detailed description of the apparatus and procedure used has been presented.[2]

The data on averages and ranges of work for 10 pairs of rats are summarized in Table I. Inferiority as regards the ability of castrated female rats to sustain work of the gastrocnemius muscle was not observed in this experiment.

TABLE I.
Record of Work for 10 Normal and 10 Castrated Female Rats.

Hr of work	Normal			Castrated		
		Range*			Range*	
	Avg*	Minimum	Maximum	Avg*	Minimum	Maximum
0 to 24	61.2	41.1	82.9	60.7	32.1	70.9
24 to 48	31.3	9.2	52.6	28.6	6.5	42.1
48 to 72	33.6	20.6	42.7	36.3	16.7	50.3
72 to 96	39.3	28.7	49.9	45.6	22.4	61.3
96 to 120	32.4	0	50.5	42.8	21.8	60.9
Total period of work	197.8	147.2	240.5	214.0	99.7	259.1

* Expressed in kilogram-meters; error for relative values does not exceed 10%.

The results of this experiment are similar to those of my previous study on castrated male rats. They do not agree with the results of Miley,[3] who found that castrated female rats were deficient in their capacity for work.

The daily values for work in this experiment were occasionally higher than on the preceding day although the stimulation was continuous. This is a frequent observation on performance of work when studied under the experimental conditions used in this investigation.

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Effect of Cortin on Survival and Work Capacity of Rats after Removal of Intra-Abdominal Organs.

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The site of action of cortin is unknown. In this study I have attempted to determine whether cortin will act after all the abdominal

[2] Heron, W. T., Hales, W. M., and Ingle, D. J., *Am. J. Physiol.*, 1934, **110**, 357.
[3] Miley, H. H., *Am. J. Physiol.*, 1927, **82**, 7.

viscera have been removed from the rat. Adult male rats of the Wistar strain were used. The operations were carried out in two stages. In the first stage the vena cava was completely ligated between the points of entrance of the renal veins and those of the hepatic veins. Owing to the immediate circulatory changes induced by such a procedure, the adrenal glands are injured. Following this first stage of the operation death may occur in 40 to 60% of cases. Because of the possible relation between the adrenal gland and survival, I treated all of the animals with 1 cc of cortin daily in their drinking water for 5 days following operation. The mortality rate was reduced to less than 10% by this procedure.

Following a minimal period of delay of 21 days during which time an adequate collateral circulation was established the animals were closely matched into pairs on the basis of weight and all of the intestines, liver, kidneys and adrenal glands were removed from the abdominal cavity. Ether was used for anesthesia.

In Experiment 1, each of 10 pairs of animals was given 1 cc of a 20% solution of glucose immediately following operation and at each succeeding interval of 2 hours. One animal of each pair was given 0.5 cc of cortin (each cubic centimeter of cortin represented 75 g of whole gland) immediately following operation and at each succeeding interval of 2 hours. Of each pair one animal was used as a control; it received similar amounts of a physiologic saline solution at intervals of 2 hours. The animals which received injections of cortin survived for an average of 28 hours with a range of 20 to 32 hours. The animals which were not treated with cortin survived for an average of 17 hours with a range of 8 to 26 hours.

In Experiment 2, ten pairs of animals, all the abdominal viscera of which had been removed, were anesthetized with phenobarbital sodium and the gastrocnemius muscle was stimulated to lift 100 g three times per second. The injections were made in the same manner as in Experiment 1. The work done was registered automatically. The details of the methods used have been described.[1]

The initial rates of work among eviscerated rats were similar to those among the animals not operated on and, during the first 3 hours of work, the height of muscular contraction was well maintained among all of the animals. Those animals which received cortin worked for longer periods of time and performed more work before insufficiency occurred than did the controls. The data of Experiment 2 are presented in Table I.

It has not been generally recognized that an animal may be made

[1] Heron, W. T., Hales, W. M., and Ingle, D. J., *Am. J. Physiol.*, 1934, **110**, 357.

TABLE I.
Work of Pairs of Completely Eviscerated Rats.

Body wt, g		Initial rate of work*		Total work		Hr work*	
Cortin	No cortin	Cortin	No cortin	Cortin	No cortin	Cortin	No cortin
270	270	15	15	4270	3774	13.0	10.0
215	215	12	15	7296	2545	18.0	6.5
290	295	17	17	6674	5785	16.0	9.5
235	230	17	15	7703	3577	14.0	7.5
280	280	15	18	6137	4505	12.5	7.0
320	300	21	18	7788	3953	11.0	4.5
225	225	17	16	7320	2342	19.0	5.0
240	240	15	17	4075	2848	12.5	6.5
240	245	13	17	7014	2742	11.0	5.0
380	380	22	25	7754	2543	10.5	5.5

*Expressed as recorder revolutions. Each revolution is the equivalent of approximately 400 g-cm of work. The error for relative values does not exceed 10%.

to manifest adrenal insufficiency within a few hours after removal of the adrenal glands. It is true that when the rat is adrenalectomized with a minimum of trauma and is maintained under conditions optimal for survival it may live indefinitely without treatment with cortin. On the other hand, when the adrenalectomized animal is made to undergo severe stress, insufficiency may be induced very rapidly unless large amounts of cortin are administered frequently.[2] This has been observed in my own experiments and by many other investigators.

It is evident that cortin can act in the animal organism, that is, it can maintain life, after all the organs of the peritoneal cavity have been removed. This cannot be interpreted to mean that cortin does not influence these organs when they are present, because there is a large amount of experimental data which indicates that the functions of the kidneys and of the liver are altered by either a deficiency or an excess of cortin in the body.[3] The results of the experiments reported herein support the hypothesis that cortin does not have a specific site of action in the body which is essential for all of its effects. It is of additional interest that a normal rate of muscular work can be sustained for several hours by an animal treated with glucose, from which the liver and pancreas have been removed.

[2] Ingle, D. J., and Kendall, E. C., *Am. J. Physiol.*, 1936, **117**, 200.

[3] Ingle, D. J., Nilson, H. W., and Kendall, E. C., *Am. J. Physiol.*, 1937, **118**, 302.