DELETION OF THE SYSTEMIC ARCHES AND EVOLUTION OF THE AORTIC ARCH SYSTEM IN BIRDS

FRED H. GLENNY

Blue Sea Lake Biological Laboratory, Messines, Quebec

Evolution of the aortic arch system has been one of progressive deletion and substitution, accompanied by a reorientation or rerouting of the blood supply.

The greatest changes in the system occurred in the transition from the holoaquatic to the terrestrial habit, with deletion of the first, second, and finally the fifth pairs of arches. Associated with these deletions, and the development of the pulmonary circulation, was reduction and atrophy of the dorsal portion of the sixth arches.

Subsequently, evolution of the system has resulted in atrophy of one of the radices aortae (left in birds and right in mammals), loss of the left systemic arch in birds, and loss or functional modification of the right systemic arch in mammals.

Still further changes and deletions in this system are found to occur in the birds. Of very common occurrence is reduction or loss of the dorsal portion of either the left or right 3rd aortic arch, accompanied by fusion of the dorsal carotids, anterior to the carotid arch (unicarotid condition). In a few instances, however, both left and right dorsal carotids become reduced to ligamentous vestiges (ligamenti ottleyi) and cephalic blood flow is carried by the vertebral and superficial cervical arteries. In such instances, the dorsal portions of both left and right carotid arches become obliterated.

With loss of the left systemic arch, the left ductus caroticus loses its posterior connection, and usually becomes functionally modified. In most instances this is followed by a similar disconnection of the right ductus caroticus. The latter, however, frequently retains its connection between the carotid and systemic arches and remains as a patent vessel.

Recent studies on 810 species and subspecies of birds have revealed the following, rather interesting, fact. In a single specimen of *Megapodius freycinet layardi*, and over 30 specimens of the Trochilidae, both left and right systemic (4th aortic) arches were lacking. In each of these instances, it was apparent that the right ductus caroticus remained as the functional systemic arch which carried the blood supply to the abdominal aorta. Such a condition is not to be regarded as totally unexpected in the course of evolution of the aortic arch system, although it has not, to the writer's knowledge, been reported previously.

The particular significance of the occurrence of this reduction in *Megapodius* and among the Trochilidae cannot be satisfactorily evaluated at this time. It seems to me to be significant that the Trochilidae appear to present a highly uniform occurrence in the deletion of the right systemic arch, particularly in view of their rather restricted distribution. Evolution of this family of birds probably centered in South America, after an earlier origin from the common Apode stock in Antarctica.

Insular isolation of *Megapodius layardi* may have been a factor contributing to the evolution and deletion of the right systemic arch in this specimen. It has not, however, been ascertained to what extent this deletion may occur in this species, but further studies might reveal the expected frequency of occurrence.

In conclusion, it may be expected that, in the course of evolution of the aortic arch system of birds, only the proximal or ventral portions of the 3rd aortic (carotid) and 6th aortic (pulmonary) arches and the right ductus caroticus will remain as the functional portions of the embryonic aortic arch system. The major cephalic blood supply will then be carried by the vertebral and superficial cervical arteries, while the blood supply to the abdominal region will be carried by the ductus caroticus and abdominal aorta.

THE OHIO JOURNAL OF SCIENCE 54(4): 240, July, 1954.