COMPARATIVE SURVEY OF THE ANAL GLANDS OF BIRDS

W. B. QUAY

GLANDS of the skin or integument of birds are frequently assumed to be limited to the uropygeal glands (Pycraft, 1910; Grassé, 1950; and others). Nevertheless, if one includes with integument those areas that are histologically skin-like but form unions with mucous membranes or deeper structures, additional glands must be considered. One set of these little-known glands is that found in the integument around the anal opening (Greschik, 1914) and along the anal canal. These anal glands are external with respect to the cloacal chambers and the truly cloacal glands of the cloacal walls, but they have been lumped with the cloacal glands in some of the previous articles mentioning them. The comparative histological survey presented here serves to show that avian anal glands comprise a well defined glandular category of wide taxonomic distribution. At the same time, there are evident distributional and structural characteristics or peculiarities in certain species, suggesting the merit of more detailed study of the glands within particular systematic assemblages of birds.

MATERIALS AND METHODS

Anal-cloacal tissue blocks were taken from specimens either preserved in fluids in museum collections or by the author. Adequate material for detailed microscopic study was obtained from 86 specimens, representing 72 species and 42 families of birds (Table 1). The classification of these specimens follows Storer (1960) for the major groups and Peters (1931–1951) in most instances for the arrangement of genera and species. Serial paraffin tissue sections, 7 microns in thickness, were cut in planes parallel to the sagittal plane of each bird. Most of the slides containing the sections were stained with Ehrlich's acid alum hematoxylin and eosin Y, but occasional or alternate slides from each specimen were stained by the following techniques: periodic acid-Schiff technique with hematoxylin (Lillie, 1954); alcian blue method for acid mucopolysaccharides (Pearse, 1960); oil red O for lipids (Lillie, 1954); DMAB-nitrite method for proteins containing tryptophan (Pearse, 1960); and Perl's method for ferric iron (Pearse, 1960).

RESULTS

General characteristics.—The anal glands of all of the specimens had certain features in common: (1) They were always associated with, and secreted onto the surface of, the relatively thick stratified squamous epithelium of the anal canal or anal region. In some species the epithelium was well keratinized, but in none were the glands ever found in an area where feathers were present also. Where the glands were outside of the anal opening they were in areas of naked or featherless skin. (2) The secretory portions of the glands were always in the form of either simple

Figure 1. Parasagittal section of the cloaca and anus of the Red-winged Blackbird (*Agelaius phoeniceus*). Hematoxylin and eosin. For abbreviations see key on p. 385.

Figure 2. Parasagittal section of the cloaca and anus of a House Sparrow (*Passer domesticus*) showing anal eversion and external position of the anal glands. Hematoxylin and eosin.

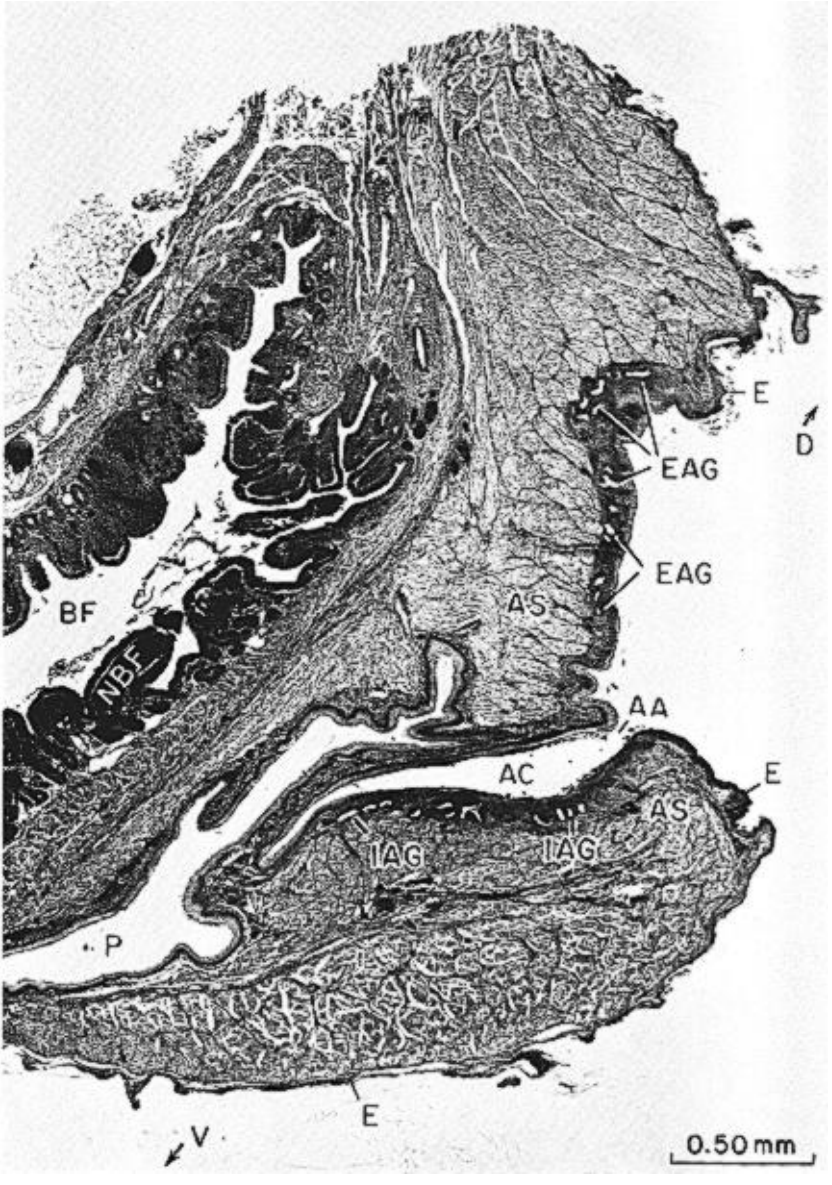


Figure 3. Parasagittal section of the cloaca and anus of a House Sparrow (*Passer domesticus*) showing mixed dorsal external and ventral internal positions of the anal glands. Hematoxylin and eosin. For abbreviations see key on p. 385.

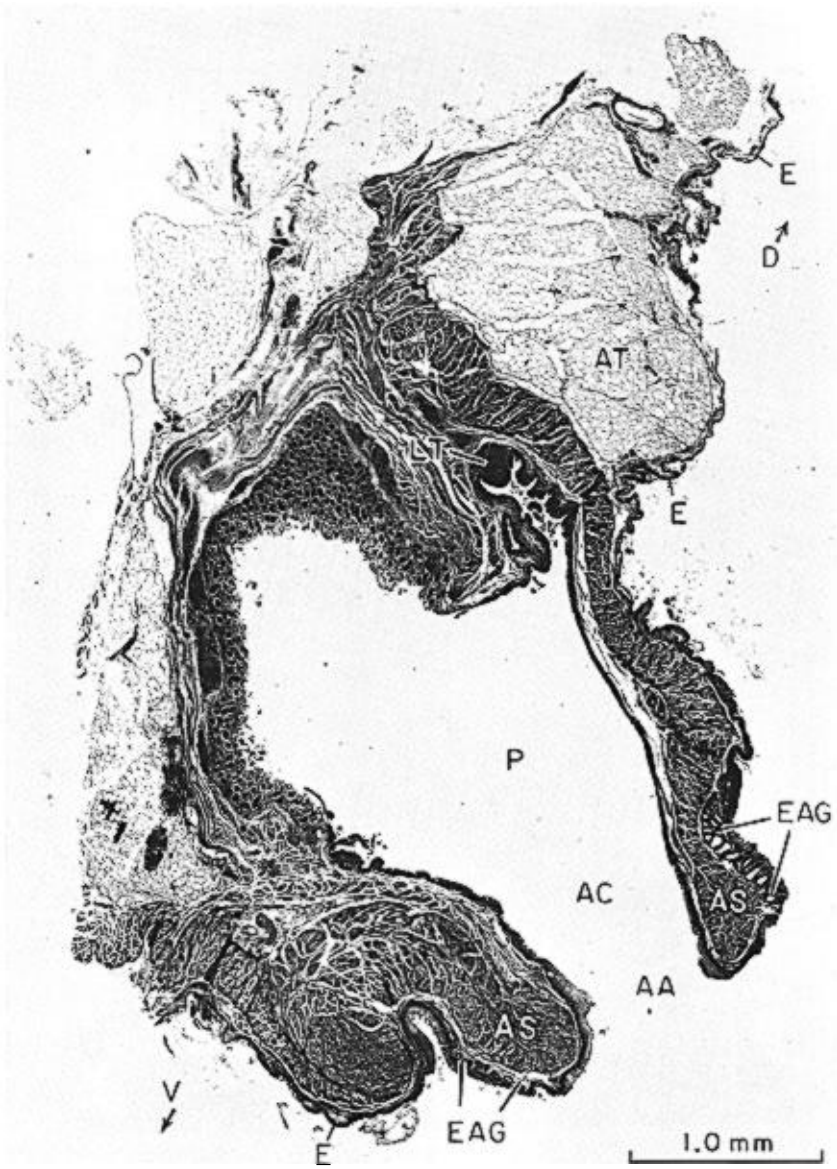


Figure 4. Parasagittal section of the cloaca and anus of a Western Sandpiper (*Ereunetes mauri*) showing external positions for both dorsal and ventral anal glands. Hematoxylin and eosin.

TABLE 1

SPECIES EXAMINED AND RELATIVE SIZE OF EXTERNAL (EAG) AND INTERNAL (IAG) ANAL GLANDS[1]

Classification	*N*	*Age*	*EAG*	*IAG*
Tinamidae				
Crypturellus sp.	1	A	0	++
Tinamotis pentlandi	1	SA	+	+
Podicipedidae				
Podiceps caspicus	1	A	+	+
Aechmophorus occidentalis	1	Y	0	0
Centropelma micropterum	1	A	0	+
Podilymbus podiceps	1	Y	0	0
Hydrobatidae				
Oceanodroma homochroa	1	A	0	++
Pelecanidae				
Pelecanus erythrorhynchos	1	Y	0	0
Phalacrocoracidae				
Phalacrocorax auritus	1	Y	0	0
Phalacrocorax penicillatus	1	Y	0	++
Ardeidae				
Nycticorax nycticorax	2	Y & SA	0	++
Anatidae				
Anas acuta	1	Y	0	0
Aix sponsa	1	Y	0	0
Clangula hyemalis	1	Y	0	0
Melanitta perspicillata	1	A	0	0
Cathartidae				
Cathartes aura	1	–	0	0
Accipitridae				
Elanus leucurus	1	SA	0	0
Accipiter cooperii	1	A	0	+
Buteo swainsoni	1	A	0	++
Opisthocomidae				
Opisthocomus hoazin	1	–	0	++
Cracidae				
Ortalis sp.	1	A	0	+
Phasianidae				
Lophortyx californicus	1	–	0	0
Hierophasis swinhoii	1	Y	0	0
Polyplectron emphanum	1	Y	0	0
Haematopodidae				
Haematopus bachmani	1	A	++	++
Charadriidae				
Arenaria melanocephala	1	A	++	++
Scolopacidae				
Limnodromus griseus	1	A♂	0	+++
	1	A♀	+++	0
Ereunetes mauri	1	A♀	++	0
Laridae				
Larus occidentalis	2	A & SA	0	++
Alcidae				
Uria aalge	1	A	+	+
Columbidae				
Columba livia	1	A♂	0	++++
Nesopelia galapagoensis	1	A	0	+++
Columbigallina passerina	1	SA	0	++++
Columbigallina talpacoti	1	A	0	++
Columbigallina minuta	1	A	0	++++
Oena capensis	1	A	0	++++
Phaps elegans	1	SA	0	+++
Geotrygon frenata	1	A	0	++++
Psittacidae				
Forpus conspicillatus	1	A♂	0	0
Cuculidae				
Crotophaga sp.	1	A	0	+++++
Strigidae				
Otus asio	1	A	0	+
Speotyto cunicularia	1	A	+	+
Caprimulgidae				
Phalaenoptilus nuttallii	1	A	0	++
Apodidae				
Chaetura vauxi	1	A	0	++
Trochilidae				
Calypte anna	1	A♂	0	++
Dendrocolaptidae				
Xiphorynchus picus	1	A	+	0
Xiphocolaptes promeropirhynchus	1	A	0	++
Furnariidae				
Xenops rutilans	1	A	0	++
Formicariidae				
Thamnophilus doliatus	1	A	0	++
Cotingidae				
Pipreola riefferii	1	A	0	++
Pachyramphus polychopterus	1	A	0	++
Pipridae				
Manacus vitellinus	1	A	0	++
Tyrannidae				
Myiodynastes maculatus	1	A	++	0
Nuttallornis borealis	1	A	+	0
Hirundinidae				
Hirundo rustica	1	Y	0	+
Pycnonotidae				
Pycnonotus finlaysoni	1	A	0	++
Hypsipetes propinquus	1	A	++	++
Oriolidae				
Sphecotheres sp.	1	SA	0	++

[1] N = number of specimens examined histologically. 0 = anal glands absent. + to +++++ = relative size of the anal glands, from small sacs to large masses consisting of confluent sacs and tubules. Ages = adult (A), subadult (SA), and young (Y).

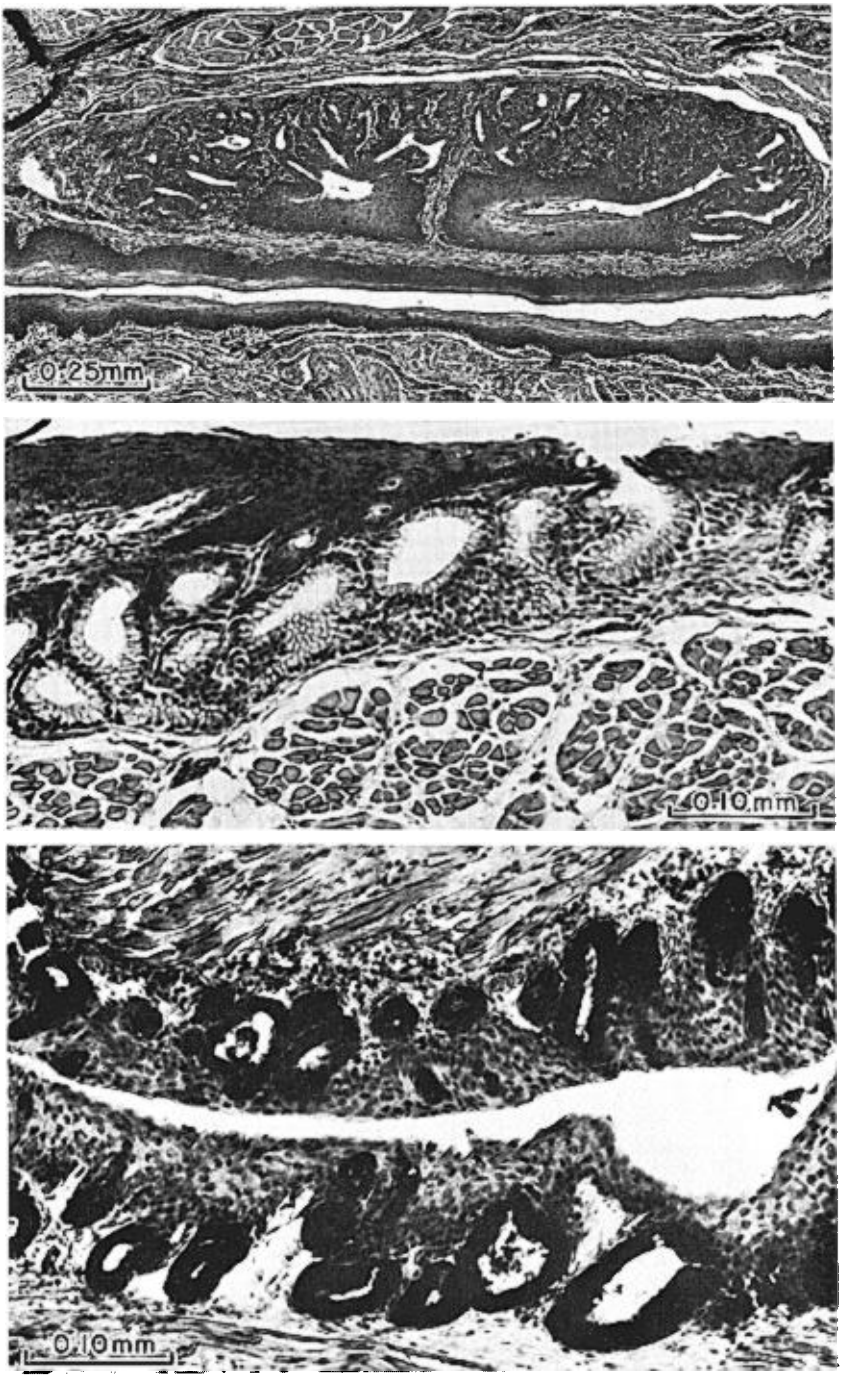
TABLE 1 (*Continued*)

Classification	*N*	*Age*	*EAG*	*IAG*
Corvidae				
Corvus brachyrhynchos	1	A	0	++
Gymnorhinus cyanocephalus	3	Y & SA	0	0 to +
Timaliidae				
Chamaea fasciata	1	A	++	++
Turdidae				
Ixoreus naevius	2	A	0	+++
Troglodytidae				
Campylorhynchus rufinucha	2	Y & A	0	++ to +++
Leucolepis thoracica	1	A	0	++++
Cinclidae				
Cinclus mexicanus	1	A	0	++
Nectariniidae				
Arachnothera longirostra	1	A	0	++
Meliphagidae				
Myzomela sp.	1	SA	0	++
Ploceidae				
Passer domesticus	2	A♂	0	++
	1	A♂	++	++
	2	A♂	++	0
	3	A♀	++	0
Icteridae				
Agelaius phoeniceus	1	A♂	0	++
Emberizidae				
Camarhynchus sp.	1	A	+	0
Pipilo erythrophthalmus	1	A	0	++
Melospiza melodia	1	A	+	0

KEY TO ABBREVIATIONS USED IN FIGURES

AA = anal aperture	IAG = internal anal glands
AC = anal canal	J = junction of stratified squamous and columnar epithelium
AS = anal sphincters (skeletal muscle)	LCT = loose areolar connective tissue
AT = adipose (fat) tissue	LT = lymphoid tissue
BF = bursa of Fabricius	NBF = lymphoid nodules of the bursa Fabricii
D = dorsad	P = inner part of proctodeum
E = epidermis	V = ventrad
EAG = external anal glands	

or branched sacs or tubules of simple, columnar secretory epithelial cells. The simple or multiple saccular units attached directly to the overlying epithelium without any intervening duct or nonsecretory tubule. At each attachment site of a gland unit to epithelium, an open channel between the overlying epithelial cells served as the passage of egress for the secretion. (3) The relative number and size of the glands were usually about the same in the dorsal and ventral walls and regions. (4) The precise position of the glands along the anal canal, and indeed, whether they were external or internal, appeared to vary in large measure according to the relative degree of dilation and eversion of the anus at the time of death and fixation. The most typical, and contracted, pattern is that shown in Figure 1. Within the series of House Sparrows, *Passer domesticus*, studied, all from the same locality at the same time of the year, are individuals with the anal glands external, at least partly as a result of edema or anal eversion (Figure 2). Other individuals of the series had anal glands either wholly or in part (Figure 3) restricted to the anal canal (see also the list in Table 1 for *Passer domesticus*). Another example of external anal glands


0.25mm
0.10mm
0.10mm

is shown in Figure 4, in which the proctodeal-anal canal is dilated. Figures 1 through 4 may serve to demonstrate also the anatomical relations of the anal glands with respect to the anal skeletal muscle sphincter (AS), the proctodeum (P), and the bursa of Fabricius (BF).

Development.—Within the series of examined species (Table 1) there are several for which young as well as adults were present. It was evident in these that the anal glands developed somewhat later than the uropygeal and the cloacal glands in the same species. In the very young chicks the anal glands were either absent or manifest only as solid cords of epithelial cells. Complete or even adequate description of the development of the glands must await series of specimens of known ages of selected species. The probability of anal glandular growth and activity being augmented further in adults, as a result of sexual or other hormonal control, can not be evaluated without additional specimens and experimental studies. It can be noted, however, that among the eight *Passer domesticus* studied no consistent sexual differences in anal gland size or activity were seen. However, these birds were all taken from mid-January to mid-February in Michigan, so the possibility that sexual differences occur at some other season, or in some other species, is not ruled out.

Taxonomic distribution and specialization.—Table 1 suffices to show that the anal glands occur in most, but perhaps not all, groups of birds. The tentative suggestion of their absence in ducks (Anatidae) and certain other families should be investigated further. The tabulated relative sizes of the glands in the different species may be possibly at least partially a function of age, sex, and physiological state. Of more significance in taxonomic differentiation at this stage of our knowledge are structural and staining differences in the glands. Thus, of all of the specimens that of the ani (*Crotophaga*) is unique in having all of the anal glandular tissue consolidated in a mass ventral to the anal canal and with gland units confluent within this mass, somewhat as in the uropygeal gland of many birds. Slight trends toward glandular consolidation are seen in a few other species, such as the Black Oystercatcher (*Haematopus bachmani*) (Figure 5, top). A fairly sharp distinction between taxonomic groups is also seen in regard to staining of the secretory cells and their secretions. Although the glands of all of the birds are in some degree positive with the periodic acid-Schiff technique, those of some species are acidophilic or weakly stained after formalin fixation (Figure 5, middle) and those of other species are strongly

---

←

Figure 5. Top, glands of the anal canal in *Haematopus bachmani*; middle, typical area of anal glands from *Pycnonotus finlaysoni*; bottom, typical area of anal glands from *Pipreola reifferii*. All were identically treated with hematoxylin and eosin.

basophilic (Figure 5, bottom). The latter type probably produces a less soluble and more acidic mucous secretion than the former. The latter type also is stained most strongly by alcian blue. This last staining method was the most selective one for the anal glands and furthermore demonstrated a number of structural and cytological differences between the glands of the cloacal chambers and those of the anal canal. Review and comparison of the gland types of the cloacal chambers must be deferred at this time. The special staining techniques for insoluble lipids, tryptophan-containing proteins, and ferric iron did not reveal any notably reactive contents of the anal glands, although expected positive staining reactions occurred in certain of the other tissues in the same sections.

DISCUSSION

The earliest clear description that I have been able to find of the anal glands of any bird is that by Greschik (1914), concerning the European "Saatkrähe" or Rook (*Corvus frugilegus*). His description for this species matches well what I have observed in the North American Common Crow (*Corvus brachyrhynchos*) (Table 1). He categorizes the shapes of the glands as being tubular or bulbous and the gland cells as being mucus-producing. Clara's (1925) diagram of the "schleimdrüsen" of the avian anal region was based on a young dove. Again, present observations confirm the anatomical relations diagramed in the earlier report. However, during recent years two circumstances may have served to confuse the situation. First, anal and cloacal glands have by implication, if not by purpose, been lumped together by some authors. Second, anal glands were apparently not found in detailed histological studies of the alimentary and reproductive tracts of domestic fowl (*Gallus domesticus*) (Calhoun, 1933; Lake, 1957). Calhoun's (1933) published photomicrograph of the anal canal of the chicken shows no sign of such glands. On the other hand, the Eurasian or Japanese quail (*Coturnix coturnix*) has a very large gland in the cloacal-anal region (Coil and Wetherbee, 1959). Although these authors describe its position as being in the "dorsal lip of the cloaca," the structural, cytological, and cytochemical features that they provide suggest that it is a member of the anal gland series and not a gland of the cloacal chambers or wall proper. Coil and Wetherbee (1959) found a correlation of hypertrophy of this gland with enlarged testes as well as a high level of sexual activity. The mucoid secretion was observed to form a "meringue-like froth" which was suggested as being associated with the mechanics of internal fertilization. The functional significance of these anal glands, both in their more usual and less overt form and in their more egregious formations, as in *Coturnix* and *Crotophaga,* remain to be investigated.

ACKNOWLEDGMENTS

I am grateful to the late Alden H. Miller, Peter L. Ames, and Robert T. Orr for use of certain specimens in their care and to Richard Holmes, Ned Johnson, Don Medina, and Aristeo Renzoni for aid in the obtaining of additional material. Acknowledged with sincere thanks also is the patient laboratory assistance of Carol Pearson, Scott Manders, and George Lewbel.

SUMMARY

The occurrences and characteristics of anal glands in birds were appraised by the study of serial histological sections of the anal-cloacal region from 86 specimens, representing 72 species and 42 families. These glands were found in most but not all groups of birds, and revealed differences in organization, structure, and staining which warrant further study. The glands appeared to have always originated from, and to secrete onto, stratified squamous epithelium, which was sometimes keratinized, and variably external or internal in relation to the anal opening. The secretory cells and their products were well stained by the periodic acid-Schiff and the alcian blue techniques and were of the mucus-secreting type. The function(s) of the glands remain unknown although significance in the mechanics of internal fertilization in one species has been suggested.

LITERATURE CITED

CALHOUN, M. L. 1933. The microscopic anatomy of the digestive tract of *Gallus domesticus*. Iowa State Coll. J. Sci., **7**: 261–381.

CLARA, M. 1925. Beiträge zur Kenntnis des Vogeldarmes. I. Teil. Mikroskopische Anatomie. Zeit. für Mikroskopisch-Anat. Forsch., **4**: 346–416.

COIL, W. H., AND D. K. WETHERBEE. 1959. Observations on the cloacal gland of the Eurasian quail, *Coturnix coturnix*. Ohio J. Sci., **59**: 268–270.

GRASSÉ, P. 1950. La glande uropygienne. Pp. 285–289 *in* Traité de Zoologie, vol. 15 (P. Grassé, ed.). Paris, Masson et Cie.

GRESCHIK, E. 1914. Histologie des Darmkanales der Saatkrähe (*Corvus frugilegus* L.). Aquila, **21**: 121–136.

LAKE, P. E. 1957. The male reproductive tract of the fowl. J. Anat. (London), **91**: 116–129.

LILLIE, R. D. 1954. Histopathologic technic and practical histochemistry. New York, Blakiston Co.

PEARSE, A. G. E. 1960. Histochemistry, theoretical and applied. 2nd edit. London, Churchill.

PETERS, J. L. 1931–1951. Check-list of birds of the world. Cambridge, Massachusetts, Harvard Univ. Press.

PYCRAFT, W. P. 1910. A history of birds. London, Methuen and Co.

STORER, R. W. 1960. The classification of birds. Pp. 57–93 *in* Biology and comparative physiology of birds, vol. 1 (A. J. Marshall, ed.). New York, Academic Press.

Department of Zoology, University of California, Berkeley, California.