

ON CERTAIN SECONDARY SEXUAL CHARACTERS IN THE  
MALE RUDDY DUCK, *ERISMATURA JAMAICENSIS*  
(GMELIN).

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Among recorded peculiarities of the ruddy duck (*Erismatura jamaicensis*) the lack of an enlargement at the bronchial bifurcation of the trachea in the male has been most noteworthy. The absence of this *bullæ ossea* is the more striking as such an ampulla is developed with comparatively few exceptions among all of the river and sea ducks. MacGillivray,<sup>1</sup> apparently the only ornithotomist to examine and describe the trachea in the ruddy duck, first noted this peculiarity. Forbes found that a *bullæ ossea* was lacking also in the male of the Australian duck, *Biziura lobata*, and in his discussion of this fact calls attention<sup>2</sup> to MacGillivray's note on *Erismatura*. Later Beddard<sup>3</sup> noted that males of *Oidemia nigra* and *Oidemia fusca* also lack this modification of the syrinx but did not give full enough credence to MacGillivray's account to include *Erismatura* in the same category unreservedly. In dissections of *Erismatura jamaicensis* made recently I have verified MacGillivray's observations of eighty or more years ago and have found in addition a remarkable secondary sexual structure that has apparently never been described.

Ornithologists who have skinned and prepared various species of ducks are familiar with the fact that in the ruddy duck the skin of the neck is full and loose, slipping easily over the occiput. In most other species of ducks it is necessary to slit the integument of the neck in skinning out the head. While examining a fresh specimen of the male ruddy duck my attention was attracted to the broad development of the paired dermal muscle (the deeper layer of the *cucullaris*) covering the ventral side of the skin of the neck. Further examination revealed a median broadening of the muscle *sterno-trachealis* and finally a remarkable tracheal air-sac which is used when males are displaying during mating. This tracheal air-sac has no connection with the pulmonary air-sacs of the body. It opens as a

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<sup>1</sup> Audubon, J. J., *Ornithological Biography*, vol. 4, 1838, p. 331.

<sup>2</sup> Forbes, W. A., *Collected Scientific Papers*, 1885, p. 355.

<sup>3</sup> Beddard, F. E., *Structure and Classification of Birds*, 1898, p. 464.

depression in the dorsal wall of the trachea immediately behind the larynx and lies between the trachea below and the esophagus above. When fully distended this air-sac like those of the pulmonary system is found to have thin transparent walls. In form it is somewhat pear-shaped, flattened ventrally and rounded dorsally. The anterior end for a space of 8 or 10 mm. is narrow, forming a slender neck which broadens abruptly into the body of the sac. In one specimen (Cat. No. 224829, U.S.N.M.), the distended sac measured 50 mm. long by 43 mm. broad. The depth was equal to the lateral measurement (43 mm.). In another (Cat. No. 224831, U.S.N.M.) the vesicle measured 65 mm. long by 32 mm. wide at the broad basal end. The diameter of the anterior extension or neck of the sac in this bird was 10 mm. In a third bird (Cat. No. 224832, U.S.N.M.) the measurements were intermediate between these two.

In dissecting these ruddy ducks I found that the paired dermal muscles (called by Gadow<sup>1</sup> the deeper layer of the muscle *cucullaris*) arise on the side of the head posterior to the orbit and pass backward converging immediately below the larynx until separated by only the space of a millimeter. The two muscles expand at once to cover entirely the loose skin of the ventral sides of the neck. They insert by two strong attachments on the furculum. For its anterior half each muscle is a single broad sheet. Posteriorly, (covering the tracheal air-sac) each divides into 20 or 22 fasciculae. While the lateral bands of each muscle are thin and weak the series of fascicles increases markedly in strength as the median line is approached. MacGillivray, in his notes on the trachea in the male ruddy duck,<sup>2</sup> remarks that the tracheal muscles are similar to those of other ducks but in this he was mistaken. The paired muscle *sterno-trachealis* is inserted as a slender band on either side of the thyroid cartilage. Passing back on reaching the anterior end of the tracheal air-sac it broadens suddenly to a width of 10 mm. The anterior edge of the expansion attaches firmly at its outer angle to the esophagus. Each muscle narrows gradually until at the posterior margin of the air-sac it is only 2 mm. wide. It is closely attached to the air-sac touching the trachea only along its internal edge. Posteriorly the entire narrowed muscle transfers rather abruptly from the air-sac to the trachea.

The depression marking the mouth of the air-sac is immediately behind the larynx on the dorsal surface of the trachea (fig. 1, *d*). Its sides are abrupt and it is broad anteriorly, somewhat constricted medially, and truncated posteriorly. From its posterior end leads the canal for the passage of air. In one specimen examined four of the anterior tracheal rings are interrupted over the opening of the canal; in another these rings are entire.

<sup>1</sup> Gadow, Hans, Bronn's Klassen und Ordnungen des Thier-Reichs. Vögel, vol. 1, 1891, p. 215.

<sup>2</sup> Aduhon, J. J., Ornithological Biography, vol. 4, 1838, p. 331.

The internal structure of the larynx in the male ruddy duck is peculiar. Behind the rima glottidis (fig. 1, *b*) on either side is an elongate cushion of connective tissue from which a somewhat triangular elevation projects into the cavity of the larynx (fig. 1, *c*). These pads may be called the *pulvini laryngis*. In addition there is a flap of connective tissue developed along the median line of the thyroid cartilage for the length of the larynx. This flap is between 4 and 5 mm. high and is bent over toward the left side. It is not mentioned certainly in anatomies save by Sir Richard Owen<sup>1</sup> who speaks of finding it in "the Pelican, the Gigantic Crane, and most of the Rasores." I have called it the *ligula laryngis*. Apparently it has the same function as the mammalian epiglottis. From a study of the larynx in fresh birds I believe the probable mechanics of inflating the tracheal air-sac to be as follows: The male ruddy duck about to display fills the air-sacs of the pulmonary series with air. The rima glottidis is then closed by the action of muscles controlling the arytenoid cartilages. This brings the points of connective tissue (*pulvini laryngis*) in the larynx together and these with the *ligula* close the larynx save behind. With the sterno-tracheal and cucullaris muscles relaxed a slight contraction of the respiratory muscles would inflate the tracheal air-sac. Though no sphincter muscle is present, contraction at the anterior attachment of the *sterno-tracheales* may close the aperture of the air-sac by pressing the esophagus against it. The release of this pressure and contraction of the broad dermal muscle would serve to deflate the sac.

The tracheal air-sac is absent in females. The deeper layer of the muscle *cucullaris* too is less in bulk than in males and the *sterno-trachealis* shows no unusual broadening. In a young male about 10 days old, however, a tracheal sac was present that measured when inflated 18 mm. long by 15 mm. wide (Cat. No. 224830, U.S.N.M.). It was placed as in the adult male. From examining this bird it was apparent that the sac grows by backward expansion from the opening in the trachea. The development of the *sterno-trachealis* muscle in the young bird was extraordinary. It spread over the entire ventral surface of the sac, covering it completely.

Adult males that were seen in display swam about with swelling breast and neck drawn in, turning or alternately advancing and retreating before the females. At short intervals the head was

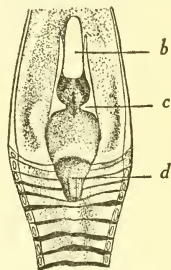


FIG. 1.—LONGITUDINAL SECTION OF LARYNX OF MALE RUDDY DUCK FROM BELOW (X2). *b*, RIMA GLOTTIDIS. *c*, PULVINUS LARYNGIS, *d*, MOUTH OF AIR-SAC.

<sup>1</sup> Owen, Richard, Comparative Anatomy and Physiology of Vertebrates, vol. 2, 1866, p. 219.

extended with a series of short jerks as the male called *tick-tick-tickity quo-ack*. At the last note the bill opened widely and the head was thrown forward, and then immediately withdrawn to the first position, when the display continued as before.

There is little question that similar air-sacs will be found upon examination in other species of the genus *Erismatura* as recognized at present. Kerr<sup>1</sup> in describing the courtship of *E. vittata* (witnessed near Buenos Aires, Argentina) says that at one stage the male "stretches out his neck on the surface of the water right in front of him, and then ruffles up the feathers of his neck and *inflates his crop* [*italics mine*] until his neck seems to disappear altogether." And Bennett<sup>2</sup> writing on *E. australis* says that this species has habits identical with those of *E. vittata* as described by Kerr<sup>2</sup> "even to the peculiar manner of courtship adopted by the male bird." From examination of study skins of males of other species of ducks in the collections of the United States National Museum, that are placed now in the anatine subfamily *Erismaturinae*, it is expected that tracheal air-sacs similar to that described in the male ruddy duck may be found. The additional species seen are:

*Thalassornis leuconotus* (Smith).

*Thalassornis insularis* Richmond (female only seen).

*Nomonyx dominicus* (Linnaeus).

*Erismatura leucocephala* (Scopoli).

*Erismatura ferruginea* Eyton.

All these species have the skin of the neck full and loose so that in no case was there a slit made around the head by the collectors who prepared the birds. In addition the skin on the necks of these birds beneath the feathers is thick and leathery to the touch as though underlaid by heavy dermal muscle.

It is worthy of note that in the species of ducks at present known to have no dilation of the syrinx in the males some other peculiarity of the trachea or mouth is present. According to Forbes<sup>3</sup> in *Biziura lobata* there is a small distensible sac contained in a loose gular fold of skin with its opening in the mouth anterior to the *fraenum linguae*. In *Oidemia nigra* the trachea and the bronchi of the male are both somewhat dilated. *Oidemia fusca* has a remarkable swelling below the larynx containing a separate chamber communicating by two slits with the trachea. The peculiarities of *Erismatura jamaicensis* are described in this paper.

<sup>1</sup> Kerr, J. G., Extracts from letters of, *Ibis*, 1890, p. 360.

<sup>2</sup> Bennett, K. H., Letter from, *Ibis*, 1891, p. 143.

<sup>3</sup> Forbes, W. A., Collected Scientific Papers, 1885, pp. 355-356.