ON THE CERVICAL AND THORACIC ARTERIES IN THE NORTHERN INDIAN GREEN BARBET, *THEREICERYX ZEYLANICUS CANICEPS* (FRANKLIN), TOGETHER WITH AN ANOMALOUS CASE OF REVERSAL OF THE INTERNAL CAROTID ARTERY

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INTRODUCTION.

In the course of studies on the cervical and thoracic arteries of birds, we have come across a unique reversed arrangement of the internal carotid artery in a specimen of the Northern Indian Green Barbet, *Thereiceryx zeylanicus caniceps* (Frankl.). So far as we are aware no such case has previously been recorded in any bird (*vide* Biswas, 1946, for a recent review of abnormal cases). Some species of Capitonidae have been studied by Garrord (1873), Glenny (1943*b*) and Bhaduri and Biswas (1945), but *Thereiceryx* is not in their list. We have, therefore, included an account of the normal arrangement of the anterior arteries in *T z. caniceps*.

The terminology used by Bhaduri and Biswas (1945) is followed herewith the exception of the syringeo-bronchial artery, which, especially its bronchial portion, represents Glenny's ' ductus shawi.'

The arterial system was injected in four specimens of *T. I. z. caniceps* in the usual way, and the observations are set forth in the following pages.

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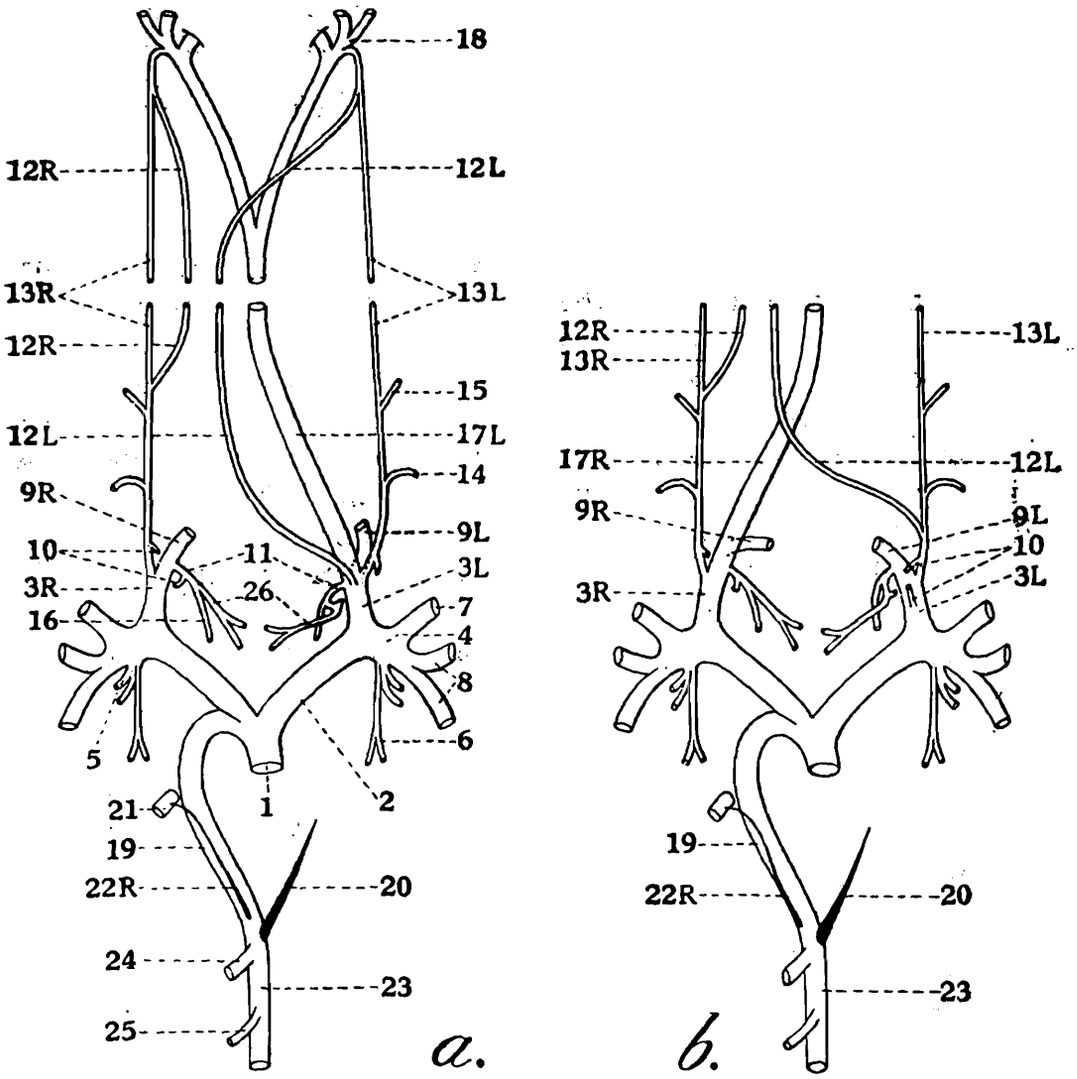
OBSERVATIONS.

In *Thereiceryx zeylanicus caniceps* the right and left innominate arteries (Text-fig. 1*a*, 2) arise from the aortic root (1) and pass on anteriorly and laterally to give rise to the common carotid (3) and subclavian (4) arteries. Each subclavian gives off the juxtaposed sterno-clavicular (5) and internal mammary (6) arteries and the axillary (7) and two pectoral (8) arteries in that order as in other Capitonids.

The left common carotid (3L) runs forward and in the region of the thyroid gland, gives off a vertebral (9L) from the dorsal side, a comes nervi vagi (13L) from the outer side, an ascending oesophageal (12L) from the ventral side and a syringeo-bronchial (11) from the inner side. The thyroid gland receives a small twig from the syringeo-bronchial stem. The left internal carotid artery (17L) alone enters the hypapophysial canal and proceeds cephalad, bifurcating eventually into right and left branches. The comes nervi vagi artery courses anteriorly, giving rise to the subscapular (14) and the cervical cutaneous (15) branches. The ascending oesophageal passes along the oesophagus towards the head.

On the right side, the common carotid (3R), in the region of the thyroid gland, passes on dorsally to become the vertebral artery (9R). The



Text-fig. 1.—Diagrammatic representation of the main cervical and thoracic arteries in *Thereiceryx zeylanicus caniceps.*

a, normal condition; *b*, abnormal case. (Ventral views.)

1, Aortic root; 2, Innominate artery; 3, Common carotid artery; 4, Subclavian artery; 5, Sterno-clavicular artery; 6, Internal mammary artery; 7, Axillary artery; 8, Pectoral arteries; 9, Vertebral artery; 10, Thyroidean artery; 11, Syringeo-bronchial artery; 12, Ascending oesophageal artery; 13, Comes nervi vagi artery; 14, Subscapular artery; 15, Cervical cutaneous artery; 16, Bronchial artery; 17, Internal carotid artery 18, External carotid artery; 19, Descending aortic arch; 20, Ligamentous vestige of left radix aorta; 21, Pulmonary artery; 22, Ligamentum botalli; 23, Dorsal aorta 24, Coeliac artery; 25, Superior mesenteric artery; 26, Syringeal artery. R=Right; L=Left.

syringeo-bronchial artery (11), in disposition and branching, is just like its fellow of the opposite side. The comes nervi vagi artery (13R) courses cephalad in a similar fashion to the left. The ascending oesophageal (12R), unlike that in other Capitonids, arises by a common stem with the comes nervi vagi artery and separates from it a little anterior to the origin of the cervical cutaneous artery.

It is of interest to note that the comes nervi vagi and the ascending oesophageal arteries of each side fuse together before anastomosing with the external carotid artery (18).

The ligamentous vestige of the left radix aorta (20) is present but without the ligamentum-botalli, which is fully represented on the right side (22R). The coeliac (24) and superior mesenteric (25) arteries are much apart from each other in their origins from the dorsal aorta (23).

The abnormal case.

In one of the four specimens dissected by us, the internal carotid artery is present on the right side instead of the left (Text-fig. 1*b*). The right internal carotid artery (17R) alone enters the hypapophysial canal and follows the same course and has the same fate as the left internal carotid of the normal birds. The left common carotid (3L) instead of continuing forwards as the internal carotid becomes the vertebral (9L) of that side, and there is no trace of the left internal carotid, not even of its ligamentous vestige. The origin and disposition of other arteries are essentially the same as in the normal specimens.

No reversal was noticed in the visceral organs, which appeared to be normal in every respect.

DISCUSSION.

According to the left-handed disposition of the internal carotid artery, the Capitonidae belongs to the '*aves laevo-carotidinae*' group (Garrord, 1873; Glenny, 1943*b*; Bhaduri and Biswas, 1945), and *Thereiceryx* is no exception to this. By comparison, the general basic pattern of the main arteries in this species appears essentially to be the same as in other Capitonids, but in some respects the condition in each species is to be regarded as characteristic, especially in the origin and fate of the ascending oesophageal and comes nervi vagi arteries. Between the two major Capitonidae groupings, as suggested by Glenny (*op. cit.*), *Thereiceryx* appears to fall in *Xantholaema*-group.

In view of the abnormal case it seems pertinent to introduce here a brief discussion on the origin of the paired and unpaired condition of the internal carotid artery.

Various explanations have been put forward by earlier authors. Bauer (1825) thought that the smaller species should have single carotids. Meckel (1826) at first thought that there was some correlation between the length of the neck and the simplicity of the carotids, but later withdrew that view. Owen (1866) stated that those birds which sleep with their necks twisted on one side lose the carotid of that side. Garrord (1873) has critically reviewed the above explanations as unsatisfactory. He, however, assumes that there is a blending of the left with the right (internal) carotid in early life of the bird in the manner of *Botaurus stellaris* and *Cacatua sulphurea*, and considers that the decreased flow of blood in the right carotid as compared with the left, owing to the right systemic arch sharing a portion of the blood from the former side, is responsible for the obliteration of the right carotid. In this connection the analogy of the mechanical principle which he draws from Wheatstone's Bridge in order to explain the disappearance of the right carotid does not seem to be very convincing. Lastly, Glenny (1943-1944 *a*) assumes that the anterior cervical portions of the internal carotids anastomose and the posterior

proximal portion of the right internal carotid remains as a superficial artery which appears to be functionally modified to serve as the ascending oesophageal in all the *laevo-carotidinae* birds. This may not be the true picture, since the ascending oesophageals are normally present on both the sides in the '*aves bicarotidinae normales*' as well as '*aves laevo-carotidinae*' (Bhaduri and Biswas, 1945). He is, however, forced to conclude in one of his latest papers (1945 *a*, p. 453) : "The probable answer to the wide differences in the arteries of the neck and thorax, especially with regard to the anastomosis of the internal carotid (trunk) arteries may be found through embryological studies." A similar conclusion was also arrived at in one of his previous papers (Glenny, 1943*c*, p. 51). It is indeed true that we have some embryological data of the '*aves bicarotidinae normales*', but unfortunately there is none so far of the '*aves laevo-carotidinae*'

Now, the abnormal condition in *T. z. caniceps* is not a case of *situs inversus viscerum*, since the visceral organs were quite normal. It is evidently a case of partial mirror image or reversal of the asymmetrical left internal carotid artery. As a result the condition resembles that in the '*aves dextro-carotidinae*' group of Garrord (1873) and Glenny (1945 *a*). The explanation of the occurrence of reversal should, as in all cases, be sought in the embryonic history. It would appear that in the normal development of either a *laevo-* or *dextro-carotidinae* bird, two internal carotids are originally laid down the anterior portions of which probably fuse with each other at some time during embryonic life. Later, the proximal part of the right internal carotid disappears in the adults in Passeriformes, Piciformes, etc. The corresponding portion of the left one atrophies only in a few birds, *e.g.*, *Eupodotis* (Garrord, 1873) and *Ixobrychus* (Glenny, 1945 *a*). In the present instance the left internal carotid artery has atrophied totally. This reversal of asymmetry may be regarded as due to some abnormal condition resulting from developmental arrest.

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