

Memory and Retention. To test for memory and retention a group of animals learned the maze and was then divided into two matched groups, experimental and control. The experimental group was subjected to increased O₂ pressure in 16 successive exposures over a period of 10 days. The control group was treated in the same way except for the exposure to oxygen. One day after the last oxygen exposure of the experimental group, both it and the control group, were tested for maze retention. It was found that the experimental group made an average of 52.9 errors in relearning the maze, whereas the control group made on average of only 2.7 errors. This difference is strikingly significant. Thus

the memory and retention of the maze previously learned was definitely impaired in the experimental group of animals as a result of their exposure to the increased O₂ pressure.

Conclusion. The data were interpreted to mean (1) that successive intermittent exposures to O₂ at high barometric pressure had no effect on the ability to learn a maze habit; (2) that the retention and memory of a maze previously mastered was adversely affected to a striking degree by intermittent exposures to increased O₂ pressure; (3) that certain mental processes may suffer deleterious effects as a result of exposure to increased O₂ pressure even when such exposure causes no evident motor dysfunction.

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Similarity of Response of Thymus and Lymph Nodes to Administration of Adrenocorticotrophic Hormone in the Rat.*

MIRIAM E. SIMPSON, CHOH HAO LI, WILLIAM O. REINHARDT AND HERBERT M. EVANS.

From the Institute of Experimental Biology and the Department of Anatomy, University of California, Berkeley.

Enlargement of the thymus and lymphoid tissues has been noted experimentally and clinically¹ as the result of adrenalectomy or hypofunction of the adrenal cortex. On the other hand, adrenal cortical extracts² and the administration of adrenocorticotrophic hormone³ have been shown to cause thymic involution. Since it has been shown experimentally⁴ that lymph nodes respond to adrenalectomy in the rat in the same manner as does the thymus, it is of interest to note that adminis-

tration of purified adrenocorticotrophic hormone causes a similar involutionary change in lymph nodes as well as thymus.

Methods. The reaction of thymus and lymph nodes to purified sheep adrenocorticotrophic hormone (ACT)⁵ was established in the following experiments. (1) Action of ACT in the normal rat. (2) Action of ACT in the hypophysectomized rat. (3) Action of ACT in the adrenalectomized rat maintained in good condition on 1% NaCl. All animals employed were 26-day-old male rats at onset of the experiment. The treated animals were given a total dose, daily, of 1 mg ACT by intraperitoneal injection in 3 injections distributed through the 8-hour-day (2 injections on Saturday, 1 injection on Sunday). Injections were begun on the day of operation. All animals were maintained under identical nutritional and environmental con-

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¹ Moon, V. H., *Shock*, Lea and Febiger, Philadelphia, 1942, 198-203.

² Ingle, D. J., Higgins, G. M., and Kendall, E. C., *Anat. Rec.*, 1938, 71, 363.

³ Evans, H. M., Moon, H. D., Simpson, M. E., and Lyons, W. R., *Proc. Soc. Exp. Biol. and Med.*, 1938, 38, 419.

⁴ Reinhardt, W. O., and Holmes, R. O., *Ibid.*, 1940, 45, 267.

⁵ Li, C. H., Simpson, M. E., and Evans, H. M., *Science*, 1942, 96, 450.

TABLE I.
Effect of Adrenocorticotrophic Hormone on Weights of Thymus and Lymph Nodes.

Type of rat	No. of rats	Final body wt, g	Thymus wt, mg	Cervical lymph node wt, mg
Unoperated				
Control	6	236 (210-252)†	579 (475-700)	347 (193-423)
Treated*	6	158 (142-175)	72 (39-100)	83 (38-117)
Hypophysectomized				
Control	5	114 (100-120)	219 (98-299)‡	185 (123-289)
Treated	5	107 (95-124)	43 (26-52)	99 (60-114)
Adrenalectomized				
Control	10	186 (147-224)	550 (389-760)	400 (308-505)
Treated	10	188 (152-227)	549 (335-750)	385 (255-502)

* 1 mg daily dose divided in 3 injections during an 8-hr period; Saturday, 2 injections, and Sunday, 1 injection. Injections were begun on the day of operation. Experimental periods were of 30 days duration with the exception of the hypophysectomized group which were treated for 15 days. All rats were males, 26 days of age at onset of the experiment.

† Ranges in the group.

‡ 4 animals.

ditions. Duration of the experiment was 30 days for the normal and adrenalectomized animals, 15 days for the hypophysectomized group. At autopsy, thymus and cervical lymph nodes were removed according to a technic previously described,⁴ weighed and fixed for histological study.

Results. The results of the above experiments are found in Table I. It is apparent that ACT produces a striking and similar effect on the weights of the thymus and cervical lymph nodes. That the remarkable reduction in the size of these tissues is not due to reduction in food intake has been ruled out by other experiments in which (1) food intake of the control and injected animals was measured and found to be identical, and (2) food intake of controls was restricted to the point where the control animals maintained the same body weight as ACT injected animals; in these experiments the thymus and lymph nodes underwent some reduction in weight, but this reduction was not in any sense as extensive as that produced by ACT injection. Effects were noted after ACT was injected into either immature (26-day-old) or mature (89-day-old) male rats. Histological examination of the lymph nodes of the ACT-treated rats shows a flushing out of the adult lymphocytes with a corresponding decrease in the size of the other components of the node. There was no histologically observable effect of the ACT injections on the

nodes of the adrenalectomized animals.

It seems apparent that ACT acting through the adrenal cortex is effective in producing a striking reduction in weight and size of the thymus and cervical lymph nodes in the rat. This confirms the recent similar findings of Dougherty and White for the mouse.⁶ It is probable that this effect is not mediated by the pituitary gland, since the effect is easily demonstrable in the hypophysectomized animal. It is further doubtful that the effect is mediated through the gonads, since it has been shown elsewhere³ that thymus reduction after ACT injection occurs with equal facility following double ovariectomy. It is likewise doubtful that secretion of an androgenic substance by the adrenal cortex under the influence of ACT treatment is responsible for the effects on the thymus and lymph nodes, since in none of the experiments here cited was there evidence of coincident stimulation of the accessory sexual tissues (prostate, seminal vesicles, Cowper's gland).

These experiments furnish evidence that there is a reciprocal relationship as regards the effect on the thymus and cervical lymph nodes of adrenalectomy on the one hand, and administration of ACT on the other. It is notable that these tissues show probably a more profound reaction to these procedures

⁶ Dougherty, T. F., and White, A., *PROC. SOC. EXP. BIOL. AND MED.*, 1943, **53**, 132.

than do any other tissues in the body. Certainly this reaction is of some importance to the animal economy. Further experimental procedures should give some clue to the function of this widespread organ system and to the fundamental importance of the lymphocyte.

Summary. Administration of purified ACT to the male rat produces by its action on the

adrenal cortex a striking reduction in the weight and size of the thymus gland and the cervical lymph nodes. This same effect is not manifest in the adrenalectomized animal. This finding furnishes further evidence for the existence of a definite relationship between adrenal cortex and thymus and lymph nodes. Functional interpretation of this relationship awaits further experimental and clinical study.

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Age as a Factor in Susceptibility of Mice to the Endotoxin of Bacillary Dysentery.

PAUL A. ZAHL, S. H. HUTNER, AND F. S. COOPER.

From the Haskins Laboratories, New York City.

As a part of a series of studies dealing with the effects of bacterial toxins on mice,¹⁻⁵ experiments were set up to ascertain the susceptibility exhibited by mice of different ages, and therefore, of different body weights, to a specific endotoxin. The toxic material used in these experiments was obtained from the cell bodies of *Shigella paradysenteriae* Flexner by methods previously described.⁵

Three age-weight groups of normal male Rockland mice were chosen for the tests, and comprised 12-, 20-, and 35-g mice with ages of approximately 25, 50, and 350 days, respectively.* Survival curves were obtained by injecting the endotoxin in dosages ranging from the minimal effective killing level to that causing death in nearly all the mice. All injections were of aqueous solutions by the

intraperitoneal route. Survivors were counted at the end of a 24-hour interval, experience indicating this to be an adequate period. The data from two duplicate experiments are presented graphically.

In Fig. 1 the experimental data are presented as percent survival against dosage expressed in the usual terms of grams of toxin per kilogram of body weight. The curves indicate different susceptibilities for animals of the 3 age-weight groups. This difference may be interpreted as meaning that the 35-g mice, at the 50% survival level, are about 3 times more sensitive to the lethal action of the toxin than are the 10-g mice, and somewhat less than twice as sensitive as the 20-g. It would be assumed from such an interpretation that the aging process in mice involves an increasing sensitivity to the endotoxin.

A more plausible interpretation of this type of toxication becomes apparent if percent survival is plotted against the absolute dose required to kill (Fig. 2). The curves obtained when the data are plotted in this manner appear to be almost superimposable within the limits of experimental error. This suggests that the toxic material in causing death in the mouse acts by disabling a single physiological system, and that this unit injury is to a system which is substantially independent of age or normal body weight for the range tested.

¹ Zahl, Paul A., Hutner, S. H., Spitz, S., Sugiura, K., and Cooper, F. S., *Am. J. Hyg.*, 1942, **36**, 224.

² Zahl, Paul A., and Hutner, S. H., *Proc. Soc. Exp. Biol. and Med.*, 1942, **51**, 285.

³ Zahl, Paul A., and Hutner, S. H., *Proc. Soc. Exp. Biol. and Med.*, 1943, **52**, 116.

⁴ Hutner, S. H., and Zahl, Paul A., *Proc. Soc. Exp. Biol. and Med.*, 1943, **52**, 364.

⁵ Zahl, Paul A., Hutner, S. H., and Cooper, F. S., *Proc. Soc. Exp. Biol. and Med.*, 1943, in press.

* The mice used in these experiments were of a standardized inbred strain tested at regular intervals for freedom from bacterial infections.