Adrenal Responses of California Quail Subjected to Various Physiologic Stimuli.* (24509)

DON DAMIAN FLICKINGER† (Introduced by Howard A. Bern)
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The well established pituitary-adrenal relationship in mammals is still poorly defined in birds(1). There are indications that the avian pituitary-adrenal axis may not be, in every sense, the physiologic equivalent of its mammalian counterpart. Several workers have noted the relative refractoriness of the avian adrenal(2,3,4) and have suggested that a certain degree of autonomy may be characteristic of the bird adrenal (interrenal) gland. The purpose of our experiments was to determine, using both wild and pen-raised California valley quail, the adrenal responses elicited by factors known to result in alteration of the adrenal cortex in laboratory mammals.

Materials and methods. A total of 67 California valley quail, *Lophortyx californica,* was used. Of these, 32 were wild birds and 35 were pen-raised. Birds were placed, 2/cage, in wire cages measuring 22″ x 14″ x 12″. Generally, a male and female were placed together. With the exception of uncaged control birds, each group of quail was caged 7 days. Then birds were aged, weighed to nearest gram (subsequently corrected for weight of food in the crop), decapitated, and thyroids, adrenals and spleen removed and fixed in 10% neutral formalin. Coloration of primary coverts was used as criterion for aging (5). Adrenals were cleaned of connective tissues, and weighed out of formalin on a 0-50 mg Roller-Smith balance.

Wild and pen-raised birds were divided into 5 main groups, each totalling about a dozen quail. These groups were (1) controls (taken directly from field or game farm and killed immediately), (2) caged controls (caged and sham-injected), (3) cold-treated, (4) cortisol-treated, and (5) ACTH-treated. Wild and pen-raised components of one experiment were not run simultaneously, but as near the same time as possible. Caged control birds were sham-injected with 0.2 ml of 0.9% saline/day for 7 days. All injections were intramuscular. Cold-treated birds were maintained at 40°F for 7 days. Cortisol-treated birds were injected with 1 mg of cortisol acetate in 0.2 ml saline daily for 7 days. ACTH-treated birds were injected with 1 unit of Upjohn Corticotropin in 0.2 ml 16% gelatin-1% thymol solution daily for 7 days. Dosages chosen would be expected to induce adrenal changes in laboratory mice, if given proportionately to body weight (Bern and Nandi, personal communication). Left adrenals, with exception of some birds which died, were embedded in paraffin, sectioned at 8 μ and stained with hematoxylin and eosin. For each sectioned adrenal, 50 measurements of width of interrenal cords were made with ocular micrometer (at 400 x) and average cord width computed.

Results. Weights of individual adrenals revealed no consistent difference between left and right glands. No consistent sex difference in combined adrenal weight or adrenal weight/body weight ratio (AW/BW) was found, nor was any definite evidence for seasonal changes found. Histologic examination of the quail adrenal revealed that groups of chromaffin cells are scattered throughout the interrenal tissue. These islands of chromaffin cells vary in size and shape not only in different areas of same gland, but also from gland to gland. Interrenal tissue is arranged in cords generally 2 cells thick, that loop and branch throughout the entire gland.

The pen-raised caged control group had a mean combined adrenal weight and mean AW/BW ratio significantly greater than wild caged control group. The mean AW/BW ratio of the pen-raised ACTH-treated group was significantly higher (at 1% level) than that

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TABLE I. Adrenal Weight and Histometric Data for Pen-raised and Wild California Quail.

Treatment	No. of quail	Adrenal wt (l + r) in mg	Adrenal wt, mg / Final body wt, g	Interrenal cord width, μ
Pen-raised				
Uncaged control	6*	11.6 ± 1.2	.069 ±.009	26.7 ± .8
Caged control	11	17.7 ± 1.1‡	.116 ±.003‡	29.4 ± .4‡
Cold	6	15.2 ± 1.0	.095 ±.007§	27.2 ±1.0
Cortisol†	3	13.2 ± 1.2§	.091 ±.015	27.0
ACTH	6	19.0 ± 1.2	.140 ±.011§	28.6 ± .8
Wild				
Uncaged control	6	15.8 ± 1.5	.087 ±.006	28.4 ± .8
Caged control	8	14.3 ± .8	.090 ±.008	29.0 ±1.1
Cold	5	13.7 ± .2	.086 ±.003	28.6 ± .6
Cortisol†	4	11.4 ± 1.4	.088 ±.008	25.5
ACTH	5	16.7 ± .9	.102 ±.001	29.9 ± .4

* Weight data from 1 bird excluded because adrenals were partially fused.
† Included some animals that died during experiment, but received at least 5 cortisol inj.
‡ Significantly different from respective uncaged controls at 1% level of confidence.
§ *Idem* caged 5%

of wild ACTH-treated birds (Table I). Adrenal data from all caged control birds were compared with those from all cortisol-treated birds. No significant difference in mean AW/BW ratios was found, but cortisol-treated birds had a significantly smaller mean combined adrenal weight and mean cord width. Comparing combined adrenal data from all caged controls with those from all ACTH-treated quail, no significant differences were seen between mean values. To test the significance of the difference between the 2 possible extremes in the experimental series, data from all ACTH-treated birds were compared with those from all cortisol-treated birds. The mean AW/BW ratio, mean combined adrenal weight, and mean cord width were greater in ACTH-treated birds, the differences being significant at the 5%, 1%, and 5% levels respectively.

Spleen weights and spleen weight/body weight ratios (SW/BW) were so highly variable that no attempt was made to treat the data statistically. No consistent or significant difference was found between the SW/BW ratios of pen-raised and wild groups. In addition, the mean epithelial height of thyroid follicles from wild and pen-raised cold-treated quail was not found to vary significantly from those of the respective caged control birds.

Discussion. There is evidence that the avian adrenal cortex possesses some activity independent of pituitary control(2,3). Recent work(4) on domestic chickens indicates that hormones secreted by the bird adrenal elicit responses similar to those in the mammal. However, it was believed that the bird adrenal may be relatively autonomous and that it may function at a relatively high level even in the absence of the anterior pituitary.

Various treatments to which our quail were exposed are known to elicit definite changes in adrenals of laboratory mammals. The main limitation of this study involves the comparatively small number of birds used. Nevertheless, the lack of consistent differences between experimental and control groups, particularly in the case of cortisol-treated birds, and the failure of cold treatment to activate the adrenal, indicate that the mechanisms involved here may differ somewhat from those known to operate in mammals. It is concluded that these treatments did not provide sufficiently intense stimuli to cause comparable pituitary-adrenal activation. Several investigators have demonstrated direct relationship between cold environmental temperatures and thyroid activation(6,7,8,9). However, in the quail, cold treatment (7 days at 40°F) was again not a sufficiently intense stimulus to cause pituitary-thyroid activation.

Summary. Adrenal responses of pen-raised and wild California valley quail subjected to caging, cold, cortisol, and ACTH

treatments have been studied and compared. Groups of pen-raised and wild birds showed no consistent nor significant differences in either adrenal weight or histometry. Spleen weights were highly variable. No histologic evidence of thyroid activation was seen in birds subjected to cold. Experimental treatments, potentially capable of causing marked adrenal responses in common laboratory mammals, were relatively ineffectual in eliciting adrenal response in the quail. It is suggested that the adrenal, and possibly the thyroid, may be comparatively non-reactive in quail as compared with laboratory mammals.

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Mating Types of *Paramecium bursaria* from Japan.* (24510)

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Paramecium bursaria is known to include 6 varieties(1,2,3). These varieties may differ greatly in geographical distribution; some are widely distributed, others are relatively restricted. Variety III, for example, is highly restricted; during many years of collecting in this country, this variety has been found in only 3 localities, 2 in North Carolina, one in Massachusetts(1). Varieties VI and I, on the other hand, are widely distributed. Variety VI has been found in England, Ireland and Czechoslovakia; and Variety I in many parts of United States, China(4), and as reported here, apparently in Japan also. Members of any one of these 6 varieties do not, as a rule, mate with members of any of the other varieties. Within each variety, animals of diverse mating types conjugate readily; animals of the same mating type do not conjugate. Variety I, found in the United States and China, and apparently Japan, contains 4 mating types designated A, B, C, and D. Variety II, found in United States, contains 8 mating types, designated E, F, G, H, J, K, L, and M. Variety III, also found in United States, contains 4 mating types designated N, O, P, and Q. Varieties IV and V were found in Russia. Variety IV is known to have 2 mating types, designated R and S. Only one mating type (mating type T) has so far been found in Variety V. Further collections from Russia would probably yield other mating types in this variety. Variety VI, in Czechoslovakia, England and Ireland, is known to contain 4 mating types designated U, V, W, and X. Thus, there are now known in this species of Paramecium 6 varieties containing 23 mating types. Reported here are results of investigation on *P. bursaria* collected in Japan. The material included the following collections: Two, one from Kyoto, the other from Tokyo, sent by Dr. Shozo Inoki of Osaka Univ., Osaka, in Feb. 1953; these 2 collections yielded 16 clones. A collection sent by Dr. Toshiko Watanabe of Ashiya

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