VI. THE STRUCTURE AND THE DISPOSITION OF THE MUSCLES OF THE FEEDING APPARATUS AND THE NECK

The movements of the feeding apparatus are brought about by a series of actions of a number of muscles which together are responsible for the food manipulation. During the ingestion, the food is handled by different birds in different ways. For instance, some birds peck the seeds, a few others snap the insects, some catch the fishes and still others tear the flesh. Since the feeding behaviour differs in different birds, it is natural to expect that the involved muscles are variously disposed and adapted to bring about different food manoeuvring operation.

A number of workers have studied the disposition of the jaw and the neck muscles with a view to correlate their structure with the operation for specific feeding habits. Dubale (1968) has given a general account of the functional anatomy of a number of avian jaw muscles and has explained the adaptive significance of their variations in relation to the feeding habits. The disposition and structure of the jaw and the neck muscles were studied by Goodman and Fisher (1962) in a number of Anatids as an adaptation to the feeding behaviour. Zusi & Storer (1969) reported the presence of heavy jaw musculature of the pied billed grebes as an adaptation to kill the fishes and frogs. Mansuri (1969) described the variations in the development of the jaw muscles of four Ardeid birds which feed on different aquatic food materials such as fishes, aquatic insects, crustaceans etc. Raval (1973) threw considerable light on the structure and disposition of the jaw and the neck muscles to accomplish the task of thrusting the hooked bill into the body of the
prey and tearing the flesh in a number of falconiformes. Burton in 1974 reported the presence of well developed depressor mandibulae to permit the abduction of the lower jaw with a greater force as an adaptation to the specialized feeding by gaping or preying in huia.

The disposition and the structure of the jaw and the neck muscles of the two birds under investigation have been studied here in detail with a view to find out the variations if any and see whether they have any bearing on the feeding behaviour.

**THE JAW MUSCLES**

Based on the main functions, the jaw muscles of the feeding apparatus of birds may be grouped as follows.

<table>
<thead>
<tr>
<th>I</th>
<th>Adductors of the lower jaw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Adductor mandibulae externus</td>
</tr>
<tr>
<td>Ia.1</td>
<td>M. Adductor mandibulae externus superficialis</td>
</tr>
<tr>
<td>Ia.1.1</td>
<td>M. Adductor mandibulae externus superficialis pars dorsalis</td>
</tr>
<tr>
<td>Ia.1.2</td>
<td>M. Adductor mandibulae externus superficialis pars ventralis</td>
</tr>
<tr>
<td>Ia.2</td>
<td>M. Adductor mandibulae externus medialis</td>
</tr>
<tr>
<td>Ia.2.1</td>
<td>M. Adductor mandibulae externus medialis outer slip</td>
</tr>
<tr>
<td>Ia.2.2</td>
<td>M. Adductor mandibulae externus medialis inner slip</td>
</tr>
<tr>
<td>Ia.3</td>
<td>M. Adductor mandibulae externus profundus</td>
</tr>
<tr>
<td>Ib</td>
<td>M. Adductor mandibulae medius</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>II</td>
<td>Adductors of the lower jaw and the retractors of the upper jaw</td>
</tr>
<tr>
<td>II a</td>
<td>M. Pseudotemporalis profundus</td>
</tr>
<tr>
<td>II b</td>
<td>M. Adductor mandibulae posterior</td>
</tr>
<tr>
<td>II c</td>
<td>M. Adductor mandibulae internus</td>
</tr>
<tr>
<td>II c. 1</td>
<td>M. Adductor mandibulae internus ventralis anterior</td>
</tr>
<tr>
<td>II c. 2</td>
<td>M. Adductor mandibulae internus ventralis posterior</td>
</tr>
<tr>
<td>II d. 1</td>
<td>M. Adductor mandibulae internus dorsalis anterior</td>
</tr>
<tr>
<td>II d. 2</td>
<td>M. Adductor mandibulae internus dorsalis posterior</td>
</tr>
<tr>
<td>III</td>
<td>Abductor of the lower jaw</td>
</tr>
<tr>
<td></td>
<td>M. Depressor mandibulae</td>
</tr>
<tr>
<td>IV</td>
<td>Protractor of the upper beak</td>
</tr>
<tr>
<td></td>
<td>M. Spheno-pterygo-quadratus</td>
</tr>
</tbody>
</table>

**The tongue muscles**

<table>
<thead>
<tr>
<th>Number</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M. Gularis</td>
</tr>
<tr>
<td>1 a</td>
<td>M. Gularis anterior</td>
</tr>
<tr>
<td>1 b</td>
<td>M. Gularis posterior</td>
</tr>
<tr>
<td>2</td>
<td>M. Branchiomandibularis</td>
</tr>
<tr>
<td>3</td>
<td>M. Interkeratoideus</td>
</tr>
<tr>
<td>4</td>
<td>M. Hypoglossus</td>
</tr>
<tr>
<td>5</td>
<td>M. Hyoglossus</td>
</tr>
<tr>
<td>6</td>
<td>M. Sternohyoideus</td>
</tr>
<tr>
<td>7</td>
<td>M. Tracheohyoideus</td>
</tr>
<tr>
<td>8</td>
<td>M. Cricohyoideus</td>
</tr>
</tbody>
</table>
The nomenclature of the muscles followed in the present work is that of Edgeworth (1935). Since there is no uniformity in the nomenclature used by the different authors while describing the muscle, synonyms of the muscles have also given here for ready reference.

**Nomenclature and synonymy**

**Mandibular muscles**

**M. Adductor mandibulae externus superficialis**

M. Temporalis (Part) M. masseter (Part) -- Wiedemann (1802)
M. Temporalis (Part) -- Nitzsch (1857, 1866), Gadow (1891)
M. Temporalis -- Shufeldt (1890)
M. Adductor mandibulae externus (Part) -- Lakjer (1926), Edgeworth (1935)
M. Adductor mandibulae externus superficialis -- Hofer (1950), Beecher (1951), Rooth (1953)
M. Adductor mandibulae externus superficialis -- Fisher and Goodman (1955)
M. Adductor mandibulae externus superficialis part I a -- Goodman and Fisher (1952)
M. Adductor mandibulae externus part A -- Zusi (1962)

**M. Adductor mandibulae externus medialis**

M. Temporalis (Part) M. masseter (Part) -- Wiedemann (1802)
M. Temporalis -- Nitzsch (1857, 1866), Gadow (1891)
M. Masseter -- Shufeldt (1890)
M. Adductor mandibulae externus (Part) -- Lakjer (1926), Edgeworth (1935)
M. Adductor mandibulae externus medialis -- Hofer (1950), Beecher (1951), Rooth (1953)
M. Adductor mandibulae medius -- Fisher and Goodman (1955)
M. Adductor mandibulae medialis -- Goodman and Fisher (1962)
M. Adductor mandibulae externus part B -- Zusi (1962)
M. Adductor mandibulae externus profundus

M. Temporalis (part) masseter (part) — Wiedemann (1802)
M. Temporalis (part) — Nitzsch (1857, 1866), Gadou (1891)
M. Temporalis (part) — Shufeldt (1890)
M. Adductor mandibulae externus (part) — Lakjer (1926), Edgeworth (1935)
M. Adductor mandibulae externus profundus — Fisher and Goodman (1955)
M. Adductor mandibulae externus profundus — Hofer (1950), Beecher (1951), Rooth (1953), Goodman and Fisher (1962)
M. Adductor mandibulae externus part M — Zusi (1962, 1969)

M. Adductor mandibulae medius

M. Temporalis (part) M. quadratotempomaxillaris (part) — Wiedemann (1802)
M. Ethmo-spheno-orbito and quadratomaxillaris — Nitzsch (1857, 1866), Gadou (1891)
M. Pterygoideus (part) — Shufeldt (1890)
M. Pseudotemporalis superficialis — Lakjer (1826), Beecher (1951), Goodman and Fisher (1962) and Zusi (1962)
M. Adductor mandibulae medius — Edgeworth (1935)
M. Pseudotemporalis — Hofer (1950)
M. Adductor mandibulae, internus pseudotemporalis superficialis — Rooth (1953)
M. Adductor mandibulae externus medialis — Fisher and Goodman (1955)

M. Adductor mandibulae internus ventralis anterior

M. Pterygoideus (part) — Wiedemann (1802)
M. Pterygoideus (part) pterygoideus internus S. palatobasilaris — Nitzsch (1857, 1866)
M. Pterygoideus internus (part) — Shufeldt (1890)
M. Pterygoidei (part) — Gadou (1891)
M. Pterygoideus ventralis (part) — Lakjer (1926), Fisher and Goodman (1955)
M. Adductor mandibulae internus (part) — Edgeworth (1935)
M. Pterygoideus dorsalis — Hofer (1950)
M. Pterygoideus ventralis anterior — Beecher (1951)
M. Adductor mandibulae internus pterygoideus (part) — Rooth (1953)
M. Pterygoideus dorsalis (part) — Fisher and Goodman (1955)
M. Pterygoideus ventralis, lateral part — Goodman and Fisher (1962)
M. Pterygoideus (part) — Zusi (1962, 1969)

M. Adductor mandibulae internus dorsalis

M. Pterygoideus (part) — Wiedemann (1802)
M. Pterygoideus (part) pterygoideus internus S. palatobasilaris — Nitzsch (1857, 1866)
M. Pterygoideus internus (part) — Shufeldt (1890)
M. Pterygoidei (part) Gadow (1891)
M. Pterygoideus dorsalis — Lakjer (1926)
M. Adductor mandibulae internus (part) — Edgeworth (1935)
M. Pterygoideus dorsalis — Beecher (1951)
M. Adductor mandibulae internus pterygoideus (part) — Rooth (1953)
M. Pterygoideus dorsalis, medial part — Fisher and Goodman (1955)
M. Pterygoideus dorsalis — Goodman and Fisher (1962)
M. Pterygoideus (part) — Zusi (1962)

M. Pseudotemporalis

M. Quadrato maxillaris (part) — Wiedemann (1802)
M. Ethmo, sphenoh, orbito, and quadrato-maxillaris — Nitzsch (1857, 1866), Gadow (1891)
Pterygoideus externus — Shufeldt (1890)
Pseudotemporalis profundus — Lakjer (1926), Beecher (1951), Goodman and Fisher (1962), Zusi (1962)
Adductor mandibulae medius (part) — Edgeworth (1935)
Quadrato-mandibularis — Hofer (1950)
Adductor mandibulae internus pseudotemporalis profundus — Rooth (1953)

Adductor mandibulae posterior

Quadrato-maxillaris (part) — Wiedemann (1802)
Temporalis (part) — Nitzsch (1857, 1866)
Temporalis portion 3 — Gadou (1891)
Adductor posterior — Lakjer (1926)

Spheno-ptyeygo-quadratus

Orbito-quadratus orbito-omoideus — Tiedemann (1810)
Orbito-quadratus — Nitzsch (1857, 1866)
Ento-tympanicus — Shufeldt (1890)
Orbito-quadratus (1 and 2) Ethmo-palatinus — Gadou (1891)
Protractor pterygoidei protractor quadrati — Lakjer (1926)
Spheno-ptyeygo-quadratus — Edgeworth (1935)
Protractor quadrati — Hofer (1950), Beecher (1951)
Protractor quadrati et pterygoidei — Rooth (1953)
Protractor quadrati — Zusi (1962)

Intermandibularis

Mylohyoideus transversus — Nitzsch (1857, 1866), Tiedemann (1810)
M. Mylohyoideus — Shufeldt (1890), Moller (1938), Engels (1938), Zusi and Storer (1969)
M. Mylohyoideus anterior — Gadou (1891), Mudge (1903)
M. Interkeratoideus
M. Ceratoideus — Nitzsch (1857, 1866), Gadou (1891), Mudge (1903)
M. Interkeratoideus — Edgeworth (1935)
M. Depressor mandibulae
M. Biventer maxillae — Shufeldt (1890)
M. Digastricus — Owen (1866)
M. Digastricus depressor mandibulae — Gadou (1891)
M. Apertor rostri part major part minor — Nitzsch (1857, 1866)
M. Depressor mandibulae — Edgeworth (1935), Beecher (1951), Rooth (1933), Goodman and Fisher (1962), Zusi (1962)
M. Gularis
M. Mylo-hyoideus obliquus (part) — Tiedemann (1810)
M. Retractor lingui (part) — Watson (1883)
M. Mylohyoideus posterior (part) — Gadou (1891)
M. Hyomandibularis lateralis, M. hyomandibularis medialis — Kallius (1901, 1905)
M. Serpihyoideus — Mudge (1903)
M. Hyomandibularis lateralis — Moller (1930)
M. Gularis — Edgeworth (1935)
**M. Branchiomandibularis**

- Genio-hyoideus — Shufeldt (1890), Gadou (1891), Mudge (1903), Fisher and Goodman (1955)
- Kerato-mandibularis — Kallus (1901, 1905), Moller (1930)

**M. Hypoglossus anterior**

- Hypoglossus rectus — Nitzsch (1857, 1866), Gadou (1891), Fisher and Goodman (1955)
- Depressor glossus (part) — Shufeldt (1890)
- Hypoglossus anterior — Kallus (1901, 1905)
- Hypoglossus anterior — Edgeworth (1935)

**M. Hypoglossus posterior**

- Hypoglossus obliquus — Nitzsch (1857, 1866), Gadou (1891), Fisher and Goodman (1955)
- Depressor glossus (part) — Shufeldt (1890)
- Hypoglossus posterior — Kallus (1901, 1905)

**M. Hyoglossus**

- Cerato-glossus — Shufeldt (1890), Engels (1938), Zusi and Storer (1969)
- Kerato hyoideus — Kallus (1901, 1905)
- Hyoglossus — Edgeworth (1935)
- Ceratoglossus — Fisher and Goodman (1955)
The following is an account of the description of the avian jaw muscles based on their function with special reference to the birds under the present investigation.
Adductors of the lower jaw

M. Adductor mandibulae externus (Plates IX & X)

The M. adductor mandibulae externus is a well developed muscle which occupies the lower corner of the posterior region of the orbit. The muscle extends from the wall of the cranium to the middle of the mandible. It is divided into a superficialis, a medialis and a profundus parts.

M. Adductor mandibulae externus superficialis

This is the most superficial part of the three muscles and is further divided into two parts viz., a pars dorsalis and a pars ventralis.

Pars dorsalis

In the brahminy myna this is a large fan-shaped muscle covering almost the major temporal region of the skull. The muscle fibers arise from the depression of the squamosal bone in a broad fleshy origin. The origin extends from the base of the postorbital process to the lamboidal crest posteroventrally and a short way into the orbit below and behind the postorbital process. These fibers exhibit parallel type of arrangement. The muscle becomes narrow as it runs forwards and downwards. Fibers from the upper side are attached to a tendon which gradually merges with another tendon on which the lower fibers are attached. The muscle thus gains a tendinous insertion on the anterior coronoid process of the surangular.
The development of the pars dorsalis in the wagtail is more or less similar to that of the brahminy myna. However, its origin besides as mentioned in the brahminy myna, also extends to the suprameatal ridge of the squamosal. Further the muscle is provided only with a single tendon towards the insertion. The fibers form a unipinnate pattern of arrangement on this tendon which inserts on the anterior cornoid process of the surangular bone.

I a.1.2 Pars ventralis

It is also a well developed muscle extending between the zygomatic process and the mandible below and behind the origin of its counterpart. The muscle partly covers the lower part of the M. A.M.E. superficialis pars dorsalis.

Most of the muscle fibers arise from a strong aponeurosis attached to the anterior part of the zygomatic process. Some other fibers arise from the tendon of pars dorsalis. The remaining fibers share the origin from the anterior margin of the M. A.M.E. medialis outer slip. The fibers show a parallel pattern of arrangement. All these fibers run forward and downward and gain attachment to a tendon which gradually becomes thick towards the insertion. This tendon gains insertion on the upper border of the surangular bone, anterior to the insertion of its counterpart.

The only difference which was observed in the M. A.M.E. superficialis in the wagtail is that all its
fibers arise aponeurotically from the suprameatal ridge of the squamosal bone.

Both parts of the muscle are innervated by the mandibular branches of the Vth nerve.

Due to the combined action of the two parts of the M. A.M.E. superficialis together, the mandible is subjected to strong upward pull resulting in the adduction of the lower jaw.

I a.2. M. Adductor mandibulae externus medialis (Plates IX & X)

The M. Adductor mandibulae externus medialis occupies a lower temporal region where its upper part is covered by the M. A.M.E. superficialis. The muscle is divided into an outer and an inner slips.

I a.2.1 M. Adductor mandibulae externus medialis outer slip

In both the birds studied here this muscle is large and fan-shaped. It extends between the squamosal bone and the mandibular ramus. It arises from the zygomatic process below and slightly behind the origin of the M. A.M.E. superficialis pars ventralis. The origin is partly fleshy and partly tendinous. The tendon gradually spreads over the muscle fibers as an aponeurotic sheet. The muscle exhibits a parallel type of fiber arrangement. Towards the insertion, the muscle becomes very broad and covers the outer lateral surface of the mandible, covering the foramen mandibulae (most of the lateral surface of the surangular).

I a.2.2 M. Adductor mandibulae externus medialis inner slip

This muscle is less developed than its counterpart.
It extends between the base of the postorbital process and the medial surface of the mandible. The dorsal edge of the surangular bone forms a small wedge between the two slips.

In the brahminy myna as well as in the wagtail the muscle arises in a broad origin from the outer edge of the posterior orbital wall. A few superficial fibers of the muscle arise fleshily and gain attachment on a tendinous ribbon. The arrangement of the fibers is bipinnate. The rest of the fibers arise in a unipinnate manner from a well developed tendon which cover the muscle fibers from the inner surface. The tendon gains insertion on the anterior coronoid process of the surangular bone above the foramen mandibulae. The rest of the fibers gain a fleshy insertion on the inner lateral side of the mandibular ramus.

Both the slips of the muscle are innervated by the mandibular branch of the 5th nerve.

This muscle is a strong adductor of the lower jaw by pulling the mandible upward due to its contraction.

The disposition of both the slips of the M. A.M.E. medialis is similar in both the birds.

I a.3  M. Adductor mandibulae externus profundus
(Plates XI & XII)

The M. A.M.E. profundus is a moderately developed muscle, covered mostly by the M. A.M.E. medialis from above. It occupies a position between the posterolateral part of the otic region of the squamosal and the coronoid process of the surangular.
PLATE XI

Jaw muscles of the brahminy myna viewed from the lateral side.

Fig. 1. Deeper view
Fig. 2. Deepest view

PSE, TEMP., Pseudotemporalis; A.M. Post., Adductor mandibulae posterior

Other abbreviations are as in Plate IX.
In the brahminy myna the upper fibers of this muscle arise fleshily from the squamosal bone, below the zygomatic process and the origin of the M. A.M.E. medialis. As the fibers move forward they gain attachment to a well developed tendon. On the lower side, a second tendon arises from the squamosal bone below the fleshily originating fibers. The muscle fibers arise from both the sides of this tendon and run obliquely to attach along the surface of the first tendon. The first and the second tendons merge together forming a single tendon towards the insertion. A few fibers arise fleshily from the squamosal bone below the origin of the second tendon and are attached to a third tendon towards the insertion. The two tendons insert close to each other on the coronoid process of the surangular.

Unlike the brahminy myna, in the wagtail the origin of the upper fibers is mainly from an aponeurotic sheet arising from the zygomatic process and the lower fibers directly from the squamosal bone. Otherwise the muscle disposition is similar to that in the brahminy myna.

This muscle is innervated by a branch of Vth nerve.

The muscle assists in the adduction of the lower jaw by pulling it upward.

I b. **M. Adductor mandibulae medius** (Plates XI & XII)

The M. adductor mandibulae medius occupies the posterolateral region of the orbit and runs vertically towards the inner surface of the lower jaw. It is mostly
Jaw muscles of the wagtail viewed from the lateral side.

Fig. 1. Deeper view
Fig. 2. Deepest view

Abbreviations are same as in plates IX & XI.
Fig. 1.

Fig. 2.

PLATE - XII
covered by the M. adductor mandibulae externus and M. A.M.E. medialis.

Most of the muscle fibers in the brahminy myna arise in a broad fleshy origin from the squamosal and the orbitosphenoid bones inner to the origin of the M. A.M.E. medialis. These fibers run downward and attach to a tendinous sheet located towards the insertion. The fibers show a unipinnate pattern of arrangement. A small superficial aponeurotic sheet which originates from the cristae present on the posterior wall of the orbit forms the origin of the remaining fibers. All these fibers finally move downward to gain a common tendinous insertion on the inner side of the surangular.

In the wagtail the muscle fiber arrangement is complicated. The muscle fibers arise from the posterior wall of the orbit and inserted on three separate tendinous strips found attached to the belly of the muscle. The insertion is similar to that in the brahminy myna.

The M. A.M. medius is innervated by a branch of Vth nerve.

The contraction of this muscle creates an upward pull of the lower jaw.

II Adductors of the lower jaw and retractors of upper jaw

While describing these muscles, they are considered here as the adductors and their origins and insertions have been treated accordingly. In order to study them as retractors, their origins have to be considered as insertions and vice versa.
II a. **M. Pseudotemporalis profundus (Plates XI & XII)**

The *M. pseudotemporalis profundus* occupies a position between the anterior part of the orbital process of the quadrate and the medial surface of the lower jaw. Most of the origin is covered by the *M. A.M. medius*.

In both the animals studied here the origin of the muscle fibers is partly fleshy and partly aponeurotic. The muscle is provided with a small but strong aponeurotic sheet towards the tip of the orbital process of the quadrate. Most of the fibers arise fleshy from the tip of the orbital process. A few fibers also arise from the inner surface of the aponeurotic sheet. The aponeurotic sheet covers most of the fibers from above. As the muscle moves downward and forward towards the mandible, it becomes broad, massive and the fibers spread so as to cover almost the entire medial surface of the dentary around the foramen of mandibulae on which the muscle inserts fleshy. The muscle fibers show a unipinnate type of fiber arrangement.

The above mentioned description holds good for the muscles of the wagtail also.

The mandibular branch of the Vth nerve innervates this muscle.

This muscle works as a powerful retractor of the upper jaw and also as an adductor of the lower jaw. Its attachment over a large area on the medial side of the mandible creates a marked elevation of the lower jaw.
II b. **M. Adductor mandibulae posterior** (Plates XI & XII)

The M. Adductor mandibulae posterior is located deep in the posterolateral cheek region and is covered by the M. A.M.E. profundus. The muscle runs between the quadrate and the lower jaw.

In the brahminy myna the muscle fibers arise fleshily from the ventromedial edge of the orbital process of the quadrate. As the muscle fibers run downwards they gain insertion fleshily on the median surface of the articular bone, behind the posterior coronoid process. The fibers are arranged in a parallel fashion.

A branch of the Vth nerve innervates this muscle.

The muscle helps in the retraction of the upper jaw as well as in the adduction of the lower jaw.

This muscle shows similar development in the wagtail also.

II c. **M. Adductor mandibulae internus** (Plates XI & XII)

This is a very well developed muscle occupying the basal portion of the orbit. It extends between the dorsal surface of the palatine and the articular bone.

The muscle is divided into two parts viz., a *ventralis* and a *dorsalis*. Each of this part is further divided into an anterior and a posterior part.
II c.1  M. Adductor mandibulae internus ventralis anterior

The M. A.M.I. ventralis anterior is a massive muscle occupying the floor of the orbit. The muscle extends between the dorsal surface of the palatine and the articular bone.

In the brahminy myna this muscle arises in a broad fleshy origin along the outer lateral surface of the palatine. The origin covers the transpalatine below the orbital vacuity and the palatal folds along the ventral edge of the orbital septum. The muscle shows a parallel type of fiber arrangement. As the muscle fibers run backward and downward towards the mandible, it becomes narrow and get embedded in a tendinous sheet. This sheet inserts on the anteromedial margin of the inner articular process.

In the wagtail besides the fleshy origin a few fibers also arise tendinously from the transpalatine process and exhibit bipinnate arrangement. All the fibers which arise fleshy and from the tendon gain a common tendinous insertion on the inner articular process.

II c.2  M. Adductor mandibulae internus ventralis posterior

This is a well developed muscle extending between the posterior margin of the palatine and the articular bone. The muscle is covered mostly by the M. A.M.I. ventralis anterior.

In the brahminy myna this muscle arises from the
ventral surface and the posterior margin of the palatine. The anterior fibers take an aponeurotic origin from the ventral side of the palatine, mainly from the transpalatine. The posterior fibers take fleshy origin from the bony surface of the palatal complex. The muscle fibers show a bipinnate arrangement. As the muscle moves downwards and backwards towards the insertion, it covers the ventral surface of the angular bone. From here some fibers move upward so as to cover almost the distal tip of the angular bone along the outer surface. The inner fibers insert aponeurotically on the inner articular process whereas the outer fibers insert fleshy on the ventral surface of the articular bone anterior to the insertion of the M. depressor mandibulae.

In the wagtail the origin of all the fibers is fleshy from the transpalatine and the mediopalatine process behind the origin of its anterior counterpart. The fibers are embedded in a tendinous sheet which become narrow towards the insertion. The muscle inserts tendinously on the inner articular process behind that of the insertion of its anterior counterpart.

The muscle is innervated by the maxillary branch of Vth nerve.

This muscle is a powerful retractor of the upper jaw. Contraction of this muscle gives a backward pull on the palato-pterigo-quadrate complex which results in the downward pull on the upper beak and an upward pull on the mandible concomitantly. Extension of the insertion of the M. A.M.I. ventralis posterior over the outer side of the articular bone of the mandible holds the lower jaw firmly
against quadrate and prevents the backward disarticulation of the jaw.

II d.1  *M. Adductor mandibulae internus dorsalis anterior*

This is a small muscle extending between the orbital septum and the articular bone, running anterior to the pterygoid and posterior to the *M. A.M.I. ventralis*.

In the brahminy myna this muscle arises in a fleshy origin from the outer surface of the pterygoid along the posterior three fourth of its length. The muscle fibers are arranged in a parallel fashion. As the muscle moves backwards, downwards and outward, it becomes narrow where the superficial fibers are attached to an aponeurotic sheet. This aponeurotic sheet gains insertion on the base of the inner articular process. The remaining fibers insert fleshily on the base of the inner articular process below the aponeurotic insertion.

In the wagtail also the origin is fleshy and extends up to the base of orbital septum. As the muscle fibers move backward and downward they gain attachment to an aponeurotic tendon so as to form a unipinnate pattern of fiber arrangement. The muscle inserts tendinously on the base of the inner articular process.

II d.2  *M. Adductor mandibulae internus dorsalis posterior*

The muscle extends between the base of the orbital septum and the inner articular process behind the pterygoid bone.
In the brahminy myna the muscle fibers arise fleshily from the pterygoid and attach to two tendons which also arise from the pterygoid, in a bipinnate arrangement. The two tendons merge together towards the insertion and gain insertion on the inner articular process.

In the wagtail the tendons are not observed. Instead, there is an aponeurotic sheet on which all the fibers are attached in a parallel fashion. The insertion is same as in the brahminy myna.

The muscle is innervated by the maxillary branch of the Vth nerve.

The M. A.M.I. dorsalis serves as a retractor of the upper jaw. The contraction of this muscle results in the backward pull of the pterygoid which pulls the palatine backward resulting in a downward movement of the upper jaw. It also helps in a backward movement of the quadrate which pulls the mandible posteriorly bringing the elevation of the lower jaw.

III Abductors of the lower jaw

M. depressor mandibulae (Plates XI & XII)

The M. depressor mandibulae is a broad massive muscle occupying the posterolateral position of the cranium behind the tympanum. The muscle extends from the occipital region to the retroarticular and the internal process of the mandible.
PLATE XIII

Fig 1 Nerve supply of the jaw muscles of the brahminy myna

Fig 2 Nerve supply of the jaw muscles of the wagtail

Nerve supply of jaw muscles

Fig. 1.

Fig. 2.

PLATE—XIII
In the brahminy myna the muscle fibers arise fleshily from the squamosal and the exoccipital bones, slightly spreading over the supraoccipital bone. They are attached to a tendon located in the belly of the muscle in a bipinnate arrangement. Towards the insertion some of the superficial fibers attach on an aponeurotic sheet which inserts on the posterior articular process along the entire ventrolateral surface. The remaining fibers insert fleshily on the posterior articular process below the tendinous insertion.

In the wagtail the fibers arise in a broad fleshy origin from the squamosal and the exoccipital bones. The belly of the muscle is devoid of a tendon as in the brahminy myna. Consequently the arrangement of the fibers is parallel. The fibers gain a tendinous insertion on the articular process behind the articulation.

The muscle is innervated by a branch of the Vth nerve.

The muscle is a powerful depressor of the lower jaw. The contraction of the muscle elevates the posterior articular process of the mandible behind its articulation with the quadrate. Thus the lower jaw is drawn away from the upper beak.

IV The protractor of the upper beak

M. Spheno-pterigo-quadratus (Plates XI & XII)

This muscle occupies the inner margin of the orbit and is located behind and inner to the M. A.M.I. dorsalis posterior.
In the brahminy myna as well as in the wagtail the muscle arises in a broad fleshy origin from the laterosphenoid bone. The origin extends over the orbitosphenoid and the antero-lateral margin of the basisphenoid bone. The muscle coverages as it runs towards the insertion. A few fibers are attached to an aponeurotic sheet so as to form a cover to these fibers. These fibers show a unipinnate arrangement. This aponeurotic sheet inserts on the base of the pterygoid bone near the quadrate pterygoid articulation. The remaining fibers which show a parallel arrangement insert fleshily on the dorsal surface of the base of the orbital process of the quadrate.

This muscle is innervated by the maxillary branch of Vth nerve.

The contraction of this muscle causes a pull on the quadrate. As a result of this pull, the quadratojugal bar and the pterygoid palatine arcade are pushed forward bringing the protraction of the upper jaw.

**V. Intermandibularis (Plates XIV & XV)**

The M. intermandibularis is a superficial sheet like muscle occupying the ventral surface of the lower jaw in between the mandibular rami.

In both the animals the muscle fibers arise in a parallel fashion from the inner surface of the surangular and the dentary in a narrow linear origin. The muscle fibres run inward towards the median line in such a way that the anterior fibers run almost parallel behind the symphysis. However, posteriorward, the fibers run gradually backward forming an acute angle on the median line. The muscle gains
PLATE XIV

Mandibular and hyoid muscles of the brahminy myna (Ventral view).

Fig. 1. Muscles shown after the removal of superficial layer from one side.

Fig. 2. Hyoid and associated muscles.

BRAN.MAND.ANT.- M. Branchiomandibularis anterior; 
BRAN.MAND.POST.- M. Branchiomandibularis posterior; 
CR.HY.- M. Cricohyoideus; DEP.MAND.- M. Depressor mandibulae; GUL. ANT.- M. Gularis anterior; GUL.POST.- 
M. Gularis posterior; HY.GL.- M. Hypoglossus; HYP.GL.ANT.- 
M. Hypoglossus anterior; HYP.GL.POST.- M. Hypoglossus posterior; IN.KER.- M. Interkeratoideus; STER. HY.- 
Sternohyoideus; TRAC.- Trachea; TRAC.HY.- M. Tracheohyoideus.
insertion on the median raphe where it meets its counterpart. Both the origin and insertion are fleshy.

The muscle is innervated by the maxillary branch of the Vth nerve.

By the contraction of this muscle the floor of the buccal cavity is raised.

THE TONGUE MUSCLES

1  **M. Gularis** (Plates XIV & XV)

This is a long, thin, tapering muscle situated along the ventral side of the lower jaw. The anterior portion of the muscle is covered by the M. intermandibularis from below. The muscle consists of an anterior and a posterior part.

1 a. **M. Gularis anterior**

This is a long, thin, flat, tapering muscle which extends between the ventral surface of the articular bone and the basihyal element of the hyoid apparatus.

In the brahminy myna the muscle arises fleshtily from the ventral surface of the articular bone as a broad sheet. The origin covers from above a small portion of the insertion of the M. adductor mandibulae internus ventralis posterior. As the muscle moves forwards and inwards gradually becomes narrow and inserts fleshtily on the posterolateral surface of the basihyal. The fibers are
Mandibular and hoid muscles of the wagtail (Ventral view)

Fig. 1. Muscles shown after the removal of the superficial layer from one side.

2. Hyoid and associated muscles

Abbreviations are same as in Plate XIV
arranged in a parallel fashion.

In the wagtail the muscle becomes compact and massive towards the basihyal. Here some fibers separate from the main mass and move anterioward to insert on the buccal floor near the symphysis of the mandible.

1 b. **M. Gularis posterior**

The **M. gularis posterior** is a broad triangular muscle situated behind the intermandibularis and inner to the **M. gularis anterior**.

In both the animals the muscle fibers take a narrow fleshy origin from the crista of the basitemporal plate and the exoccipital bone. The fibers are arranged in a parallel fashion. The muscle becomes gradually broad as it moves anteriowards and inwards towards the insertion where the muscle meets its counterpart along the midline forming a median raphé.

Both parts of the muscle are innervated by the VIIth nerve.

The contraction of the anterior part brings about the withdrawal of the tongue whereas the posterior part by its action raises the floor of the buccal cavity.

2 **M. Branchiomanndibularis** (Plates XIV & XV)

The **M. branchiomanndibularis** is a strap shaped parallel fibered muscle extending between the mandibular
ramus and the posterior cornua of the hyoid apparatus. As observed from the ventral side most of the muscle remains superficial except the midportion which is covered by the M. gularis muscle. The muscle is divided into two parts, an anterior and a posterior one.

In the brahminy myna as well as in the wagtail both the slips arise independently by fleshy origins close to each other from the inner surface of the angular and the surangular bones, ventral to the origin of the M. intermandibularis. The muscles run parallel to each other towards the insertion. Both the muscles merge towards the insertion and ensheath the posterior region of the ceratobranchial and epibranchial elements. The insertion is on the distal end of the epibranchial.

The M. branchiomandibularis is innervated by the IXth nerve.

The muscle helps in protruding out the tongue.

3 M. Interkeratoideus (Plates XIV & XV)

This is a very thin parallel fibered sheet of muscle running between the urohyal and the ceratobranchial elements of the hyoid apparatus.

In the brahminy myna the muscle takes a fleshy origin from the medial surface of the distal end of the ceratobranchial, immediately anterior to its articulation with the epibranchial. The origin is completely covered by the M. branchiomandibularis.
As the muscle moves forward and inward it meets its counterpart on the median raphe ventral to the urohyal.

The muscle has a dual function. It assists the intermandibularis in raising the floor of the buccal cavity. Besides, it also helps the M. branchiomandibularis in protruding the tongue.

The structure of the muscle is more or less similar in the wagtail.

4. M. Hypoglossus (Plates XIV & XV)

The M. hypoglossus is divided into an anterior and a posterior parts. The anterior part may be feebly developed or absent.

The hypoglossus anterior is absent in the brahminy myna. The hypoglossus posterior is a broad, transverse band of muscle fibers connecting the two paraglossae. The muscle originates fleshily from the whole cup-like depression of the paraglossae. The fibers from each side meet in the midline to form a single muscle in appearance. The muscle fibers show a parallel arrangement.

In the wagtail the M. hypoglossus anterior as well as the M. hypoglossus posterior is present. The anterior part is very feebly developed. The muscle meets its counterpart along the midline between the two paraglossae.

The hypoglossus muscle is innervated by the XIIth nerve.

Both the parts of the muscle help in the depression of the tongue.
5. **M. Hyoglossus (Plates XIV & XV)**

This is a long muscle extending between the ceratobranchial and the paraglossum. In the brahminy myna, the muscle arises in a fleshy origin from the junction between the epibranchial and the ceratobranchial. The origin continues along the inner surface of the ceratobranchial till three fourth of its length. The fibers attach to a large and tough tendinous cord giving a bipinnate structure. This tendinous cord inserts on the ventral side of the paraglossum.

In the wagtail the muscle takes a fleshy origin from the inner lateral sides of the anterior part of the epibranchial and along the three fourth of the ceratobranchial. Insertion is similar to that in the brahminy myna.

The muscle is innervated by the XIIth nerve.

The M. hyoglossus acts as a strong depressor of the tongue.

6. **M. Sternohyoideus (Plates XIV & XV)**

This is a long and thin ribbon-shaped muscle extending between the sternum and the cricoid cartilage. The muscle runs on either side of the trachea with which it is attached.

In both the animals the muscle arises fleshily from the sternocoracoid process of the sternum and shows a
parallel type of fiber arrangement. As the muscle moves forward it gradually becomes narrow and inserts fleshily on the ventral surface of the cricoid cartilage.

The M. sternothyroides is supplied by a branch of the XIIth nerve.

The muscle depresses the tongue along with the other muscles.

7  M. Tracheothyroides (Plates XIV & XV)

The M. tracheothyroides is a long ribbon-like parallel fibered muscle extending between the syrinx and the cricoid cartilage.

In the brahminy myna the muscle has a dual origin with two heads, one on the ventrolateral and the other on the dorsolateral surface of the syrinx. Both the origins are narrow and fleshy. As the two parts of the muscle move toward the insertion, merge together to form a common muscle to run along the lateral surface of the trachea. Towards the insertion also the muscle forms two heads each of which inserts independently on the sides of the cricoid cartilage.

In the wagtail all the muscle fibers arise fleshily from the syrinx laterally, runs along the trachea and insert on the cricoid cartilage as in the brahminy myna.

The muscle is innervated by the XIIth nerve.
The muscle acts as a depressor of the tongue and also assists in the withdrawal of the tongue back into the buccal cavity.

8 M. Cricohyoideus (Plates XIV & XV)

This is a small compact muscle running between the cricoid cartilage and the basihyal. The muscle occupies a slightly oblique position along the urohyal.

In the brahminy myna the muscle arises from the ventral surface of the cricoid cartilage in between the insertions of the M. sternohyoideus. As the muscle moves forward it gains insertion on the lateral surface of the basihyal. Both the origin and the insertion are fleshy in nature.

In the wagtail the origin consists of two slips. Each slip arises fleshily from the cricoid cartilage on either side of the insertion of the tracheohyoideus and the sternohyoideus. The inner slip is slightly larger than the outer one. As the muscle moves anteriorly the two slips merge together and gain a fleshy insertion on the lateral surface of the basihyal as in the brahminy myna.

The M. cricohyoideus is innervated by XIIth nerve.

By its contraction, the muscle helps in the depression of the tongue.
THE NECK MUSCLES

Based on their disposition the major neck muscles have been divided into three sets as follows, viz., a dorsal, a lateral and a ventral sets.

A The muscles of the dorsal set
1. M. Complexus
2. M. Biventer cervicis
3. M. Spinalis cervicis
4. M. Splenius colli
5. M. Ascendentes cervicis
6. M. Splenius capitis
7. M. Rectus capitis superior

B The muscles of the lateral set
1. M. Intertransversarii
2. M. Rectus capitis lateralis

C The muscles of the ventral set
1. M. Rectus capitis ventralis
2. M. Flexor colli brevis
3. M. Flexor colli profundus
4. M. Longus colli ventralis

The structure and the disposition of the neck muscles of the brahminy myna are described in detail and only the variations, if any, in the neck muscles of the wagtail have been noted.
The muscles of the dorsal set

A 1. M. Complexus (Plate XVI)

The M. complexus is a broad, flat, ribbon-shaped muscle connecting the posterolateral region of the skull with the anterior lateral part of the neck. It extends from the vertebra 6 to the wall of the cranium.

The muscle comprises three slips. Each slip arises by a tendon from the anapophysis of the vertebra 4 and from the tubercle on the transverse processes of the vertebrae 5 and 6 respectively. All the three slips are well developed and move anteriorward to form a single sheet of muscle. However, the muscle mass is partitioned by three intersections and the fibers show parallel arrangement. The insertion is fleshy on the occipital crest.

In the wagtail the first two slips of the M. complexus arise fleshily and the third slip arises aponeurotically.

The contraction of the muscle results in raising of the head. However, the contraction of the one side muscle brings about moderate turning of the head and a lateral bending of the first section.

A 2. M. Biventer cervicis. (Plate XVI)

This is a long slender muscle extending between the vertebra 14 and the posterior region of the skull. It has two bellies, an anterior and a posterior one connected by a common tendon.
PLATE XVI

Fig. 1. Neck muscles of the brahminy myna
Fig. 2. Neck muscles of the wagtail
Fig. 3. (a) Anterior neck muscles of the brahminy myna after removal of superficial muscles.
(b) Anterior neck muscles of the wagtail after removal of superficial muscles.

ASC.CER.- M. Ascendentes cervicis;
BIV.CER.- M. Biventer cervicis;
COMPL.- M. Complexus;
IN.TR.- M. m. intertransversarii;
FIX.COL.BREV.- Flexor colli brevis;
L.C.V.- M. Lângue colli ventralis;
R.C.L.- M. Rectus capitis lateralis;
R.C.V.- M. Rectus capitis ventralis;
R.C.S.- M. Rectus capitis superior;
SP. CER.- M. Spinalis cervicis;
SPL.CAP.- M. Splenius capitis
PLATE - XVI
In both the birds the muscle has a tendinous origin from the neural spine of 14. The tendon is bound with the aponeurosis of the M. spinalis cervicis (to be described) along the medial edge of the neural spine of 13. The muscle fibers of the posterior belly arise from the dorsal side of this tendon at the level of 12. The fibers run anteriorly up to the level of 8 where they are attached on the ventral surface of another tendon. This tendon runs up to the level of 4 and the fibers of the anterior belly arise from the dorsal side of it. Some of the superficial fibers insert on the ventral side of a short, thin aponeurosis attached to the occipital bone immediately below the insertion of the M. complexus. The rest of the fibers gain a fleshy insertion on the occipital bone below the aponeurotic insertion.

The muscle tilts the depressed head around the pivot formed by the atlas and the occipital condyle. In addition to this the muscle also arises the section I over II and the section II over III.

M. Spinalis cervicis (Plates XVI & XVII)

This is a large complex muscle consisting of 10 slips placed towards the dorsolateral side of the cervical muscle mass and ventral to the M. biventer cervicis. The muscle extends between the vertebrae 16 and 2.

The muscle arises from a well developed, broad aponeurotic sheet from the neural spine of 16. This aponeurotic sheet runs antero-laterally and the muscle
Diagrammatic representation of muscle slips of

Fig. 1. M. ascendentes cervicis of the brahminy myna
Fig. 2. M. ascendentes cervicis of the wagtail
Fig. 3. M. spinalis cervicis and M. splenius colli of the brahminy myna
Fig. 4. M. spinalis cervicis and M. splenius colli of the wagtail.
Fig. 5. M. longus colli of brahminy myna
Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

PLATE-XVII
slips take a common origin along the aponeurotic sheet at the level of 14. As the muscle moves forwards, splits into 10 slips. All the slips run obliquely forward and outward toward the sites of aponeurotic insertion on their respective vertebrae.

The last slip which is dorsalmost in position, runs anteriorward below and parallel to the M. biventer cervicis. The slip is massive with a very well developed belly. Its muscle fibers attach to a long tendon at the level of 4. This tendon finally gets inserted on the anapophysis of the axis. All the other slips are inserted tendinously on the anapophyses of the vertebrae 14 through 6. The second, third, fourth and fifth slips share their tendinous insertion with the M. ascendentes cervicis (to be described). The remaining slips insert directly on the anapophyses of the vertebrae 10 through 14.

In the wagtail only seven slips are present. The muscle splits at the level of 12. The posterior six slips share insertion along with the insertion of the M. ascendentes cervicis on the anapophyses of the vertebrae 11 through 6.

The contraction of the anteriormost slip straightens the sections I and II. The remaining slips bring about the raising of the section II and III. However, the contraction of the muscle of one side results in a lateral bending of the neck.

A 4 M. Splenius colli (Plates XVI & XVII)

The M. splenius colli is situated below the anterior
part of the spinalis cervicis. It comprises 5 slips running from the neural arches of the vertebrae 7 through 3 to the long tendon of the M. spinalis cervicis.

In both the birds each slip arises fleshily from the anterior and the lateral sides of the neural spines of 7 through 3. The anterior 4 slips are more developed than the fifth one.

All the slips except the anteriormost i.e., the one which arises from the neural spine of 3, insert along the strong tendon of the M. spinalis cervicis on the anapophysis of the axis. The fibers of the anteriormost slip is attached to an aponeurotic sheet which inserts inner and close to the insertion of the other slips on the anapophysis of the axis. The muscle fibers exhibit a weak unipinnate structure.

The contraction of this muscle causes flexing of the first section of the neck.

A 5 M. Ascendentes cervicis (Plates XVI & XVII)

The muscles of the M. ascendentes cervicis are a series of overlapping forms which lie along the dorsal part of the neck.

The muscle arises from the transverse processes and the diapophyses of the vertebrae 15 through 4. The muscle arising from the vertebrae 15 and 4 has only one slip each and those arising from the vertebrae 14, 9 through 7 and 5 are with two slips. All the other muscles have three slips. Out of the three slips the superficial slip reaches
the third vertebra anterior, the middle one to the second vertebra anterior and the inner one to the first one anterior. The anteriormost muscle is connected with the third slip of the M. complexus by an aponeurosis. Besides, the slips of all the muscles are connected superficially with the aponeurosis of the intertransversarii. Further, the muscles arising from the vertebrae 12 through 8 share their insertion with the tendinous insertion of the M. spinalis cervicis. The insertion is on the anapophyses of the vertebrae 13 through 3.

In the wagtail each muscle arises in a tendinous origin from the lateral tubercles and the transverse processes of vertebrae 14 through 4. Each muscle splits into two slips except the one arising from the vertebra 7 which has an additional third slip.

The contraction of the M. ascendentes cervicis causes the straightening of the first section and raising it on the second section. Besides bending both the first and the second section, the muscle also flexes second section on the third. The contraction of the one side muscle brings lateral bending of the neck.

A 6  M. Splenius capitis (Plate XVI)

The M. splenius capitis is a stout, well developed triangular shaped muscle lying deep to the M. complexus and the M. biventer cervicis. The muscle extends between the vertebra 2 (axis) to the posterior wall of the cranium.
The muscle fibers take partly aponeurotic and partly fleshy origin from the neural spine of the axis. Most of the fibers arise from the aponeurosis. The rest of the fibers arise fleshily from the lateral and the posterior part of the neural spine. The fibers show a dipinnate arrangement. As the muscle runs cephalad, gradually becomes broad and gains a fleshy insertion on the occipital region below the insertion of the M. complexus and the M. biventer cervicis.

The contraction of the muscle brings about the tilting and raising of the head.

A 7 M. Rectus capitis superior (Plate XVI)

The M. rectus capitis superior is situated towards the ventrolateral side of the anterior neck region. Laterally its anterior region is covered by the overlying muscles, viz., the M. rectus capitis lateralis.

The muscle extends between the first 4 vertebrae and the posterior ridge of the basioccipital plate. The muscle has an aponeurotic origin from the transverse process of 4 and the anapophysis of 3. Below the aponeurotic origin, some of the fibers take a small tendinous origin from the anapophysis of 3. The rest of the fibers arise aponeurotically from the neural arches of 2 and 1.

As the muscle moves anteriorward all the slips from their respective vertebrae join to form the mass of muscle which runs downward towards the basioccipital plate. Most of the fibers converge on the dorsal surface of a broad aponeurosis and insert on the transverse ridge.
of the basitemporal plate. The remaining fibers gain a fleshy insertion above the aponeurosis on the basitemporal plate.

In the wagtail this muscle extends between the vertebrae 3 and the basitemporal plate. The disposition of the muscle is same as in the brahminy myna.

By its contraction the muscle tilts the head downward and also flexes the first section downward.

8 The muscles of the lateral set

8 1 M. Intertransversarii (Plate XVI)

The M. intertransversarii constitutes the main lateral musculature of the neck. It consists of a series of well developed muscle bellies with multipinnate fiber arrangement, connecting the transverse processes of the adjacent vertebrae. The muscle shares its aponeurosis and tendons with the ascendentes cervicis and with the M. longus colli ventralis. Medially the muscles are intimately and inseparably connected with the M. inclusi (Boas).

The fibers of the belly which run between the transverse processes or the aponeuroses are very short whereas the aponeuroses are long and almost overlap the succeeding belly.

Due to the complexity of the aponeurosis and the differences in the number among the muscle bellies of this series, the aponeuroses located towards the origin and the insertion have been termed as I and II respectively (Zusi & Storer). The positions of the attachment of I and II on
the dorsal tubercle are termed as Id, IId and those with the ventral lateral tubercle are termed as Iv and IIv respectively.

In the section I the origin of the muscle is partly aponeurotic and partly fleshy from the lateral and the transverse processes. The aponeurosis Iv arises from the costal processes of 4. The fibers arising from the outer face of the aponeurosis share their insertion with the aponeurosis of M. longus colli ventralis. The fibers from the inner face insert tendinously on the vertebra 3. The aponeurosis Id arises from the anterior part of the transverse process and the fibers arising from it run anteriorward and end on the posterior edge of the transverse process of the vertebra 3.

In the second section the superficial aponeurosis Iv extend beyond the next transverse process and the fibers fan out to several vertebrae. The fibers from Iv of the costal processes of vertebrae 7 through 5 extend forward beyond the transverse processes of the succeeding vertebrae and insert tendinously along the insertion of the M. longus colli ventralis on the cervical ribs. The fibers which arise from the inner surface of Iv insert on the inner surface of IIv of the successive vertebrae. The aponeurosis Id arises from the transverse processes and the fibers from it insert on the IId of the preceding vertebrae. One or more aponeuroses of origin I arise from the tubercles of the transverse processes of 8 and 9 and run forward to interleave with the aponeurosis of insertion II. The fibers from the aponeurosis Id insert on the aponeurosis of insertion IId. The aponeuroses Iv are flat and sheet-like. The fibers arising from the outer surface of Iv insert...
on IIId and II Iv. Those fibers which arise from the inner surface of IV are inserted on the centra of their preceding vertebrae.

In the third section also the origin of the muscle is partly fleshy and partly aponeurotic. The fibers arising from IIId end on the aponeurosis of insertion IIId of the preceding vertebrae. Some fibers also fan out from the lateral faces of the aponeurosis IV and end on the lateral face of the aponeuroses IIId and II Iv. A few fibers arising from the medial surface of IIId and IV end directly on the body of the preceding vertebrae. The remaining fibers arise directly from the body of the vertebra and end on the tendon of the insertion of the M. longus colli ventralis.

The contraction of this muscle brings about the lateral bending of the neck. However, it also straightens the entire cervical region.

The disposition of this muscle in the wagtail is similar to that of the brahminy myna.

B 2 M. Rectus capitis lateralis (Plate XVI)

This is a thin strap-shaped muscle occupying a superficial position on the lateral side of the cranio-cervical region. The muscle extends between the vertebra 4 and the cranium. The origin is covered by the M. rectus capitis ventralis and the M. rectus capitis superior.

In both the birds the muscle fibers arise aponeurotically from the aponeuroses of 4, 3 and 2. The remaining fibers arise fleshy from the lateral surfaces of the hypapophyses. The fibers run anteriorward toward
the lateral side of the cranium to gain a common fleshy insertion on the occipital region between the insertions of the M. splenius capitis and the M. depressor mandibulae.

The contraction of this muscle tilts the head and also bends the section I sideward.

C  The muscles of the ventral set

C 1  M. Rectus capitis ventralis (Plate XVI)

The M. rectus capitis ventralis is the most superficial muscle of the anteroventral portion of the neck. The muscle extends between the basi-temporal plate and the vertebra 5.

The muscle takes its origin tendinously from the hypapophyses of the vertebrae 4 through 1 as well as from a tendon connecting the sublateral process of 5 with the hypapophysis of 4. All the fibers run cephalad and form two bellies which are separated by the intervening dorsal carotid arteries. As the muscle moves forward, gains insertion fleshily on the basi-temporal plate.

The only difference in the wagtail is that there are no fibers taking origin from the atlas (1) as seen in brahminy myna.

The muscle functions as a downward flexor of the section I. The contraction of the muscles of one side turns the head laterally.
C 2  M. flexor colli brevis (Plate XVI)

The M. flexor colli brevis is a flat fan-shaped muscle occupying the lower half of the anterior region of the neck. The muscle lies deep to the M. rectus capitis superior.

The muscle comprises 4 slips towards the origin. The posteriormost slip arises fleshly from the transverse process of the vertebra 5 and from an aponeurosis extending anteroventrally from the transverse process. The other slips arise from the transverse process and the lateral strut of 4, from the lateral strut and the costal process of 3 and from the costal process of 2. A few fibers arise from the lateral surface of a superficial aponeurosis of the M. intertransversarii which attach to the sublateral process of 3.

All the slips move forward ventromedially, merge to form a single muscle. The muscle fibers end on an aponeurosis towards the ventrolateral surface of the muscle. This aponeurosis becomes a strong tendon towards the insertion and attaches on the centrum of the atlas.

The wagtail does not show any fibers taking origin from the aponeurosis of the M. intertransversarii as seen in the brahminy myna.

The muscle serves as a ventral flexor of the section I. In addition to this it helps in bending the section I sideward.

C 3  M. flexor colli profundus

The M. flexor colli profundus lies deep on the
anterolateral portion of the neck and extends between the vertebrae 7 and 2.

Some of the muscle fibers arise along a long tendon from the sublateral process of 7. Some of these tendinously arising fibers are inserted on a tendon of the M. longus colli ventralis. The remaining fibers and the fibers arising from the costal processes of 3 and 4 move anteriorward and attach on a tendon which finally inserts on the hypapophysis of the axis.

The structure and disposition of this muscle in the wagtail is similar as observed in the brahminy myna.

The muscle serves as a downward flexor of the section I due to its contraction.

C 4 M. Longus colli ventralis (Plates XVI & XVII)

The M. longus colli ventralis series of muscles lie on the ventral side of the neck. Each of its individual members are divided into an overlapping series of 1 to 7 slips. The muscles together, extend between the vertebrae 3 and 13. The major part of the muscle lies posteriorly.

In both the birds the slips of the muscles arising from the vertebrae 6 through 4 have fleshy origins from the hypapophyses and the sublateral process of the respective vertebrae. There are 7 slips from the vertebrae 13 and 12, 6 slips from 11, 5 slips from 10, 4 slips from 9, 3 slips from 8, 2 slips from 7 through 5 and 1 slip from 4 to 3. The bellies of the first section are relatively shorter than the second section. The muscle bellies of the second section also take origin from the hypapophyses and the sublateral process. In this section the muscle bellies
are with long tendons receiving the main bulk of the fibers arising from the hypapophyses and the remaining fibers from the sublateral process. In the third section the muscle slips arise tendinously from the hypapophyses and the transverse processes of the respective vertebrae. The muscle slips are attached to their respective tendons which finally get inserted on the ribs of 12 through 3.

The contraction of the muscle bends the first section laterally, flexes it downward and also lowers it on the second section. The muscle also straightens the second section, lowers it on the third section.