A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART, AVES VI. TROGONIFORMES, PART 1.

BY FRED H. GLENNY[1]

INTRODUCTION

IN several recent papers, the writer has presented the important features and arrangements of the main arteries in the neck and thorax of several families and orders of birds. In addition to the functional vessels of the adult, the writer has included notations on the persistence of certain vestiges of embryonic vessels.

During these studies, the writer has observed that within orders and even families of birds there is a certain constancy in the arrangement-pattern of the main arteries in the region of the neck and thorax of birds. In the present paper, the writer presents the basic arrangement-pattern of the arteries as found in several species of trogons.

Materials for this study were made available through the coöperation of Dr. Alexander Wetmore, Assistant Secretary, Smithsonian Institution, and Dr. Herbert Friedmann, Curator, Division of Birds, United States National Museum.

MATERIALS

Single specimens of eight species of trogons were dissected and the arrangement of the arteries compared. Specimens of *Chrysotrogon caligatus* (Gould), *Priotelus temnurus* (Temminck), *Pyrotrogon erythrocephalus* (Gould), *Temnotrogon roseigaster* (Vieillot), *Curucujus (Trogon) massena* (Gould), *Trogon melanocephalus* Gould, *Trogon strigilatus* Linné, and *Trogonurus variegatus behni* (Gould) were included in this study.

The information thus obtained is set forth in the following observations.

OBSERVATIONS

The basic arrangement of the main arteries in the neck and thorax is essentially the same in each of the species studied.

The left and right innominate arteries arise from the aortic root and pass anteriorly and laterally to divide into the common carotid and subclavian arteries. The right systemic arch alone persists as the functional 4th aortic arch which joins the right radix aortae. The subclavian arteries each receive the coracoid major, axillary, inter-

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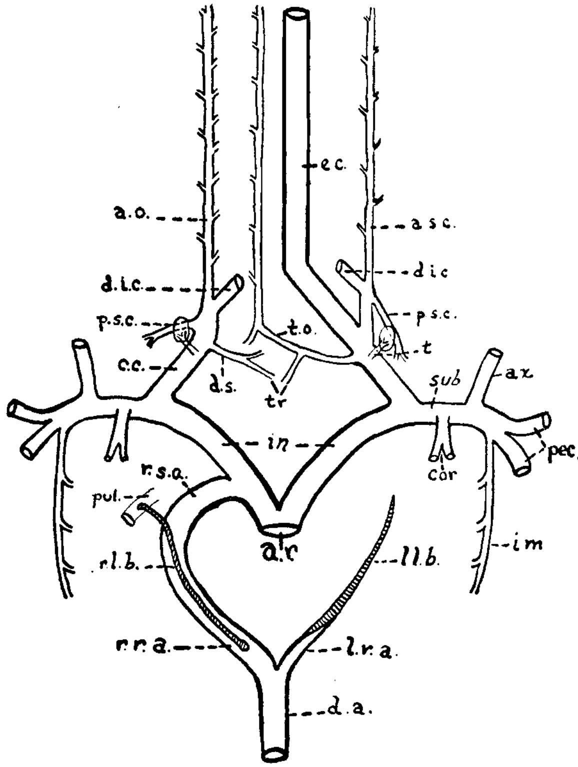
costal, and two pectoral arteries in order. The intercostal artery arises from the subclavian artery at the base of the posterior pectoral artery.

The left common carotid artery gives rise to the ductus shawi (a tracheo-oesophageal artery), thyroid, internal carotid, superficial cervical, and vertebral arteries. The ductus shawi sends off branches to the syrinx, trachea, and oesophagus anteriorly and to the oesophagus and accessory tissues posteriorly. The left internal carotid artery alone enters the hypapophysial canal and passes anteriorly along the median-ventral line of the neck. The superficial cervical artery gives rise to the vertebral and basi-cervical arteries before passing anteriorly to supply the musculature of the neck. The vertebral artery passes dorsally, in the region of the brachial plexus, and anteriorly. The basi-cervical artery passes posteriorly to the musculature of the shoulder. The thyroid artery arises at the point of bifurcation of the common carotid artery.

The right common carotid artery gives rise to the basi-cervical, thyroid, ascending-oesophageal, superficial cervical, vertebral, and ductus shawi arteries. The right basi-cervical artery supplies the musculature of the right shoulder. The right ductus shawi supplies the right side of the trachea and syrinx as well as the base of the oesophagus. The ascending-oesophageal artery is comparable to the left internal carotid and serves to supply the right face of the oesophagus as well as the muscles on the right side of the neck. The superficial cervical of the right side may or may not be present, but when present generally arises as a small branch of the ascending-oesophageal artery.

The left ligamentum aortae is present and entire in *Chrysotrogon caligatus, Priotelus temnurus, Pyrotrogon erythrocephalus,* and *Trogonurus variegatus behni;* and in *Temnotrogon roseigaster, Curucujus massena, Trogon melanocephalus,* and *Trogon strigilatus* the distal portion of the radix presents at least a short lumen while the anterior portion persists as the ligamentum aortae.

The right ligamentum botalli is minute and tends to fuse with the right radix aortae in *Chrysotrogon caligatus, Pyrotrogon erythrocephalus, Temnotrogon roseigaster, Curucujus massena,* and *Trogon strigilatus.* In *Trogonurus variegatus behni* the embryonic ductus arteriosus remains only as a small ligamentous 'button' and marks the distal attachment of the ductus to the right radix, while the ligamentum botalli is very prominent in *Trogon melanocephalus* and absent (probably entirely fused to the radix) in *Priotelus temnurus.*



TEXT-FIG. 1.—Diagrammatic representation of the main arteries in the neck and thorax of *Trogon melanocephalus*. Ventral view.

a.o., ascending-oesophageal artery.
a.r., aortic root.
a.s.c., superficial cervical artery.
ax, axillary artery.
c.c., common carotid artery.
cor, coracoid major artery.
d.a., dorsal aorta.
d.i.c., vertebral artery.
d.s., right ductus shawi.
e.c., internal carotid artery.
im, intercostal artery.
in, innominate artery.
l.l.b., left ligamentum botalli.
l.r.a, ligamentum aortae.
pec, pectoral arteries.
p.s.c., basi-cervical artery.
pul., pulmonary artery.
r.l.b., right ligamentum botalli.
r.r.a., right radix aortae.
r.s.a., right systemic (4th aortic) arch.
sub, subclavian artery.
t, thyroid artery.
t.o., left ductus shawi
 (tracheo-oesophageal artery).
tr, tracheal branches of ductus shawi.

Discussion

From the above evidences, we may conclude that the species of trogons represented in this study show a characteristic relationship based on the arrangement-pattern of the main arteries in the neck and thorax. Variation in the degree of persistence of the left radix aortae and the right ductus botalli as ligamentous vestiges appears to be a specific or an individual matter and does not appear to have any generic value.

Although there are definite pattern-variations in the Coraciiformes, Anseriformes, Ciconiiformes, and other groups of birds, this is not the case in the trogons in so far as they could be represented in this study.

It may be observed that the left internal carotid artery alone enters the hypapophysial canal, whereas in some of the Coraciiformes, Anseriformes, Strigiformes, etc., both left and right internal carotids are present and enter the canal.

In the opinion of the writer, the trogons present a significantly characteristic pattern of the arteries in the neck and thorax region.

Summary

1. Eight species of trogons were dissected and drawings of the arrangement-pattern of the arteries in the neck and thorax prepared.

2. A single basic arrangement-pattern was found to be characteristic for the family.

3. Only slight variations in persistence of the ligamentous vestiges of the left radix aortae and right ductus botalli were recorded.

4. The left internal carotid artery alone entered the hypapophysial canal.

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HEARING RANGES OF FOUR SPECIES OF BIRDS

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IN continuing the experiments on the hearing of birds which the late Albert R. Brand and Prof. P. P. Kellogg began at Cornell University in 1938, observations have recently been made on the frequency range of hearing of four other species of wild birds in captivity. The apparatus used in the earlier experiments was placed at the author's disposal for the present experiments, and has made up a major part of the equipment used.

This series of experiments was begun in March, 1941, and is still in progress. The object of the work is to determine the frequency ranges of sounds to which different birds will respond. Observations have been completed on six captive individuals representing four species whose hearing ranges had not theretofore been investigated. These are as follows: one Canvas-back *(Nyroca valisineria)*; one Great Horned Owl *(Bubo virginianus)*; three Prairie Horned Larks *(Otocoris alpestris praticola)*; one Snow Bunting *(Plectrophenax nivalis)*.

An electric shock was used in teaching the birds to give a definite response when the sound stimulus was applied. Within one second after a pure tone was sounded close to the bird's cage, the bird was given an electric shock, and it soon learned that when the tone was sounded, a shock was imminent. Therefore, after a number of trials (usually 30 to 60) the bird began to respond to the sound as it did to the shock—by jumping or fluttering.

A beat-frequency oscillator was used to produce sounds with no overtones. Tones with frequencies from 20 to 17,000 vibrations per