

CHAPTER VIII

THE VASCULAR SYSTEM

THE account given by Bronn in his *Thierreich* is apparently the only published description of the circulatory organs in the Crocodilia.

This account, even when translated, is not very satisfactory, especially because it contains no diagrams of the circulation. It was, therefore, deemed worth while to work out the circulation in the Florida alligator in order that we might have not only a written description, but also a series of more or less accurate diagrams of the veins and arteries.

A number of departures from the description of Bronn were found, some of which are noted below.

Most of the work was done upon animals of about thirty inches length, which were obtained alive from the Arkansas Alligator Farm at Hot Springs, Ark.

The arteries were injected with a colored starch mass by inserting a two-way cannula into the dorsal aorta. With the blood thus forced into them from the arteries, the veins could, in most cases, be traced without difficulty.

In the diagrams the outlines of the more important organs are accurately shown by dotted lines, and the relative diameters of the blood-vessels are shown as accurately as possible by the solid black lines.

THE HEART

In the Crocodylia, as is well known, the heart is four-chambered and has about the same general shape as in the higher vertebrates, Fig. 58.

The venous blood is emptied into a thin-walled sinus venosus on the dorsal side of the heart by three large vessels and one small one. The largest of these, the postcava, empties into the posterior side of the sinus venosus and brings blood from the posterior regions of the body; it is quite wide, but is exposed for a very short distance between the liver and the heart. Two large hepatic veins empty into the postcava so near the sinus venosus that they practically have openings into the sinus, as is shown in a somewhat exaggerated way in Fig. 59. Near the postcaval and hepatic openings is the distinct coronary vein, lying in a slight depression between the right and left ventricles.

From the anterior regions of the body the blood is brought back through two fairly wide but very thin-walled precaval veins which pass across the dorsal surface of the heart to enter the sinus venosus.

The arterial blood is brought from the lungs by

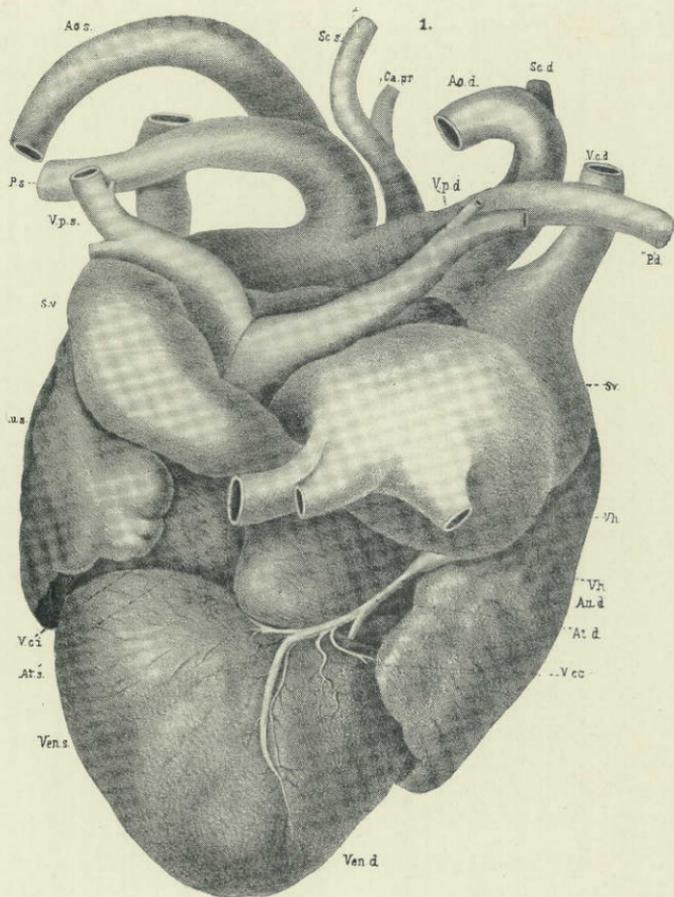


FIG. 58. HEART OF *A. LUCIUS*. (Dorsal View.)
 (From Bronn, after Fritsch.)

Ao, d, Ao, s, right and left aorta; *At, d, At, s*, right and left atria; *Au, d, Au, s*, right and left auricles; *Ca, pr*, primary carotid; *P, d, P, s*, right and left pulmonary arteries; *Sc, d, Sc, s*, right and left subclavians; *Sv*, sinus venosus; *V, cc*, coronary vein; *V, c, d, V, c, i*, right precava, and inferior cava; *Ven, d, Ven, s*, right and left ventricles; *V, h*, hepatic vein; *V, p, d, V, p, s*, right and left pulmonary veins.

two wide, thin-walled pulmonary veins, Fig. 58, V.p.s., V.p.d. They leave the lungs somewhat caudad to their middle region, near the point of entrance of the bronchii and the pulmonary arteries, pass mediad in a direction almost at right angles to the long axis of the body, and enter the left auricle at the same point.

Blood leaves the heart through five large vessels: (1) the pulmonary artery, (2) the two aortic arches, (3) the right subclavian, (4) the primary carotid.

The pulmonary leaves the small right ventricle as a single stem, which soon branches into two arteries that pass cephalad and laterad to the lungs, along with and close to the main bronchi. The other arteries that carry blood into the systemic circulation are fused at their base to form a sort of conus arteriosus which may be distended in injected specimens until it is larger than the two ventricles together. When opened this conus is found to contain two chambers that lead into the left ventricle; the larger chamber gives origin to the right systemic arch, the right subclavian, and the primary carotid; the smaller chamber is the basal part of the left systemic arch.

The two systemic vessels, Fig. 58, Ao.s, Ao.d, pass, in the usual manner, as two arches to the dorsal region, just posterior to the ventricles, where they form the dorsal aorta in the manner to be described in connection with the arterial system.

The further course of the primary carotid and

of the right subclavian will also be described in connection with the arterial system.

The auricles are very large in proportion to the

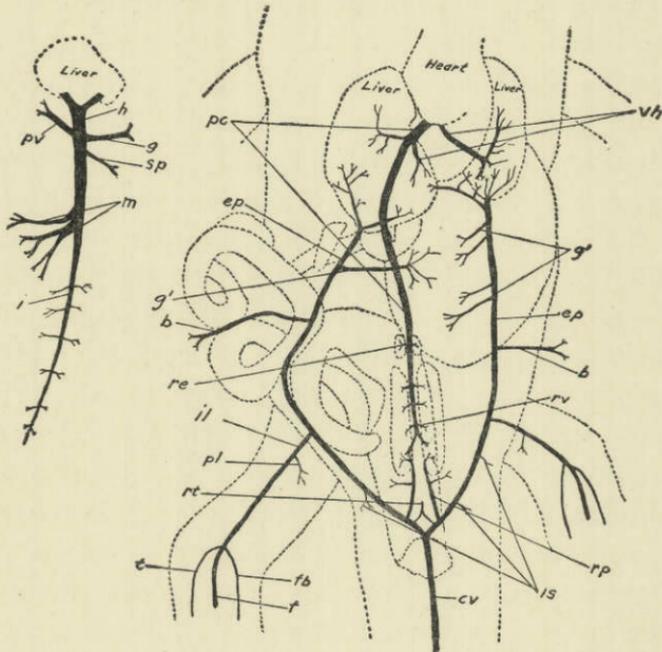


FIG. 59. The veins of the posterior region of the Florida alligator. The postcaval system and its associated veins are shown in the main figure; the hepatic portal system is shown in the smaller figure to the left.—For lettering, see pages 224-25.

ventricles, though their relative sizes will, of course, vary with the amount of contained blood.

THE VENOUS SYSTEM

The Posterior Vena Cava and its Branches. The *postcava*, Fig. 59, *pc*, as noted above, is a wide,

thin-walled vessel seen extending across the short space between the anterior face of the right lobe of the liver and the sinus venosus. As was also noted above, the hepatic veins, *vh*,—at any rate that from the left lobe of the liver,—enter the postcava so close to the heart that they may be considered to have one or more distinct openings into the sinus venosus. Followed caudad, the postcava may be traced through the large right lobe of the liver, from which it receives several branches. Emerging from the posterior border of the liver, it is seen to extend caudad, in the median line, as a rather inconspicuous vessel that receives blood from the reproductive organs and the kidneys that lie close on either side of it.

The *hepatic portal* vein, *h*, has the usual distribution for that vessel. Entering the liver in the neighborhood of the bile duct, it receives first (*i.e.*, nearest the liver) a small branch from the pancreas, *pv*; near the pancreatic are one or two branches from the stomach, *g*, and a branch from the spleen, *sp*. A short distance caudad to these vessels are two or three mesenteric veins, *m*, leading from the mesentery and small intestine. Caudad to the mesenterics, the portal system may be seen as a vein of diminished caliber, *i*, leading from the posterior part of the small intestine and from the large intestine.

The connection mentioned by Bronn between the rectal branch of the portal vein and the caudal

vein could not be demonstrated. After entering the liver, the portal, of course, breaks up into capillaries, and the blood thus distributed is re-collected by the capillaries of the hepatic veins above mentioned.

The *internal epigastric* veins, ep, are, perhaps, the most conspicuous vessels of the postcaval system. When the ventral abdominal wall of the animal is removed, they may be seen extending forward from the pelvic region, on each side of the body, to enter the posterior edge of the liver. The epigastric of the right side enters the large or right lobe of the liver, where it breaks up into capillaries; the left epigastric sends its main branch into the left lobe of the liver, but also sends a branch over to enter the right lobe.

Following the epigastrics caudad, they are seen to receive vessels from nearly all parts of the posterior region of the body. The left epigastric, which extends across the ventral side of the stomach, receives from that organ four or five branches, g¹; while the farther removed right epigastric receives only one or two branches from the stomach. Posterior to these gastric veins the epigastrics receive one or more veins, b, from the body wall and skin. Posterior, again, to the last-named veins, each epigastric receives, in the pelvic region, a large vein, the *iliac*, il, which receives, in turn, a vein from the pelvis, pl, and continues down the thigh and lower leg to the foot as the *femoral*,

f, the chief vein of the posterior appendage. After receiving small branches from the muscles of the thigh, the femoral receives near the knee a small branch from the posterior surface of the lower leg, fb, and a larger one, t, that leads from the anterior surface of the lower leg and foot.

The veins of the pes were so small, in the comparatively small animals it was necessary to use, that their distribution could not be determined with certainty, though they seemed to parallel very closely their corresponding arteries to be described below.

A short distance caudad to the iliac veins, each epigastric receives one or two fairly large branches from the pelvic region, called by Bronn the *ischiodic* veins, is. Caudad to the ischiadics and dorsal to the cloaca, each epigastric is united with a short but wide *renal portal* or renal advehente vein, rp, leading to the posterior border of its respective kidney and receiving, on the way, a short branch from the pelvic region, shown just cephalad to the reference lines rt and rp.

Very close to its junction with the renal portals each epigastric gives off a small branch which unites with its fellow of the opposite side to form a median vein, rt, the *rectal* leading from the posterior part of the large intestine. A very short distance caudal to these last veins, in the region just dorsal to the anal opening, the epigastrics are formed by the division of the *caudal* vein, cv, which, of course, brings blood from the tail and is,

on account of the large size of that organ, of considerable caliber.

The Anterior Venæ Cavæ and their Branches. The entrance of the precaval veins into the heart was mentioned above; their branches, in order from the heart cephalad, will now be described. Since the two precavæ are alike, it will be necessary to describe the branches of only one side of the body. After leaving the heart, the precava may be traced forward, for a short distance, at the side of the trachea and œsophagus, as a wide, thin-walled trunk, Fig. 60, vca. The first tributaries that it receives are the internal mammary and vertebral veins, which join it at the base of the neck at almost the same place.

The *internal mammary*, Fig. 60, im, is a rather small vein, bringing blood from the ventral wall of the thorax. It may be followed along the inner surface of the ribs, near the sternum, in company with its corresponding artery.

The *vertebral* vein, Fig. 60, v, is also of small diameter and extends to the dorsal body wall near the spinal column, from which region it returns blood to the anterior vena cava; it is drawn too large in the figure.

Just cephalad to the vertebral and internal mammary, the *internal jugular*, j, enters the precava. The internal jugular may be followed directly forward, close to the side of the trachea and œsophagus, from which it receives numerous

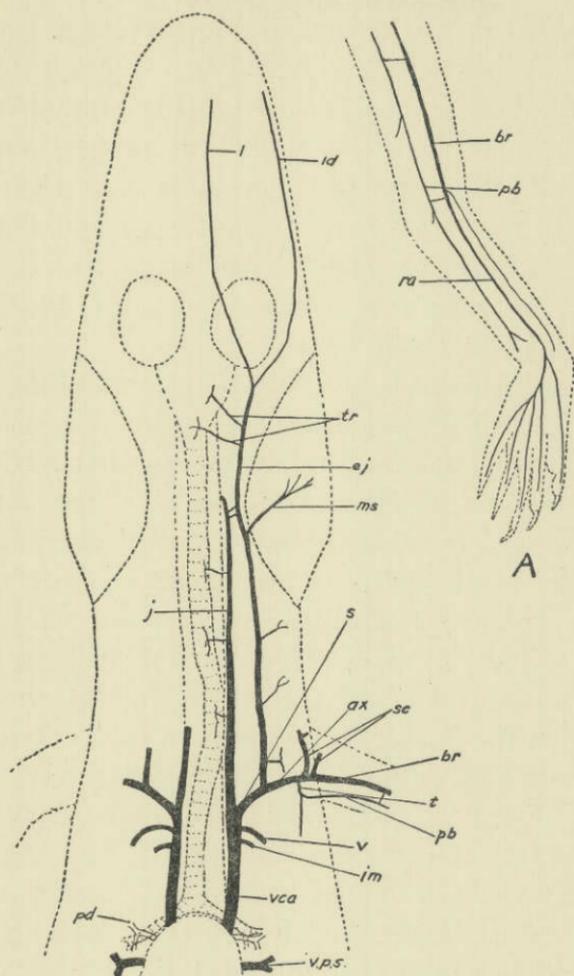


FIG. 60. The veins of the anterior region of the Florida alligator. The veins of the left foreleg are shown at A.—For lettering, see pages 224-25.

branches. Near its point of entrance to, or rather exit from, the skull, it anastomoses, by two or

three short branches, with the external jugular, ej, to be described later. Its distribution in the cranial cavity could not be determined in the available material. At the point of entry of the internal jugular the precava passes laterad for a short distance and then divides into two more or less equal branches, the above-mentioned external jugular, ej, and the subclavian, s, of which the latter will first be described.

The *subclavian*, s, of course, returns blood from the regions of the shoulder and arm. On reaching the body wall, where it might be called the *axillary*, ax, it receives, on its posterior side, a large *thoracic* vein, t, which returns blood from the thorax, shoulder, and skin. The thoracic receives a branch from the posterior surface of the arm, which might be called the *postbrachial*, pb; this postbrachial may be traced, as a rather small vessel, to the hand; at the elbow it is connected, by one or more small branches, with the brachial.

Just distal to the thoracic the axillary vein receives two fairly large vessels, the *subscapulars*, sc, that return blood from the shoulder and upper arm. After receiving the subscapulars, the axillary may be followed into the upper arm as the *brachial*, br. As has been said, the brachial and postbrachial anastomose near the elbow, and in this region the former receives a small vessel that extends parallel to it from the manus.

In the forearm the brachial may be called the *radial*, Fig. 60, A, ra; on the back of the manus the radial receives branches from the various digits and from a rather complex plexus of vessels in the carpal region.

The *external jugular*, Fig. 60, ej, after separating from the subclavian, may be traced cephalad, close beneath the skin, to the base of the skull, where it is connected with the internal jugular by short branches, as has already been noted. It receives several small branches from the skin and muscles of the neck and shoulder regions. At the region of its anastomosis with the internal jugular it receives a large branch, the *muscular*, ms, from the massive muscle at the angle of the jaw and from the skin of that region.

A short distance cephalad to the muscular the external jugular receives, on its mesial side, two or three branches from the trachea, larynx, and oesophagus, tr. Anterior to these vessels the external jugular is formed by the union of two chief veins, the *lingual*, l, from the ventro-lateral surface of the tongue, and the *inferior dental*, id, from the mesial surface of the lower jaw. The connection of the *superior dental* (extending along the bases of the maxillary teeth) with the jugular could not be determined with certainty, hence that vessel is not shown in the figure. The same is true of the small veins in the region of the cranium.

THE ARTERIAL SYSTEM

The Abdominal Aorta and its Branches. The right and left aortic arches, Fig. 6I, Aod, Aos, arising from the heart in the manner already described, form a rather long loop and approach each other in the middorsal line. Here they are united by a short, wide connective in such a way that the left arch seems continued into the coeliac artery and the right into the dorsal aorta proper. Each arch, anterior to the connective, gives off two fairly large branches, oe, to the posterior region of the oesophagus.

The *coeliac* artery, Fig. 6I, c, is the largest branch of the abdominal aortic system. After giving off a couple of small branches, oe, to the posterior region of the oesophagus, it gives off a large *spleno-intestinal* artery, si, to the spleen and small intestine.

The coeliac then breaks up into three arteries of about the same size: the *gastro-hepatico-intestinal*, ghi, carrying blood to the stomach, liver, and small intestine; the *pancreo-intestinal*, pi, leading to the pancreas and small intestine; and the *gastric*, ga, to the greater part of the stomach.

From the *dorsal aorta* proper, da, which, as has been said, seems to be the direct continuation of the right aortic arch, several arteries are given off; these will be described as they occur in an antero-posterior direction.

At about the point of union of the two aortic

arches arises the most anterior of seven or eight pairs of *lumbar* arteries, lu 1-7; this first lumbar artery is continued cephalad for some distance as a longitudinal trunk that gives off several lateral branches to the walls of the thoracic region. The other six or seven lumbar are distributed to the dorsal body wall, and arise, at more or less regular intervals, as far caudad as the sacrum, or even back of that point.

The first large branch of the aorta is the unpaired *mesenteric* artery, m¹, which is given off in about the region of the fourth pair of lumbar; it

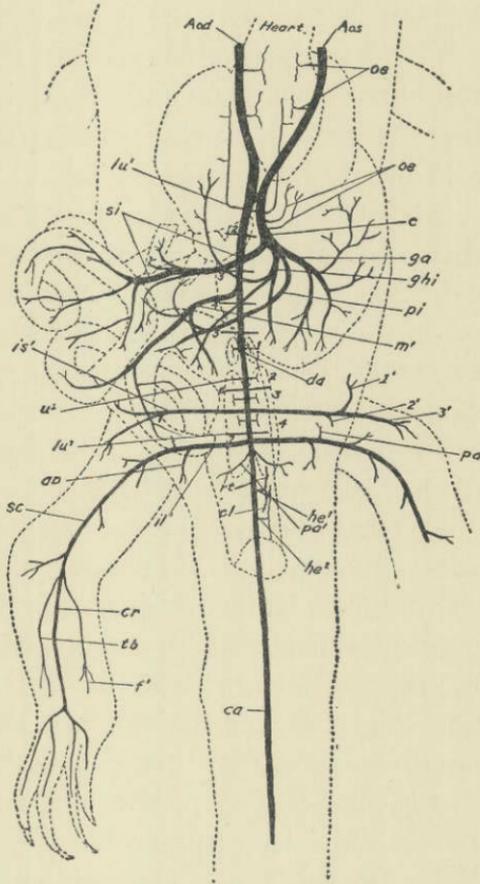


FIG. 61. The arteries of the posterior region of the Florida alligator.—For lettering, see pages 224-25.

carries blood through the mesentery to the greater part of the small intestine and also sends a small branch to the large intestine.

Posterior to the mesenteric, the aorta gives off four or five pairs of short arteries, the *urogenitals*, *u* 1-4, that lead to the nearby reproductive organs and kidneys.

About the middle region of the kidneys, a short distance anterior to the sacrum, is given off a pair of rather large arteries, called by Bronn the *ischiadica*, *is*¹; each *ischiadica*, after giving off a couple of small branches to the back, passes laterad and divides into three main branches: (1¹) to the ventral body wall, (3¹) to the anterior border and deeper region of the thigh, and (2¹) to the pelvis.

In the region of the sacrum is given off a pair of *iliac* arteries, *il*¹. Each *iliac* is of about the same diameter as the *ischiadica* and gives off, soon after leaving the aorta, an artery, *ab*, that apparently leads chiefly to the abdominal muscles. Distal to the origin of the abdominal, the *iliac* gives off a small *pelvic* artery, *pa*, which leads, as the name would indicate, to the pelvis. The *iliac* then passes into the thigh, where it gives off several large branches and may be called the *sciatic*, *sc*. At the knee the *sciatic* gives off two rather small branches: one, the *fibular* artery, *f*¹, extends down along the posterior side of the lower leg; the other is parallel to the first and may be called the *tibial* artery, *tb*, since it extends along the anterior or

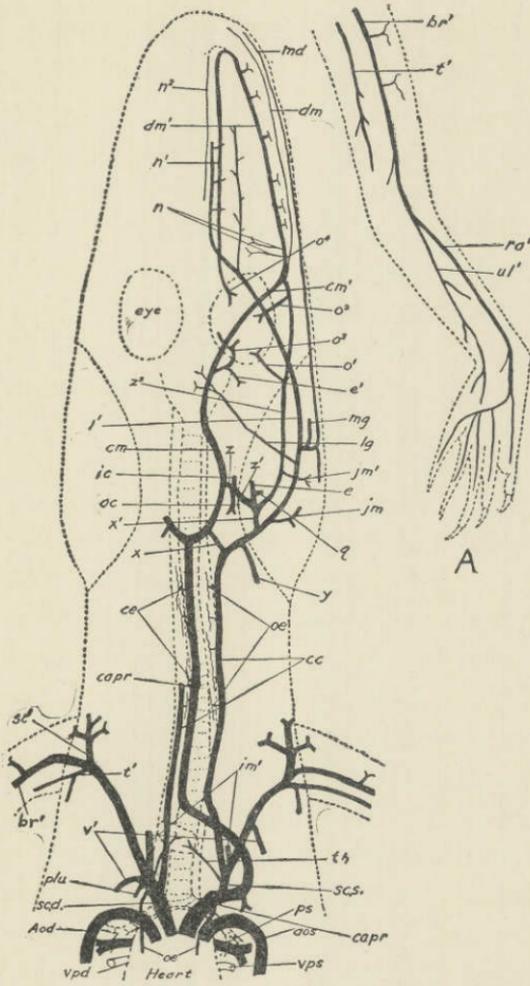


FIG. 62. The arteries of the anterior region of the Florida alligator. The arteries of the left foreleg shown at A.—For lettering, see pages 224-25.

tibial side of the shank. These two arteries give off numerous branches to the muscles of the lower

leg. After giving off the fibular and tibial arteries, the sciatic passes, as a large vessel, through the lower leg, to which it gives but few branches, and may here be called the *crural* artery, *cr.* At the tarsus it divides rather suddenly and, perhaps, variably, into four chief branches, leading to the toes.

A short distance caudad to the origin of the iliacs the dorsal aorta gives off a pair of small *pelvic* arteries, *pa*¹, going to the muscles of that region. Caudal to these pelvic arteries is given off the unpaired *first hæmorrhoidal* artery, *he*¹, which divides into a *rectal*, *rt*¹, and a *cloacal*, *cl*, branch.

Caudal to the first hæmorrhoidal arises the *second hæmorrhoidal*, *he*²; also unpaired, leading to the cloaca.

Posterior to the second hæmorrhoidal, the aorta continues into the tail as the large *caudal* artery, *ca.*

The Anterior Arteries. The origin of the great arterial trunks—the pulmonary, aortic arches, primary carotid, and right subclavian has already been given and the distribution of the pulmonary arteries and aortic arches has been described, so that it now remains to describe the distribution of the right subclavian, Fig. 62, *sc.d.*, and the primary carotid, *capr.*

The *right subclavian*, *sc.d.*, since it has an independent origin from the heart, instead of arising as a branch of the primary carotid, will be described first. After leaving the heart it passes cephalad and laterad and gives off the following branches in order, beginning at the heart: an

oesophageal artery, oe, a small, caudally directed vessel carrying blood to the posterior region of the oesophagus. Close to the oesophageal arises another small, caudally directed vessel, the *pleural* artery, plu, extending to the pleura and possibly to the pericardium. From the same region as the preceding two arteries, but extending cephalad along the trachea and oesophagus, arises the much larger branch of the right subclavian, the right *collateralis colli*, cc, whose course and distribution will be described later.

Close to the distal side of the *collateralis colli* arises the very small *thyroid* artery, th, leading to the oval thyroid gland that lies against the ventral surface of the trachea a short distance anterior to the heart.

A short distance distal to the thyroid artery the subclavian gives off a fairly large artery, the *internal mammary*, im^r (shown too large in the figure), that passes to the inner surface of the ribs near the sternum and lies parallel to the vein of the same name, described above.

A short distance distal to the internal mammary arises an artery of about the same diameter, the *vertebral*, v^r; it passes dorsad and caudad to the region of the thoracic vertebræ.

After giving off the five vessels just described, the subclavian artery passes into the shoulder where it divides into three main branches: (a) the *subscapular*, sc^r, going to the skin and muscles

of the shoulder; (b) the *thoracic*, t^1 , carrying blood to the posterior muscles of the shoulder and to the posterior region of the upper arm; (c) the *brachial*, br^1 , which is really the continuation of the subclavian and is the chief artery of the anterior appendage.

After sending several branches to the upper arm the brachial divides, in the region of the elbow, into two main vessels, the *radial*, ra^1 , and *ulnar*, ul^1 , arteries, Fig. 62, A. The radial artery, in the carpal region, divides in a complicated way into five main vessels that extend into the digits. The ulnar artery gives off several branches to the forearm, but apparently does not connect directly with the branches to the digits.

The *primary carotid*, *capr.* After leaving the heart, this very large vessel passes cephalad and laterad for some distance on the left side of the body and then gives off, from its anterior side, the large left subclavian artery, *sc.s.*, to be described later. After giving off the subclavian artery, it makes a short loop, still farther to the left, and then turns sharply mediad to pass to the head in the median plane directly dorsal to the œsophagus. Its distribution in the cervical and cephalic region will be described later. The mate to the œsophageal branch, *oe* (near heart), of the right subclavian which was mentioned above is apparently sometimes given off from the primary carotid near its base (as shown in Fig. 62) and sometimes as a branch of the left pleural artery.

The *left subclavian* artery, sc.s., although it has a different origin, has the same branches as described in connection with the right subclavian. The exact order in which the first of these (the thyroid, th; the internal mammary, im^r; the collateralis colli, cc; the pleural, plu; and the vertebral, v^r) are given off is, as might be expected, subject to some variation.

The *collateralis colli*, cc (following Bronn's nomenclature), whose origin was noted above, will now be discussed; since the two are alike only one need be described. After leaving the subclavian, it passes cephalad, at the side of the trachea and œsophagus, in company with the internal jugular vein, so that in this part of its course it would seem to be the internal carotid artery. It gives numerous small twigs to the trachea and œsophagus, oe. In the region of the posterior part of the huge jaw muscle it is connected directly, x, with the adjacent branch, cm (called by Bronn the common carotid) of the primary carotid, and indirectly, x^r, with a complicated group of branches from the common carotid. Cephalad to the connective x^r, which extends dorsad and is hence foreshortened in the figure, the collateralis colli gives off a small vessel, y (too large in Fig. 62), to the shoulder and skin; it then sends a fairly large branch, jm, into the large jaw muscle, close to which it now lies. Next a small branch, lg, is sent to the larynx. Continuing cephalad and laterad

(in Fig. 62 it is drawn farther to the side than it actually lies) for a short distance farther, it divides into three branches: (1) a short twig, *mg*, that goes to the musk gland on the side of the mandible and to the skin of that region; (2) a large branch, the *mandibular*, *md*, that enters the large foramen on the mesial side of the mandible and extends in the cavity of that bone throughout its entire length; (3) the *lingual* artery, *l^r*, which in turn divides, some distance cephalad, into two branches, one extending along the lateral region, the other nearer the mid-ventral surface of the tongue. It is seen, then, that the *collateralis colli* arteries supply directly the lower side of the head—tongue, mandible, etc.—though they may also send blood through the above-mentioned connectives to the brain and dorsal regions of the skull.

The *primary carotid*, *capr*, as was noted above, makes a curve to the left after leaving the heart and then passes back to the median plane, where it may be seen lying against the ventral side of the neck muscles and dorsal to the *oesophagus*; in this place it gives off a series of unpaired *cervical* arteries, Fig. 62, *ce*, each of which almost immediately divides into an anterior and a posterior branch, that carry blood to the cervical vertebræ. At the base of the skull, in the region where it is united by the first connective, *x*, with the *collateralis colli*, as described above, the primary carotid divides into two similar branches, called by Bronn

the *common carotids*, cm. The distribution of these two vessels is symmetrical, so that only one need be described. While the *collateralis colli*, as has been said, carry blood chiefly to the tongue and lower jaw, the common carotids supply the cranium and upper jaw.

Soon after its formation by the division of the primary carotid, the common carotid is joined, as noted above, with the *collateralis colli* of that side by the connective, x; since the common carotid and its branches all lie dorsal to the *collateralis colli* and its branches, the connectives x and x¹ extend in a more or less dorso-ventral direction. The two common carotids, almost completely surrounded by bone, in passing cephalad sweep first laterad, then mediad, so that they together form almost a complete ellipse, as seen in Fig. 62; there is, however, no apparent connection between them at the anterior region where they lie so close together.

A short distance cephalad to the connective x the common carotid is connected laterally, z, with a rather complicated plexus of vessels lying at the base of the skull; it is through this plexus that the common carotid is connected with the *collateralis colli* by the second connective, x¹.

The short branch z quickly divides into three parts: (1) a small anteriorly directed vessel which may be called the *internal carotid*, ic, since it enters the skull through the most ventral of the three foramina in the exoccipital, and probably supplies

the brain, though its further course could not be followed; (2) a somewhat larger posteriorly directed artery, oc, going to the muscles at the occipital region of the skull; (3) a short laterally directed stem, z^1 . The last-named branch, z^1 , in turn, leads in three directions: (a) to the collateralis colli artery through the connective x^1 ; (b) a short anteriorly directed vessel, e, that passes into the skull, possibly to the ear, through the large foramen that lies between the exoccipital and quadrate bones; it gives off a small twig, q, to the muscles in the region of the jaw articulation (quadrate); (c) the main stem of the branch z continues laterad and cephalad as one of the chief arteries, z^2 , to the anterior region of the skull, giving off a fairly wide branch, jm^1 , to the large jaw muscle, and then two branches, o^1 and o^2 , to the lateral surface of the eyeball and socket; it then anastomoses, just cephalad and laterad to the eye, with the forward continuation, cm^1 , of the corresponding main stem, cm, of the common carotid, already mentioned. The vessel cm^1 , after almost meeting its fellow in the middle line, passes cephalad and laterad across the ventral surface of the eye to the union, above mentioned, with the lateral branch, z^2 ; at the posterior-mesial border of the eye it gives off a branch that divides into two twigs, one, o^3 , for the posterior eye muscles, and one, e^2 , to the region of the ear and the top of the skull.

At the point of union of the branches cm^1 and z^2 a sort of simple plexus may be formed from which two vessels, n , pass to the posterior nasal region, and two vessels pass forward along the side of the upper jaw. Of the latter two vessels one, which may be called the *inferior dental* of the maxilla, dm , is very small and extends along the maxilla to its very tip, at the base of the teeth and ventral to the palatine bone; the other, which is larger and may be called the *superior dental* of the maxilla, dm^1 , extends cephalad along the mesial side of the maxilla, dorsal to the palatine bone; it sends numerous twigs into the maxillary bone among the roots of the teeth. After passing nearly to the end of the snout, the superior dental, dm^1 , suddenly forms a loop towards the median line and passes as a straight branch, n^1 , directly caudad, near and parallel to the median plane. The branch n^1 extends along the floor of the nasal cavity and, after giving off twigs to this chamber, ends in a network of vessels, o^4 , on the anterior surface of the eyeball and socket.

A pair of very small arteries, n^2 , may be seen in the nasal chamber between and parallel to the branches, n^1 ; they lie close to each side of the nasal septum and supply the anterior nasal region. They apparently arise, as shown by the broken lines, from the loop of the superior dental artery, dm^1 , though this could not be definitely determined.

LETTERING FOR FIGURES 59-62

- Aos., Aod., left and right aortic arches.
 ab, abdominal artery.
 ax, axillary vein.

 b, veins from body wall.
 br, brachial vein.
 br¹, brachial artery.

 c, cœliac artery.
 ca, caudal artery.
 capr, primary carotid.
 cc, collateralis colli artery.
 ce, cervical artery.
 cl, cloacal artery.
 cm, cm¹, common carotid artery.
 cr, crural artery.
 cv, caudal vein.

 da, dorsal aorta.
 dm, inferior dental artery of maxilla.
 dm¹, superior dental artery of maxilla.

 e, e¹, artery into skull, perhaps to ear.
 ej, external jugular vein.
 ep, internal epigastric vein.

 f, femoral vein.
 f¹, fibular artery.
 fb, fibular vein.

 g, gastric vein of portal.
 g¹, gastric vein of epigastric.
 ga, gastric artery.
 ghi, gastro-hepatico-intestinal artery.

 h, hepatic portal vein.
 he¹, he², hæmorrhoidal arteries.

 i, intestinal vein.
 ic, internal carotid artery.
 id, inferior dental vein.
 il, iliac vein.
 il¹, iliac artery.
 im, internal mammary vein.
 im¹, internal mammary artery.

 is, ischiadic vein.
 is¹, ischiadic artery.

 j, internal jugular vein.
 jm, jm¹, artery to jaw muscle.

 l, lingual vein.
 l¹, lingual artery.
 lg, laryngeal artery.
 lu, 1-7, lumber arteries (numbers on left side of figure).

 m, mesenteric vein.
 m¹, mesenteric artery.
 md, mandibular artery.
 mg, artery to musk gland.
 ms, muscular vein.

 n, artery to posterior nasal region.
 n¹, artery to anterior and mid-nasal region.
 n², artery to anterior nasal region.

 o¹-o⁴, arteries to eye.
 oc, artery to muscles at base of skull.
 oe, oesophageal arteries.

 pa, pelvic artery.
 pa¹, second pelvic artery.
 pb, post brachial vein.
 pc, post cava.
 pd, right pulmonary artery.
 pi, pancreo-intestinal artery.
 pl, pl¹, pelvic vein.
 plu, pleural artery.
 ps, left pulmonary artery.

 q, artery to muscle at angle of jaw.

 ra, radial vein.
 ra¹, radial artery.
 re, reproductive vein or artery.
 rp, renal portal vein.
 rt, rectal vein.
 rt¹, rectal artery.
 rv, renal vein.

 s, subclavian vein.
 sc, sciatic artery (Fig. 61).

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| <p>sc, subscapular vein (Fig. 60).
 sc^t, subscapular artery.
 sc.d., sc.s., right and left subclavian
 arteries.
 si, spleno-intestinal artery.
 sp, splenic vein.
 s.v., sinus venosus.</p> <p>t, thoracic vein.
 t^t, thoracic artery.
 tb, tibial artery.
 th, thyroid artery.
 tr, tracheal vein.</p> <p>u, 1-4, urogenital arteries (num-
 bers on right side of figure).
 ul^t, ulnar artery.</p> | <p>v, vertebral vein.
 v^t, vertebral artery.
 vca, anterior vena cava.
 vh, hepatic vein.
 vpd, vps, right and left pulmonary
 veins.</p> <p>x, x^t, connectives between collater-
 alis colli and carotid.</p> <p>y, artery to shoulder and skin.</p> <p>z, z¹ z², branches of common
 carotid.
 1^t, 2^t, 3^t, branches of ischiadic
 artery.</p> |
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