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OF THE
**CIRCULATION OF THE BLOOD IN THE FOOT OF
THE HORSE.**

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THE circulation of the blood being of much the same character in most quadrupeds as to the upper parts of the limbs and trunk, so we shall pass over any description of its course from the *aorta*, and commence our notice at the middle of the shank-bone. His whole foot appears to have had a more solid character imparted to it by his Almighty Creator, in order, as it would seem, to his becoming the very useful slave and ever cheerful helpmate of man; and that this solidity of the foot should not be burdensome to him, it is more richly endowed in its construction, and especially in its vascular apparatus, than that of any other quadruped; the venous system in particular is notable by its extraordinary beauty, arrangement, and extent.

And although, among animals, he may be reckoned perhaps the most splendid of the gifts of his munificent Creator, yet was not this great boon imparted without a precept for his merciful and indulgent treatment; yet in this enlightened period, in spite of this, are his faculties grievously abused, even to affecting injuriously the interests of those so employing him. Loads the most preposterous are still laid upon him, and tasks of the most painful and violent description are demanded of him, often merely to gratify a proud or a gambling avaricious disposition. And to add to his wrongs, he is made to perform these painful tasks, when the uses of his feet, by a gross and unscientific mode of defence, have been in a great degree taken from him, that only the dread fear of the whip could urge him to the attempt, with a suffering indescribable. It is however true also, that his sufferings are sometimes requited upon his oppressors by accidents the most calamitous and fatal; yet from the tyranny that has long prevailed in these things, do even these pass almost unheeded as things of course, and unreprieved, and their sources unsought also. With, we hope, the reader's pardon for being drawn unexpectedly into these reflections, we quit them to consider the immediate subject before us, the circulation of the foot.

A single artery is observable passing down the middle of the shank-bone, accompanied by a large vein outside of it. These two vessels, on arriving at the swell or enlargement of the fetlock joint, divide, or bifurcate, as the anatomists call it. The artery alone we have now to pursue, by tracing it down and through the foot to its return by the veins again to the middle part of the shank-bone from whence we set out.

The artery, on arriving at the back part of the head of the coronet bone, passes over or outside of a large transverse undulating vein placed beneath the sesamoids, and which vein is connecting the two venous circulations on the opposite sides of the foot.

Soon after leaving the above vein the artery is seen to send off at its posterior part a double branch of considerable length, parting from a single stem; one of them is dispatched to the sides of the furch, and is adhering to its cartilaginous capsule through its whole length; the other is distributed and lost in being dispersed upon the cartilaginous internal furniture of the angle of the inflexions. These two vessels are superficial, generally appearing on the removal of the skin and cellular membrane.

Quitting the sides of the bone, this artery is now seen directing its course towards the lateral cartilage, entering its enclosure opposite to a conspicuous remarkable notch in its upper margin; and behind this notch is an elevated projecting broad tooth. By this deficiency in the cartilage, is probably imparted a degree of freedom from constraint of the artery, in the various actions and contortions of the animal upon his foot, and by the broad tooth we apparently obtain a defence to the artery from external assault, especially from behind.

Below this notch, the cartilage in a remarkable manner becomes thickened and consolidated, affording a still greater defence to the artery, and guaranteeing it from injury; and further, on the side of this thickening and enlargement is seen *the elastic globe* strongly adhering to the inner surface of the cartilage, and conferring an elastic yielding to all its movements, by extending and playing to it; it is also preventing injury from bruises of the part.

When arrived about the middle region of the inside of the cartilage, the artery is sending off a branch at right angles, which entering a deep horizontal depression, or fosse, in the cartilage, is extending nearly through its lateral dimensions, and which depression has a corresponding projection externally, and being placed or situated a little above the cutidura, it is constituting very much that handsome exterior bulge we call the *coronary ring*, giving a full, rich, and noble appearance to this part of the foot. Running along within this concavity of the cartilage, the artery is sending off small twigs at right angles upwards and downwards within it, which impart to it what little blood it possesses, being a white part, and almost destitute of it.

Returning again to the main artery, we now find it on its arriving a little below the lateral extremity of the shuttle bone, to be sending off a considerable rectangular branch, which can be traced to the *retros*, or posterior appendage of the coffin bone, and is passing through a large foramen in this bone, and in its trajet or passage through it, is giving off another branch, directed backwards, and passes through a foramen backwards directed, in the bone, and which artery appears to be lost on the cartilaginous envelopements of the bone, and expended on its various irregular excrescences. To enable us readily to speak of the two above vessels, and avoid confusion, we name the first of these,—the *retrossal major artery*; the other, the *posterior*, or *retrossal minor artery*. We may here just stop to observe, that these remarkable bony appendages to the coffin bone, appear to be pretty much or entirely peculiar to the horse, and given to afford him a greater extent and increase of bearing surface of the bone upon the sole of the hoof, contributing much thereby to those very powerful and graceful movements which

he is so peculiarly susceptible of: for his congeners, of the same family even, appear hardly at all to be thus provided.

We may notice here also that the great foramen of this part is usually arched over by a square perpendicular plate of bone, on one side (the inside of the foot), and which is wanting generally on the other quarter, or side of the foot, they vary however very much in this respect, some having it in both, some in one, and some in neither. For these appearances of the bone, see Hippod. pl. 6, fig. 1, 3.

This greater branch having passed through the perforation in the retros, may now be traced climbing the outside of the coffin bone, and directing its course obliquely upwards and forwards upon this bone, occupying a remarkable groove, which is ascending from the retros, and terminating near to the front parts of the coffin bone, at or near a large foramen; for the appearance of this groove or depression we must refer the reader to the bone itself, or to pl. 6, fig. 1 and 2 of the "Hippodonomia."

This groove remained to us a mystery for a considerable time, as to what vessel should fill it, it being rarely injected, and we were in doubt also whether the vessel that belonged to it was coming out at this foramen, or was entering into it. It is now plain enough that this perforant retrorsal artery is occupying this channel, and is entering the foramen. In order conveniently to speak of this vessel and its channel, we have denominated it the *retrosso-foraminal groove*, and propose for the artery the same name.

We now return again to the main trunk of the artery, which we left within the lateral cartilage, and find it, after communicating the retrorsal branch, to be taking an almost or quite undivided course to the back of the coffin bone, in order to its entering at a singular aperture into this bone, its mouth being broad or flattened externally. Here the artery enters, having a vein on each side of it, which explains the cause of this oblate figure of it. All three vessels are, in approaching the bone, occupying a broad, deepish groove, formed in the back of the bone, beneath a strong projecting ridge or shelf of bone, which is sustaining a considerable part of the two large flattened concave surfaces of the articulation of this bone with the coronet bone.

These three vessels are brought, or are situated, immediately under the terminating expansion of the perforant tendon, perhaps acting there as a sort of cushion to the above tendon, in preventing a too solid embrace of the bone. One of these veins is seen immediately to enter a transverse connecting vein below the shuttle bone; the other is seen ascending to join the mass of veins inside the cartilage: to these, however, we shall have again to recur in giving an account of the veins.

This posterior foramen in the coffin bone, in passing inwards within the substance of the bone, descends, and is opposed frequently by a projection of the bone of the part inside, forming in some cases nearly a right angle to the passage, and much obstructing it, and which is defeating often the intentions of the artificer in injecting the foot interiorly, and on this account we have distinguished this singular construction by calling it the *shvice*. And it may be hardly necessary to remark here, that in describing one side of the foot, we describe the other also, as they agree in most respects, and not requiring a tedious repetition; some discrepancies,

however, occur, which may be noticed in their places; for instance, we have observed that the vein appeared outside the artery on the outer quarter of the foot, and inside the artery on the inner side of the foot, apparently with a view to its better protection.

This angular form of the bone at the sluice, we have thought, might have useful effect in retarding the too free access of blood to the bone, in the forcible or rapid movements of the animal, endangering otherwise a sudden rupture of the vessels on these occasions.

This passage or foramen in the back of the bone is conducting the artery to a singular provision withinside the bone,—a sort of cavity or gallery formed transversely in its substance, which, from its singularity,—for it has only been regarded as a mere perforation hitherto we believe,—and which induced us to get a drawing made of it, and a woodcut, an impression of which may be seen in a work we were then employed upon, *The Surgery of Horses*, p. 10, where its appearance in a coach horse's foot may be observed. We named it from its curved figure, *the semilunar cavity*.

The main artery, following the tortuous course of this bony canal, and entering the above cavity, divides into numerous branches, which are distributing themselves through various perforations in the interior of the cavity to all parts of the interior substance of the bone, having their provided channels in the cellular substance of the bone, and issuing out of it by very numerous foramina; they then also appear to supply the cartilaginous foliations of the podophylla, adhering between them and the keraphylla, or horn leaves, from the hoof, the others coming from the bone, they together are making a connection of singular strength for receiving the powerful impressions of the hoof in the actions of the horse.

One very large ramification from this artery is seen immediately on its entering the cavity, and supplies the perforations on the sides of this bone. These perforations are numerous about the middle region of the bone, and what is singular, a sort of second cavity, or gallery, is seen further on in the interior of the bone, below this part, and even something like a third still smaller cavity lower down, giving out the two front arteries to the pincer in straight lines.

The lower series of external apertures in the bone are rather slits than foramina, and being deeply grooved in the bone, will protect these small vessels when retired within them from any sudden twists of the hoof, or any rude external assaults from other horses by treading upon them. The second gallery, or cavity, has the arteries forming within it a sort of *areola*, from which proceed the foraminous arteries of the middle region of the bone; and the smaller straight terminating arteries may be distinguished from the other less direct ones, by the term *radiating arteries* departing as rays from a common centre, and having perhaps some reference to the fingers and toes of other families of quadrupeds.

Professor Coleman, in his treatise on the foot, see plate 12, has strangely represented the two posterior arteries entering the back of the coffin-bone to join and form an inosculating annulus of the full dimensions of the two vessels, consequently the currents opposing each other must meet and destroy all circulation, the real facts being, as we have just stated, that the two arteries occupy each their own proper moiety of the above cavity, and never meet or interfere at all in the way he has supposed. These small arteries distributed through the substance of the bone, appear to have rather denser coats than is usual to vessels of their size, and they are lying

disposed upon, and in contact with, the hard, almost siliceous lower table, forming the sole of the coffin bone. And these minute vessels examined at their very extremities, where they enter the circular vein, are often reddish, apparently thin and membranaceous, sometimes also bifurcating and entering by two oblique mouths; perhaps this structure, and the former also, may impede or prevent, being thin and limber, any regurgitation of the blood, by any pressure accruing to the hoof from without. Also without this hard flinty solear table, which is thickening as it proceeds backwards, the coffin-bone would have presented but a feeble spongy mass or the limb to act upon. The upper surface however of this bone is also strengthened with this same hard sort of flinty bone.

The above remarkable *Semilunar cavity* appears to be not only the means of distributing the circulation throughout the foot downwards, but upwards also, for on attentively examining the roofing of this cavity, it is found to be formed of a multitude of pores, each of which is receiving an artery, which, making its way into the upper substance of the bone, is coming out through numerous foramina in its surface, and which discovery served to remove some difficulties before inexplicable.

It is also probable that all these arteries, on quitting the surface of the bone, supply not only the leaves of union, but the reticulum also, which densely covers over the front of the bone.

These small vessels lining the podophylla are with difficulty injected, but we may detect them and their courses by passing small pins or wires into them, by which we find their final exit to be into the larger and longer outer *circumferent vein* of the sole. We think it probable, however, though we do not assert it as having had ocular proof of it, that the upper arteries of the bone are not pursuing the above course, but are perhaps obeying the law of convenience and proximity, by entering their contents into the veins of the coronary circle.

The only other arterial vessels of these parts we deem worth notice, are those proceeding from the cutidura, which in parallel lines enter very deeply into the longitudinal substance of the hoof itself, serving to form its growth, and to maintain its consistence and toughness, and probably also determine the degree of its length, its life depending on the presence of arterial support. I have often been led to doubt of there being any specific membrane for the secretion and production of horn, the cartilaginous mass on which it appears to repose seems alone sufficient for its formation.

However, in the structure of the horn-sole, the vessels forming it appear simply to proceed from the vascular web, without any distinct presence of cartilage. These vessels of the sole are passing in a direction obliquely forward, and soon withering, determine an early exfoliation and perishing of the horn of this part. We now proceed to a consideration of the venous circulation.

Small arteries seem also sent off to the *Podal Globes*; they are however but small, as is the case in all white parts.

Of the Venous Circulation.

There is hardly any one, on being presented with a finely injected horse's foot, but must be forcibly struck with the abundance, almost magnificent, of its venous apparatus, and also with the apparent disproportion of the arterial to the venous organization. In this respect there is, perhaps, no animal that can at all compare with him.

By this extraordinary provision, the foot is in fact reposing, as it were, on a nest of veins, which, by their abundance and effects, may not inaptly be compared to the artificial mattresses made by the upholsterer, water-tight, and being filled with water, readily give way to every point of impression brought upon them, till the extent of surface or of water operated upon and displaced, becomes tantamount or equal to the weight of the imposing body, when the utmost limit of easy sustentation is produced.

Also this vast assemblage of veins appears to be operating in connexion with the widely distributed cartilaginous apparatus surrounding the posteriors and sides of the foot, and conferring together a wonderful share of elastic adaptation and yielding of the foot, a property wholly overlooked, and by the shoeing most grossly opposed with injury always to the part itself, and fatal often to those committing themselves to the effects of it; producing numbness and impeded circulation as its first effects, and absorption of the elastic parts and finally of the bone as the secondary effects. And extraordinary it is, that the continual accidents, losses, and calamities, continually attending it, should not have awakened an earlier looking into the affair. For it must soon have occurred, that the locking up an elastic organ in bonds of iron must destroy all these properties quickly with mischievous results. It was an overbearing tyranny in these affairs that kept men from interfering, and hardly daring to think even on these simple matters. Added also to this elasticity, is the bow-like action of the hoof itself, of an extent almost indefinite, and is aptly shown by the model of the hoof of pasteboard invented by us some years back, and which renders the apprehension of it very familiar and clear.

We commence the venous circulation with considering the sole and its web, which is amply supplied with veins traversing it in all directions, and communicating freely with each other. We call this plexus, or web, the *reticulum soleare*; and that of the wall, *reticulum processigerum*, as it is there carrying the *podophylla*, or *cartilaginous processes*, which are not present in the sole, that being retained firmly enough by its situation, and especially by its being surrounded everywhere by the projecting wall of the hoof.

The arteries of the sole are few and not very conspicuous, but the veins are large, and the outlets of both, especially of the former, are not very discernible; after some research, we could trace them to the *circumferent veins*, which are found passing round the front margin or edge of the sole, and which appear to be two in number, the exterior one considerably longer than the other, and which is destined to receive, as we have already stated, the arteries of the perpendicular foliations of the *podophylla*.

The inner circumferent vein, we have thought, was a little thicker in its coats than the former, and might, perhaps, by some, be rather deemed an artery; on tracing it, however, its

course is but short, for about the middle of the quarters it advances anteriorly, and mounting over, enters the former vein; whether it be an accessorial vein for security of the circulation in case of severe or long pressure on the other, may admit of consideration. The farther passage of these two veins was traced with some difficulty near to the retrossa or extremities of the coffin-bone, where they appear to be dividing into three or four distinct vessels, and receiving other similar ones from the veins of the sole, they were finally detected piercing through the base or lower parts of the cartilage, in seven or eight places, which passages or foramina were situated backwards near its extremity, and thence being directed forwards again, they are making a very acute angle on entering the concave inside of the cartilage, where they are seen collected into fewer trunks, which are then ascending to join the grand nest or congeries of veins in the infundibulum. The singular acuteness of the angle which these vessels make in getting within the cartilage, we were disposed to attribute possibly to a design or intention of retarding the escape of the blood from the veins of the reticulum too easily, that their office as a cushion might be the better fulfilled, and not be defeated by having a too ready exit and escape of the fluid into the larger veins.

We now take a view of the veins in the wall part of the hoof. The main artery supplying these is the *post-podal*, entering the coffin-bone behind at the *foramen depressum*, as formerly stated, and in a secondary manner the bone is supplied by the *retrosso-foraminal artery*, passing up the lateral groove of the coffin-bone, see Hip. plate VII, fig. 1. We suspect this artery, which has been rarely injected, to be entering the large foramen in front of the bone, and distributing its ramifications therein, that is, in the *Semilunar cavity*, returning at length as a vein, it is passing out at the oblate or depressed, posterior opening, in juxta-position with the artery, which vein, in returning from its distribution, is making perhaps one of the two veins this foramen exhibits. The radiating arteries in the inferior parts of the coffin-bone appear however to be solitary, ending, as we have stated, in the circumferent vein, but higher up the bone these arteries appear to have their accompanying veins.

These two veins having arrived at the above foramen with the artery between them, pass along a broadish groove under the shelving projection, which is supporting the articular surfaces; one, the innermost, enters immediately the *transverse vein* connecting the two sides of the foot, and is placed beneath the tendon of the *perforans*; the other, or outermost one, goes up the inside concave of the cartilage, and joins the conglomerate veins in the infundibulum.

Still other veins appear in the superior front parts of the bone, near its summit, which apparently empty, for convenience and from their proximity, into the veins proceeding from the cutidura and coronary circle,—their arteries being one or both of the before-mentioned.

We now notice that singular nest or assemblage of veins formed in the recess of the *infundibulum*, or *funnel*, as we have termed it,—for parts without names are almost as no parts. This infundibulum, narrowing downwards to the retros, and widening upwards towards the margin of the cartilage, receives this vast collection of veins, and is assuming very different appearances in different feet, but having usually a central perpendicular large trunk in the midst, with others joining to it at right angles, and is making somewhat the figure of a short-bodied man, with his arms and legs extended at nearly right angles to his body; other vessels are

seen overlaying these in no definite order, and this singular mass we have proposed, till a better name be found, to designate as the *Venæ conglomeratæ* or *cumulatæ*, by which we may at all times refer to them without a troublesome circumlocution, or fear of a mistake. The immense transverse undulating vein beneath the sesamoids is also entering the above mass, connecting very usefully the two circulations of the opposite sides of the foot.

These veins on the inside of the cartilage, meeting an immense distribution also from the outside of the cartilage, also from under and over the extensor tendon, near the back head of the coronet bone and uppermost point of the superior margin of the cartilage, unite, to form a few considerable trunks, which, passing up the pastern bone, and there meeting and accompanying the artery, form into a solitary single trunk at the shank, and terminate our humble account.

These astonishing assemblages of veins, inside and outside of the cartilage, we are ready to conclude may be destined usefully to guard and protect these parts which are almost in themselves destitute of blood in their interior structure, from the effects of cold or of sudden chills in the more northern regions of the world, and from the destructive overcharge of heat and dryness perhaps, when exposed to the scorching sands of Arabia or of Egypt, or the sirocco of the desert; and these cartilages, probably moving, or ought at least to move, at every step of the animal, are assisting in promoting the due circulation of the blood in this remarkable organ. A vast multiplication of veins are streaming in clusters down the outside of the lateral cartilage, covering nearly its surface, and whose origin or source will escape a casual inspection, are fed perhaps from the cutaneous arteries and those of the cutidura.

We may here also remark, that we possess coffin bones very smooth and having very few external foramina indeed, and what there are are also very small. Can this be the natural state of the bone, or has it been the work of the iron compress, called a shoe, closing the vessels and diminishing their foramina?

There is also one point unascertained, which we leave for future inquirers. For on examining many coffin bones, especially of large horses, there is seen, especially on the inner quarter, a channel or groove advancing nearly in a straight line directed upwards from the sharp inferior edges of the bone, and is situated just anterior to the square plate of bone which is covering over the perforation of the retros. Now, whether this be the recipient of an artery or of a vein, whence it comes or whither it goes, we know not, and leave it as a pleasing task for others to solve, who may feel an interest in entering upon these useful pursuits.