterone daily	10	200 (175-226)	142 (112-157)	119 (90-190)	1,730 (999-2,485)	49.9 (30.8-67.8)	630† (485-757)
Group III (control)							
Rats "mock adrenalectomized" 10 days previously	6	200 (188-216)	141 (133-157)	138 (110-160)	1,760 (1,279-2,251)	60 (36.6-81.1)	712‡ (678-777)
Group IV (control)							
Adrenalectomized 4 days, no treatment	5	176 (163-190)	—	173 (130-310)	292 (86-516)	11 (3.3-22.4)	529 (480-569)

*Values for 7 rats. † Values for 8 rats ‡ Values for 5 rats §Based on wet tissue weight.

The sodium chloride-treated animals continued to have access to the NaCl solution, the rest of the animals were given tap water to drink. Four hours before sacrificing, the animals were given 1.2 g glucose (5 cc of a 25% solution) by stomach tube. The animals were anesthetized with sodium amytal, the tissues removed immediately and the following determinations made: intestinal absorption of glucose; blood sugar; liver glycogen and muscle glycogen. The results of this study are shown in Table II. It will be noted that the values for the glucose absorption and the carbohydrate levels in the blood, liver and muscle are very much the same in the first 3 groups which shows that the salt-treated adrenalectomized rats are able to absorb and store fed glucose as well as the adrenalectomized rats which were treated with a half milligram dose of desoxycorticosterone daily, and as the rats with their adrenals intact. On the other hand the untreated adrenalectomized rats of Group IV showed liver glycogen stores greatly reduced as early as the 4th day post-operative.

Summary. Adrenalectomized rats given a 1% solution of sodium chloride to drink *ad libitum* in place of tap water for a 10-day period after operation gain in weight and are able to store fed glucose in amounts comparable to that of adrenalectomized rats given 0.5 mg desoxycorticosterone daily or to that of rats in which the adrenals are intact.

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A Modified Hemmingsen-Krarup Mammalian Activity Recorder.*

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Studies in mammalian activity have made necessary the development of recording equipment.[1] Most of these recorders have been simply constructed, utilizing rubber bands, springs or excentric drives. The Hemmingsen-Krarup recorder[2] is an apparatus of considerable precision and a modified form of this equipment has been developed for the study of periodic activity of small mammals.

* Recording apparatus constructed by C. P. Clare & Co., Chicago, by means of a grant from Northwestern University.

1 Park, O., *Ecological Monographs,* 1940, **10** (July).

2 Hemmingsen, A. M., and Krarup, N. B., *Biologiske Meddel.,* 1937, **13**, 1.