MORPHOLOGY OF THE SYRINX AND SYRINGEAL MUSCLES

Judith Traul Jones

Submitted in partial fulfillment of
the requirements for the degree of
Master of Arts

BOWLING GREEN STATE UNIVERSITY

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MORPHOLOGY OF THE SYRINX AND SYRINGEAL MUSCLES

Introduction. The syrinx is the sound producing mechanism of birds found at or near that point where the trachea divides to form the bronchi. Generally, the syrinx is situated at this division and involves the last three tracheal rings as well as the intermediary bars or bronchial bars. However, the syrinx may be located well up on the trachea (e.g., in the ovenbirds, Furnariidae), or it may be bronchial (in the Oil-bird, Steatornis) with a syrinx in each bronchus (Pettingill, 1956).

The muscles of the syrinx may be divided into extrinsic and intrinsic muscles. The extrinsic muscles are those which have one attachment to a non-tracheal structure. The intrinsic muscles arise and insert on some part of the tracheal system, including the trachea and the intermediary or bronchial bars of the syrinx. Various studies have been made on the number and form of these intrinsic muscles, and this tracheal musculature has been used as a basis for classification, especially in the passerines (Marshall, 1960). Miskimen (1951) suggested that the number of muscles is a poor criterion for judging the relationships among birds; she found from three to five pairs of muscles in the fringillid genera alone. While this difference in muscles

within a genera exists. Pettingill (1956) states that within a species the condition of the syrinx is sufficiently constant to be used as a taxonomic character. Other studies have been investigations into the relationships that exist between the complexity of the syrinx and the complexity of the bird song or variety of notes produced by a bird. Miskimen (1951) concluded that there is a direct correlation between these relationships. The function of the syrinx and its related muscles was not treated in this present investigation, since the study of morphology deals with form and structure, not function.

Literature on the syrinx is confusing, very few authors agreeing on the names to be given the syringeal muscles. In many cases, non-homologous muscles in different orders of birds have been given the same name. The names of muscles used in this paper will be those suggested by Miskimen (1951), since these names describe position, origin, insertion, and/or shape of the muscles fairly accurately. The names applied to various internal structures of the syrinx are the same regardless of author.

Since only 10 per cent of the passerine genera have been studied anatomically and perhaps studied erroneously, it was the purpose of this investigation to restudy many

genera, to study as yet uninvestigated genera in an effort to determine the morphology of the muscles of the syrinx and the internal structure in these genera, and to supply the needed illustrations missing in many papers on the subject. It was, also, the purpose of this investigation to determine whether or not the condition of the syrinx is sufficiently constant to be used as a taxonomic character.

Methods. The birds studied were the Eastern Crow, Corvus brachyrynchos; the Starling, Sturnus vulgaris; the English Sparrow, Passer domesticus; the Common Goldfinch, Spinus tristis; the Common Pigeon, Columba livia; the Red-winged Blackbird, Agelaius phoeniceus; the Bronzed Grackle, Quiscalus versicolor; the Meadowlark, Sturnella magna; the Bobolink, Dolichonyx oryzivorus; and the Cowbird, Molothrus ater. Before study began, the trachea, syrinx, and the bronchi of each bird was removed. These were removed as one piece, not separately. The syringeal specimens of the crow, the pigeon, the starling, and the sparrow were removed and placed in individual, labeled vials containing 70 per cent alcohol. The syrinx from all other species, except that of the goldfinch,were removed and stored in individual, labeled vials containing a mixture of alcohol, glycerol and water in the ratio of 3:1:1. This preservative mixture prevented

excess drying of the specimens during investigations. The preservative in each vial was renewed after four days to correct for dilution by tissue fluids. The muscle positions and attachments were recorded; then the entire specimen was stained by adding methylene blue to the preservative. The amount of stain used and the timing of the process were varied according to the size of the specimen. The specimens so stained were stored in pure glycerol to retard destaining and to facilitate the observations of the muscles. The trachea and bronchi of the goldfinch were removed and studied fresh instead of being placed in preservative. While this method permitted easier manipulation of the muscles than that which is found in preserved specimens, the fresh muscles quickly dried out. It was also found that observation of the muscles was more difficult, since the fresh specimen lacked the methylene blue stain.

The internal structure of the syrinx was studied by cutting away the ventral half of the syrinx. In some species investigated the left side of the syrinx was removed in an effort to study the internal structure. However, removing the ventral side of the syrinx offered better observation of the internal elements involved.

Results. Studies of the musculature of the syringes

in the birds investigated showed that the pairs of muscles present varied. The syringeal muscles of the crow included the following (Figure 1 and Figure 2).

1. Tracheo-lateralis was located on the lateral surface of the trachea. The origin of this muscle was on the lateral surface of the thyroid cartilage of the larynx. It inserted by bifurcating at the level of the second tracheal ring, giving rise to broncho-trachealis anticus and broncho-trachealis posticus.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated at the bifurcation of tracheo-lateralis. This muscle inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was on the dorsal surface of the syrinx. It originated at the bifurcation of tracheo-lateralis and inserted at the dorsal end of the first intermediary bar, by a tendon over the end of the second intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated at the dorsal surface of the first tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended ventro-laterally from the

syrinx. It originated on the lateral cranial process of the sternum. This muscle inserted on the lateral surface of the first tracheal ring.

6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral surface of the first tracheal ring and inserted on the ventral surface of the second intermediary bar.

7. Bronchialis posticus was located on the lateral surface of the syrinx. It originated on the latero-ventral surface of the first tracheal ring and inserted on the dorsal end of the second intermediary bar.

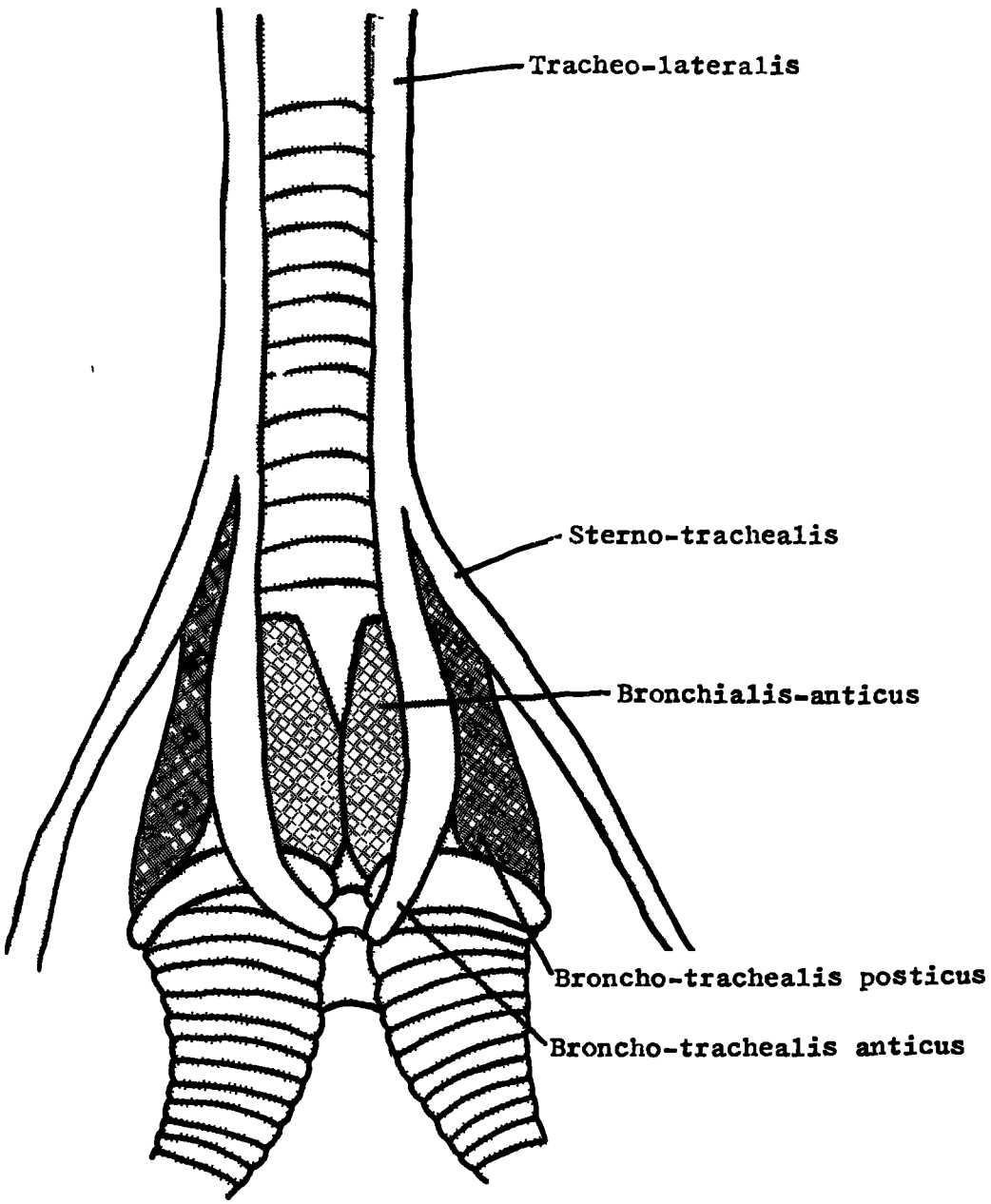

Fig. 1. Syringeal Muscles of the Crow, ventral view. (8x)

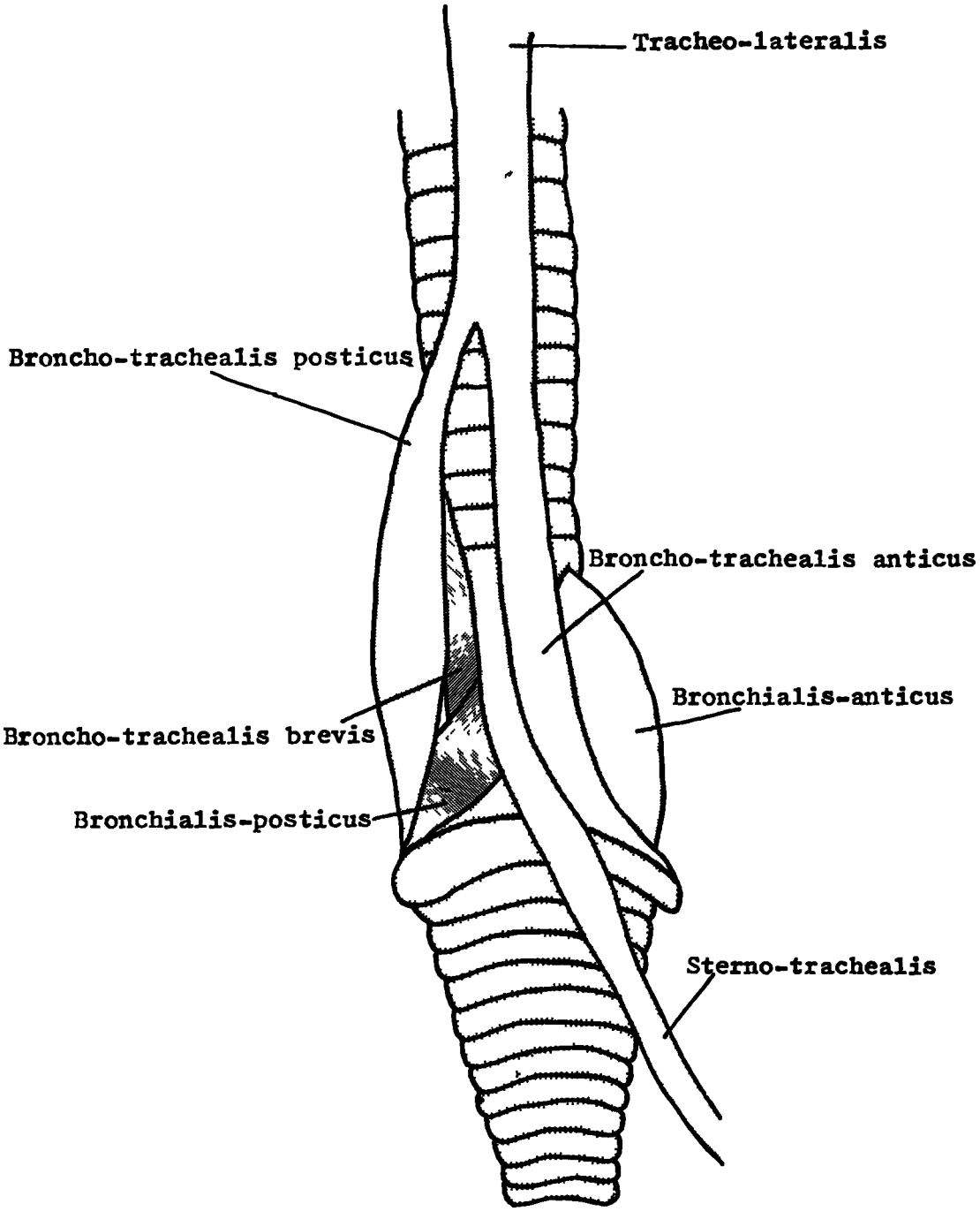

Fig. 2. Syringeal Muscles of the Crow, right side. (8x)

Muscles of the starling included the following (Figure 3).

1. Tracheo-lateralis was located on the lateral surface of the trachea. It originated at the lateral surface of the thyroid cartilage of the larynx and inserted by bifurcating at the level of the second tracheal ring, giving rise to broncho-trachealis anticus and broncho-trachealis posticus.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated at the bifurcation of tracheo-lateralis and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated at the bifurcation of tracheo-lateralis and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the dorsal surface of the first tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended ventro-laterally from the syrinx. It originated on the lateral cranial process of the sternum. This muscle inserted on the lateral

surface of the first tracheal ring.

6. Bronchialis anticus was located on the ventral surface of the syrinx. This muscle originated on the ventral surface of the first tracheal ring and inserted on the ventral end of the second intermediary bar.

7. Bronchialis posticus was located on the lateral surface of the syrinx. It originated on the latero-ventral surface of the first tracheal ring and inserted on the dorsal end of the second intermediary bar.

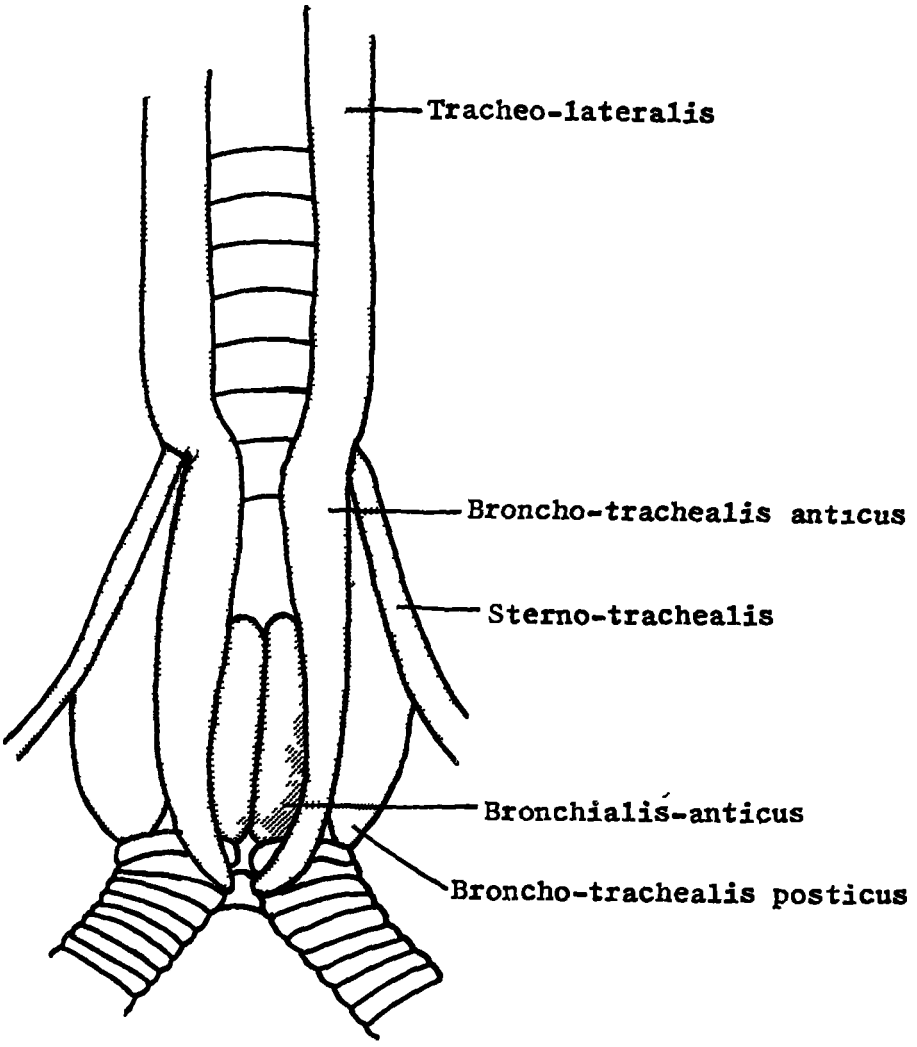

Fig. 3. Syringeal Muscles of the Starling, ventral view. (8x)

The syringeal muscles of the goldfinch include the following (Figure 4).

1. Tracheo-lateralis was not present.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. This muscle originated on the dorsal surface of the fourth tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended latero-ventrally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the lateral surface of the first tracheal ring.
6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the

ventral end of the second intermediary bar.

7. Bronchialis posticus was not present.

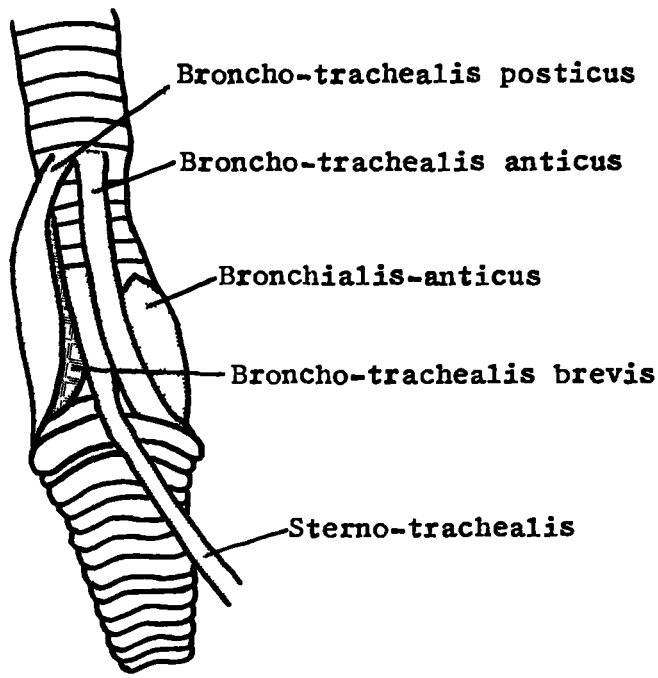

Fig. 4. Syringeal Muscles of the Goldfinch, right side. (40x)

The syringeal muscles of the English sparrow included the following (Figure 5).

1. Trachco-lateralis was not present.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated at the lateral surface of the third tracheal ring and inserted on the ventral half of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated on the lateral surface of the third tracheal ring and inserted on the first and second intermediary bars, the two united at their dorsal ends.
4. Broncho-trachealis brevis was not present.
5. Sterno-trachealis extended ventro-laterally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the lateral surface of the third tracheal ring.
6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum. It inserted on the ventral half of the second intermediary bar.
7. Bronchialis posticus was not present.

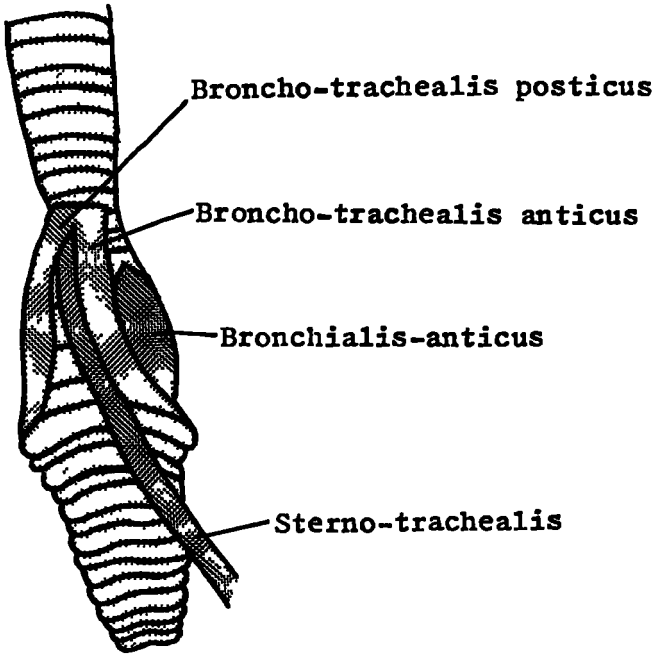

Fig. 5.

Syringeal Muscles of the English Sparrow. Right Side. (40x)

The pairs of syringeal muscles present in the common pigeon were as follows (Figure 6).

1. Trachco-lateralis was located on the lateral surface of the trachea and syrinx. It originated at the lateral surface of the thyroid cartilage of the larynx and inserted on the lateral surface of the second intermediary bar.
2. Sterno-tracheal is extended ventro-laterally from the trachea. This muscle originated on the cranial process of the sternum and inserted very high on the trachea at the sixteenth tracheal ring.

All other muscles were absent in the pigeon syrinx.

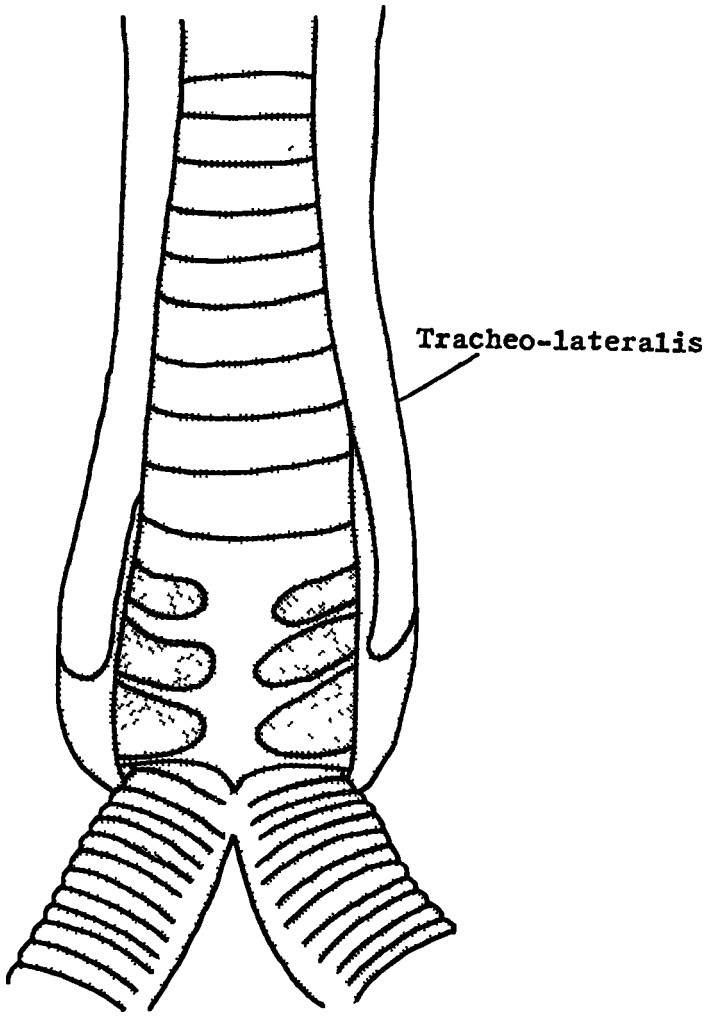

Fig. 6.

Syringeal Muscles of the Pigeon. Ventral view. (8x)

The pairs of syringeal muscles present in the Meadowlark were as follows (Figure 7).

1. Tracheo-lateralis was located on the lateral surface of the trachea. It originated on the lateral surface of the thyroid cartilage of the larynx and inserted by bifurcating at the level of the fifth tracheal ring, giving rise to broncho-trachealis anticus and broncho-trachealis posticus.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated by bifurcating with the tracheo-lateralis and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated by bifurcating with the tracheo-lateralis and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the lateral surface of the syringeal drum and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended ventro-laterally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the cephalad edge of

the lateral surface of the syringeal drum.

6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the ventral half of the second intermediary bar.

7. Bronchialis posticus was absent.

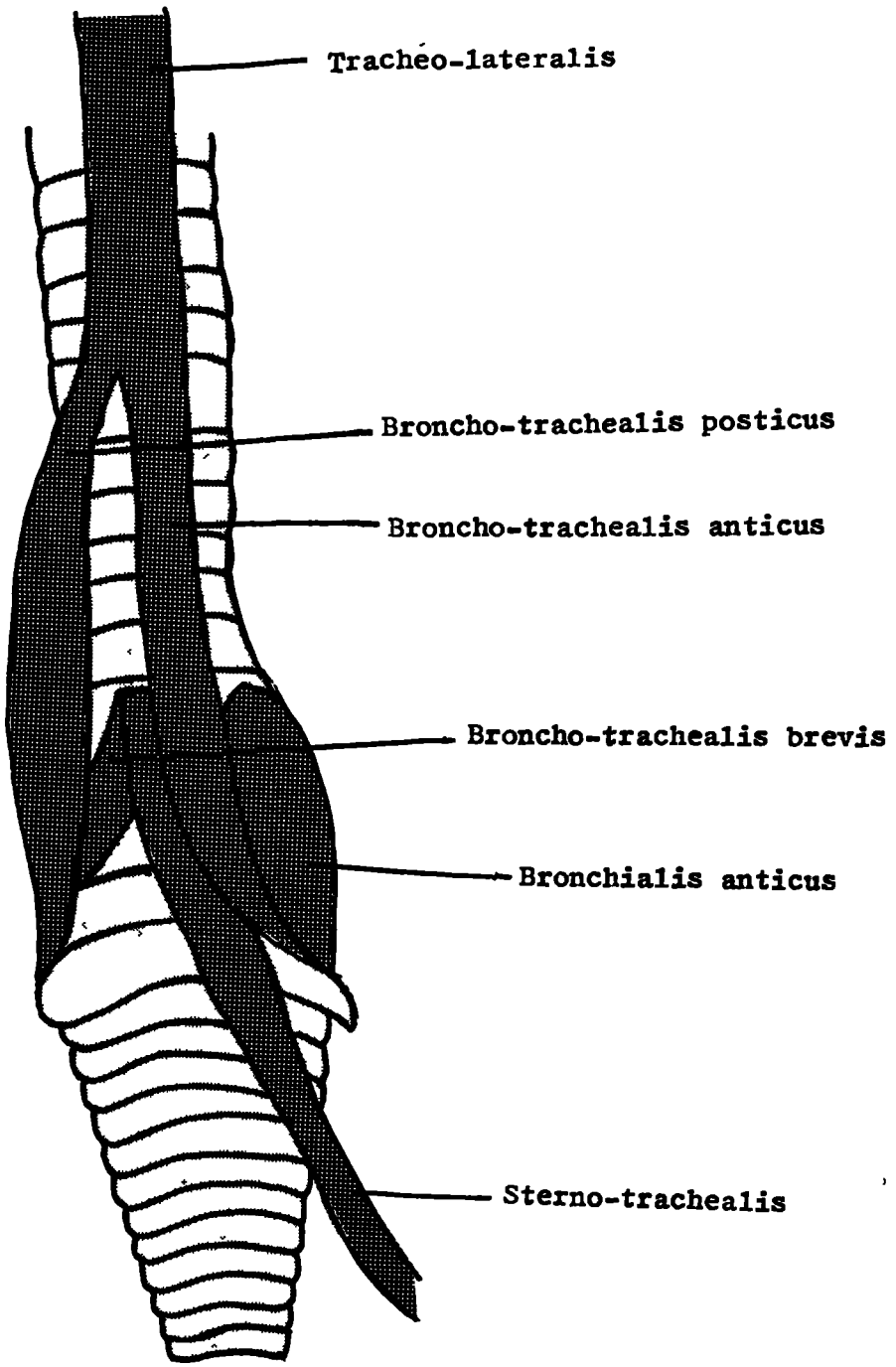

Fig. 7. Syringeal Muscles of the Meadowlark, right side. (8x)

The syringeal muscles of the bobolink include the following (Figure 8).

1. Tracheo-lateralis was located on the lateral surface of the trachea. It originated on the lateral surface of the thyroid cartilage of the larynx and inserted by bifurcating at the level of the fifth tracheal ring, giving rise to broncho-trachealis anticus and broncho-trachealis posticus.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated by bifurcating with the tracheo-lateralis and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated by bifurcating with the tracheo-lateralis and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the lateral surface of the syringeal drum and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended ventro-laterally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the cephalad edge of

the lateral surface of the syringeal drum.

6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the ventral half of the second intermediary bar.

7. Bronchialis posticus was not present.

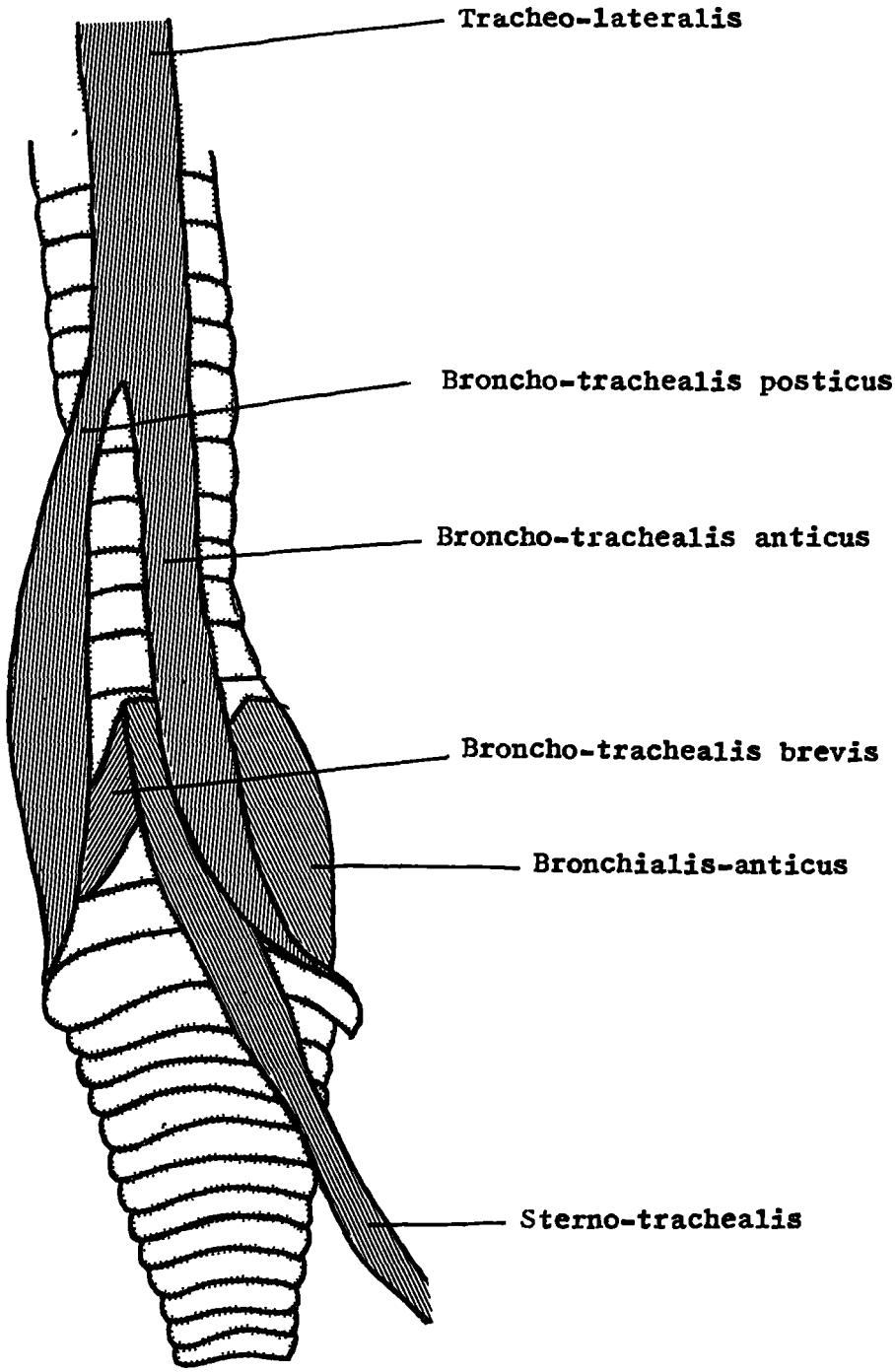

Fig. 8. Syringeal Muscles of the Bobolink, right side. (8x)

The syringeal muscles of the cowbird were as follows (Figure 9).

1. Tracheo-lateralis was not present.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the dorsal surface of the fourth tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended latero-ventrally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the lateral surface of the first tracheal ring.
6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the ventral half of the second intermediary bar.

7. Bronchialis posticus was located on the lateral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the dorsal end of the second intermediary bar.

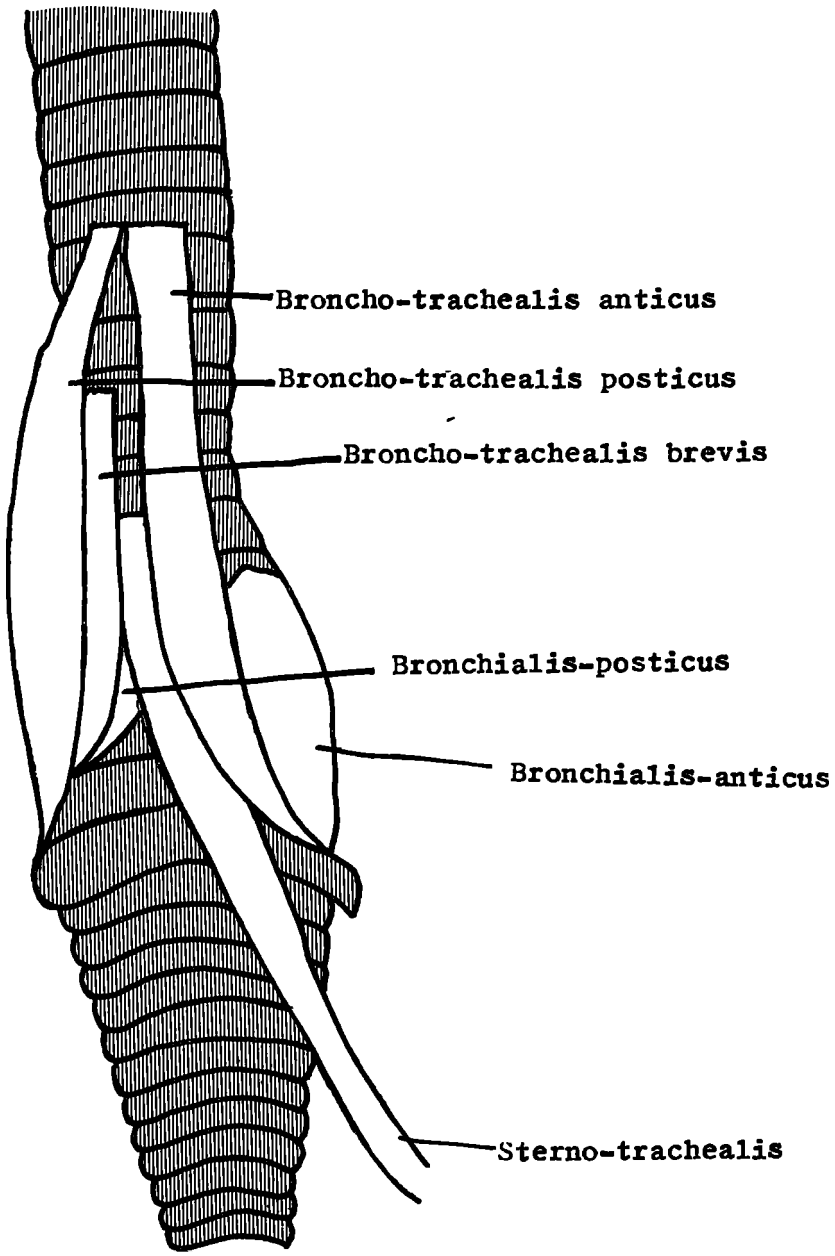

Fig. 9. Syringeal Muscles of the Cowbird, right side. (9x)

The pairs of syringeal muscles present in the red-winged blackbird were as follows (Figure 10).

1. Tracheo-lateralis was not present.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the dorsal surface of the fourth tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extended latero-ventrally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the lateral surface of the first tracheal ring.
6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the ventral half of the second intermediary bar.
7. Bronchialis posticus was not present.

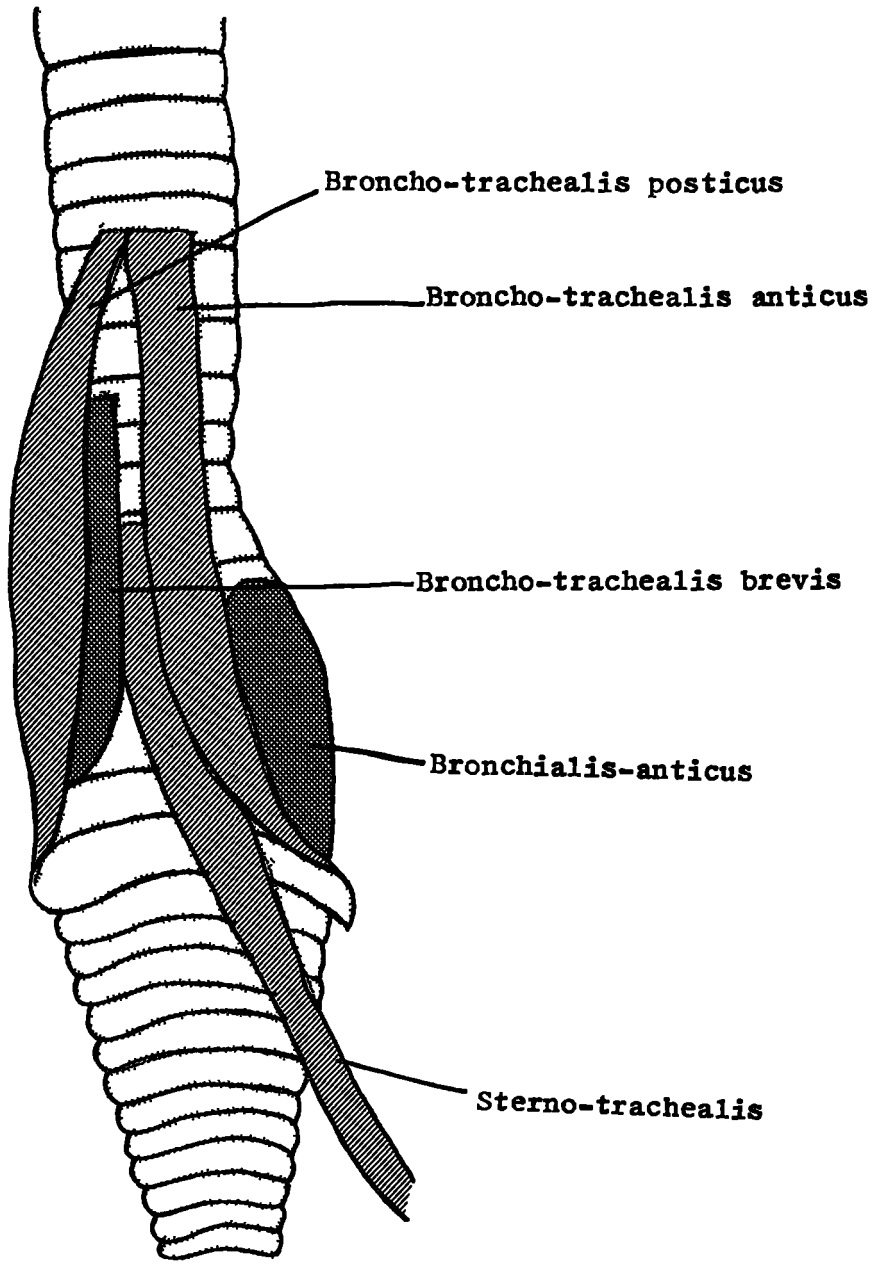

Fig. 10. Syringeal Muscles of the Red Wing Blackbird, right side. (9x)

The pairs of syringeal muscles present in the bronzed grackle were as follows (Figure 11).

1. Tracheo-lateralis was not present.
2. Broncho-trachealis anticus was located on the ventral surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the ventral end of the first intermediary bar.
3. Broncho-trachealis posticus was located on the dorsal surface of the syrinx. It originated on the lateral surface of the sixth tracheal ring and inserted on the dorsal end of the first intermediary bar.
4. Broncho-trachealis brevis was located on the dorsal surface of the syrinx. It originated on the dorsal surface of the fourth tracheal ring and inserted on the dorsal end of the second intermediary bar.
5. Sterno-trachealis extends latero-ventrally from the syrinx. It originated on the lateral cranial process of the sternum and inserted on the lateral surface of the first tracheal ring.
6. Bronchialis anticus was located on the ventral surface of the syrinx. It originated on the ventral cephalad edge of the syringeal drum and inserted on the ventral half of the second intermediary bar.
7. Bronchialis posticus was not present.

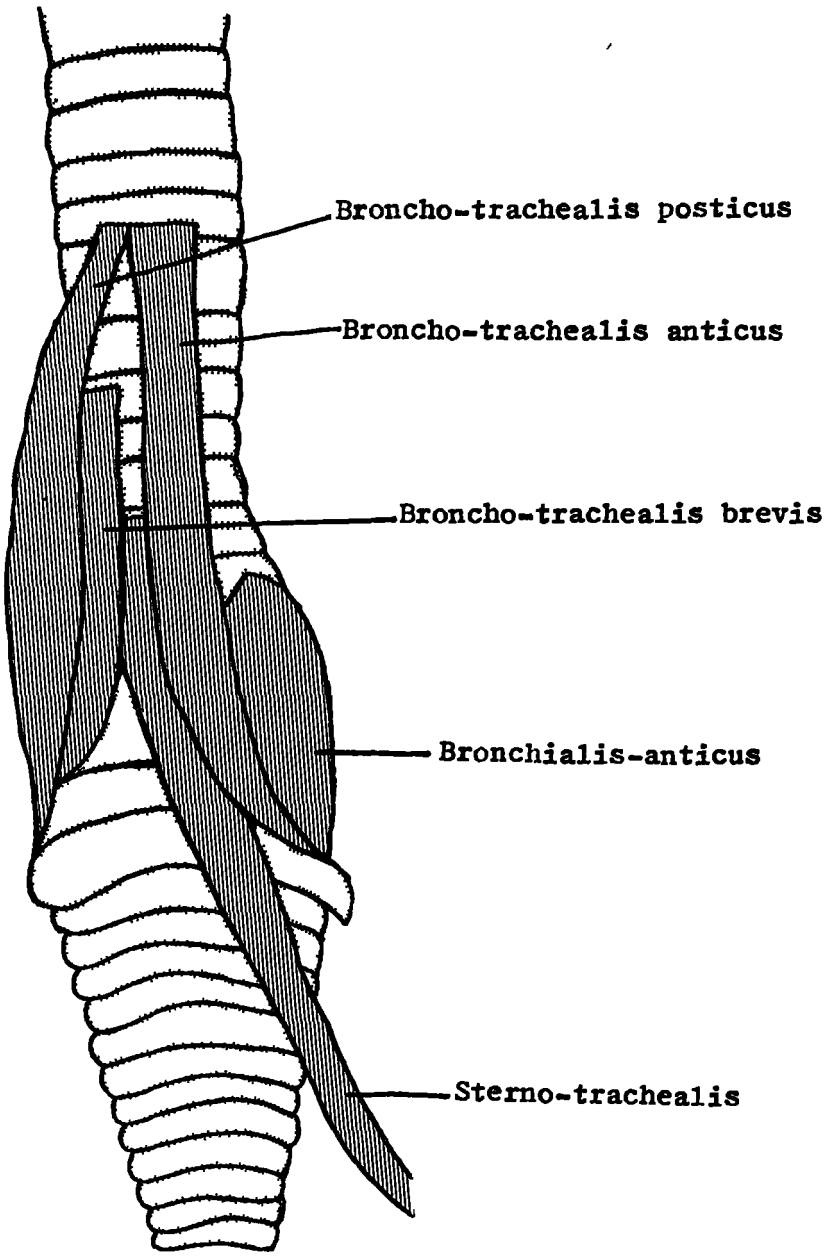

Fig. 11. Syringeal Muscles of the Bronzed Grackle, right side. (8x)

The internal syringeal structures of the birds studied were basically the same. The only difference found was that of size. Names applied to the component structures were taken from Pettingill (1956). The last tracheal rings supported the tympanum (Figure 12 and Figure 13), and the space within is called the tympanic cavity. Between the two bronchial openings a small septum extended forward into the trachea. The free margin of the septum was a crescent-shaped membrane which formed the inner lip of each bronchus and is known as the semilunar membrane. It was supported by a small ridge, the pessulus. On each side of the septum was a thin, elastic membrane which extended downward and formed the inner wall, which was without cartilaginous rings. It was a continuation posteriorly of the semilunar membrane. It is appropriately called the internal tympaniform membrane. Attached to the walls of the tympanum, directly opposite each side of the semilunar membrane, was a membranous fold, the external tympaniform membrane, which formed the outer lip of each bronchus. The external and internal tympaniform membranes gave the opening of each bronchus the shape of a slit (Pettingill, 1956).

The trachea was supported by a series of cartilaginous or bony rings; the bronchi were supported partly by complete

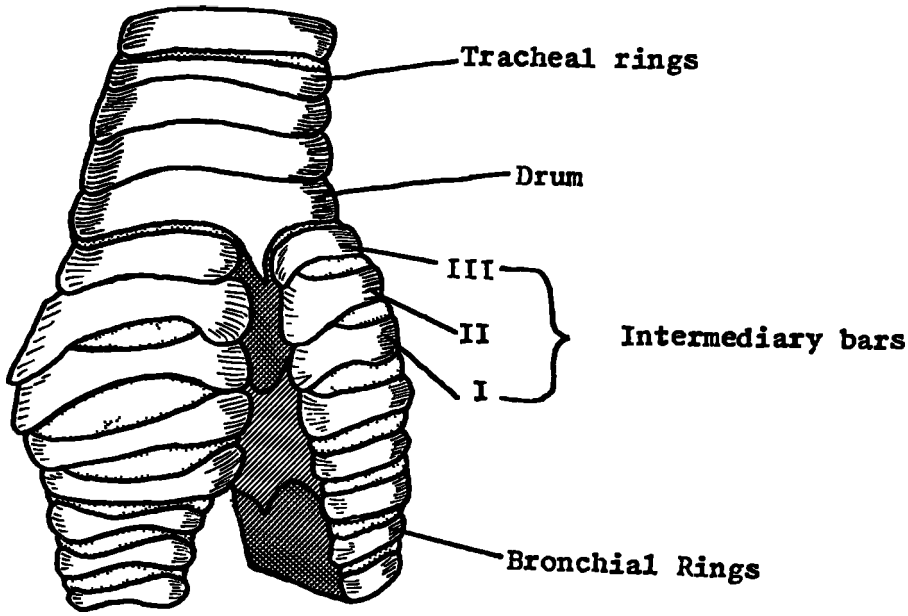

Fig. 12.

Schematic Diagram of External Structure of the Syrinx. Ventral View.

Ventral View Right Side

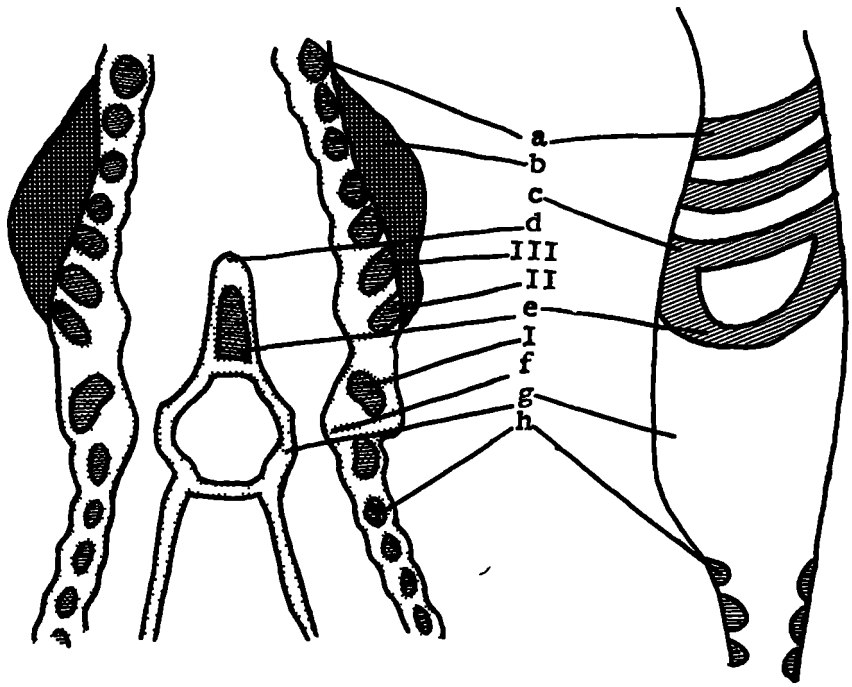

Fig. 13.
Schematic Diagram of Internal Structure of the Syrinx

a, tracheal ring; b, muscle; c, drum; d, semilunar membrane; e, pessulus; f, external tympaniform membrane; g, internal tympaniform membrane; I, II, III, intermediary bars; h, bronchial half-rings.

rings and partly by C-shaped semirings, the inner, open side of each being closed by a membrane. The tracheal rings and bronchial rings or semirings that form the syrinx are larger in diameter (and/or width) than the neighboring rings, so that the syrinx was a conspicuous dilation in the tracheobronchial tree. The drum was the fusion of several tracheal rings just cephalad to the syrinx.

The crow syrinx was 1.5 cm. long; the starling syrinx, 1.0 cm.; the goldfinch syrinx, 0.15 cm.; the red-wing blackbird syrinx, 0.9 cm.; the bronzed grackle syrinx, 1.00 cm.; the meadowlark syrinx, 0.80 cm.; the bobolink syrinx, 0.7 cm.; and the pigeon syrinx, 1.2 cm. All birds studied were adults. No data was available on the size of the syrinx as related to the growth of the bird.

Discussion and conclusions. That the syrinx of birds vary as to the number and attachments of muscles was apparent (Table I). The pigeon syrinx, having only two pairs of muscles, differed considerably from the syringes of other birds studied. Sterno-trachealis inserted very high on the trachea well anterior to the syrinx; while in the passerines studied, this muscle inserted on or near the syrinx. Although no other non-passerines were studied, the high insertion of sterno-trachealis might be a taxonomic character of the non-passerines.

TABLE I

COMPARISON OF SYRINGEAL MUSCLES PRESENT IN DIFFERENT SPECIES
(Adapted from Miskimen, 1951)

Species	Tracheo-lateralis	Broncho-trachealis anticus	Broncho-trachealis posticus	Broncho-trachealis brevis	Sterno-trachealis	Bronchialis anticus	Bronchialis posticus	Total pairs of Muscles present
Starling	X*	X	X	X	X	X	X	7
Crow	X	X	X	X	X	X	X	7
Meadowlark	X	X	X	X	X	X		6
Bobolink	X	X	X	X	X	X		6
Cowbird		X	X	X	X	X	X	6
Goldfinch		X	X	X	X	X		5
Red-winged Blackbird		X	X	X	X	X		5
Bronzed Grackle		X	X	X	X	X		5
English Sparrow		X	X		X	X		4
Common Pigeon	X				X			2

*X in this space indicated the presence of the muscle, a blank indicated its absence.

In the nine passerine species studied the number and attachments of the muscles varied. The crow and the starling both had seven pairs of muscles, and in each species the origin and insertion of the muscles were the same. The goldfinch syrinx was characterized by five pairs of syringeal muscles; the syrinx of the English sparrow had four pairs of syringeal muscles, and the origin and insertion of these muscles were different from any other syrinx studied. Sterno-trachealis inserted on the third tracheal ring, a higher insertion than found in any other passerine syrinx.

Study based on a limited number of specimens of the family Icteridae (red-winged blackbird, bronzed grackle, cowbird, bobolink, and meadowlark) resulted in tentative conclusions with regard to familial characteristics of the syrinx. The Icteridae syrinx is characterized by the presence of broncho-trachealis anticus, broncho-trachealis posticus, broncho-trachealis brevis, sterno-trachealis, and bronchialis anticus. The origin and insertion of these muscles vary with genus. Tracheo-lateralis and bronchialis posticus may or may not be present. The condition of the syrinx at the family level was not constant as shown in representative birds of the Icteridae family. Therefore, it was concluded (in agreement with Miskimen, 1951) that the condition of the syrinx is not sufficiently constant to be used as a taxonomic character.

Miskimen (1951) found from three to five pairs of muscles in the fringillid genera alone. Whether or not the condition of the syrinx is constant at the genus level within the Icteridae family remains to be studied. Pettingill (1956) states that the condition of the syrinx is constant at the species level. In the present investigation only one syrinx of most of the species was studied. Two pigeon syringes and two crow syringes were studied; and for each species, the condition of the syrinx was the same. Without more specimens from one genus or one species, no firm conclusions about the constancy of the syrinx at either level can be formed. Further studies should include descriptions of the syringes of many species and groups of species, and the embryological development of representative forms.

Summary. The purpose of this investigation was to 1) determine the morphology of the syrinx and its muscles, 2) supply the needed illustrations missing in many papers on the subject, and 3) to determine whether or not the condition of the syrinx was sufficiently constant to be used as a taxonomic character. The birds studied were the Eastern crow, the starling, the cowbird, the common pigeon, the common goldfinch, the English sparrow, the red-winged blackbird, the bronzed grackle, the meadowlark, and the bobolink.

Study of the musculature of the syrinx in the birds investigated showed that the pairs of muscles present varied. Both the crow and the starling syringes had seven pairs of muscles present: tracheo-lateralis, broncho-trachealis anticus, broncho-trachealis posticus, broncho-trachealis brevis, sterno-trachealis, bronchialis anticus, and bronchialis posticus. The meadowlark and the bobolink syringes had six pairs of muscles; bronchialis posticus was absent. The cowbird syrinx had six pairs of muscles; tracheo-lateralis was absent. The goldfinch, red-winged blackbird, and bronzed grackle syringes had five pairs of muscles; tracheo-lateralis and bronchialis posticus were absent. The English sparrow syrinx had four pairs of muscles; tracheo-lateralis, broncho-trachealis brevis, and bronchialis posticus were absent. The pigeon syrinx had two pairs of muscles. The two pairs present were tracheo-lateralis and sterno-trachealis.

Studies of the representative birds of the Icteridae family resulted in the conclusion that the condition of the syrinx is not sufficiently constant to be used as a taxonomic character. Whether or not the condition of the syrinx is constant at the genus level remained to be studied.

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MORPHOLOGY OF THE SYRINX AND SYRINGEAL MUSCLES

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An Abstract of
A Thesis

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The purpose of this investigation was to 1) determine the morphology of the syrinx and its muscles, 2) to supply the needed illustrations missing in many papers on the subject, and 3) to determine whether or not the condition of the syrinx was sufficiently constant to be used as a taxonomic character. The birds studied were the Eastern crow, the starling, the cowbird, the common pigeon, the common goldfinch, the English sparrow, the red-winged blackbird, the bronzed grackle, the meadowlark, and the bobolink. The trachea, syrinx, and bronchi of each bird were removed, fixed, stained with methylene blue, stored in glycerol, and studied anatomically with the aid of a microscope.

Study of the musculature of the syringes in the birds investigated showed that the pairs of muscles present varied. Both the crow and the starling syringes had seven pairs of muscles present: tracheo-lateralis, broncho-trachealis anticus, broncho-trachealis posticus, broncho-trachealis brevis, sterno-trachealis, bronchialis anticus, and bronchialis posticus. The meadowlark and the bobolink syringes had six pairs of muscles; bronchialis posticus was absent. The

cowbird syrinx had six pairs of muscles; tracheo-lateralis was absent. The goldfinch, red-winged blackbird, and bronzed grackle syringes had five pairs of muscles; tracheo-lateralis and bronchialis posticus were absent. The English sparrow syrinx had four pairs of muscles; tracheo-lateralis, broncho-trachealis brevis, and bronchialis posticus were absent. The pigeon syrinx had two pairs of muscles. The two pairs present were tracheo-lateralis and sterno-trachealis.

Studies of the representative birds of the Icteridae family resulted in the conclusion that the condition of the syrinx is not sufficiently constant to be used as a taxonomic character. Whether or not the condition of the syrinx is constant at the genus level remained to be studied.