3. Notes upon the Anatomy of certain Snakes of the Family *Boidæ*. By FRANK E. BEDDARD, M.A., F.R.S., Prosector to the Society.

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(Text-figures 19–23.)

The Boidæ are held by most zoologists to occupy a place near the base of the Ophidian series. This view is based chiefly upon the paired lungs, the considerable rudiments of the hind limbs, and upon some other osteological points which are duly summed up by Boulenger*. The viscera also confirm this opinion; and I propose in the following pages to call attention to some new or little-known facts relating to the circulatory system which collectively support it.

§ *Gubernaculum cordis, and Right and Left Aortæ.*

No member of the genera *Python*, *Boa*, *Eunectes*, and *Eryx* which I have dissected possesses any trace whatsoever of a gubernaculum cordis tying down the apex of the heart to the walls of the pericardium. It is not altogether unnecessary to record the absence of a gubernaculum, though it has been stated that the Lacertilia are to be contrasted with the Ophidia by the presence in the former and the absence in the latter of this gubernaculum. A more correct statement would be arrived at if the word "generally" were interpolated in both cases. I find, in fact, considerable vestiges of this tag in several Ophidia. It occurs for example in *Coronella getula*. In *Cœlopeltis monspessulana* a thin sheet of membrane runs from the ventricle some little way above the apex to the vena cava and passes down the latter to the posterior wall of the pericardium.

In the Hamadryad (*Ophiophagus bungarus*) the covering membrane of the heart (= visceral layer of peritoneum) is obvious and can be stripped off. Posteriorly, this membrane forms a tubular prolongation of which one side is attached to the vena cava at its entrance to the heart and to the pericardium beyond, while the other is attached to the pericardium wall behind. The ventricle, therefore, near to the apex, but on one side, is attached not merely to the vena cava, but also to the wall of the pericardium.

It is impossible to speak of these structures but as a gubernaculum cordis. On the other hand, it is clear that they differ somewhat from the gubernaculum in the Lacertilia, which has no relation to the vena cava but attaches the actual apex of the ventricle to the pericardial wall, and is of more ligamentous consistency.

The structure is therefore possibly a new one in the Ophidia, on which view its total absence in the Boidæ (so far as the material which I have examined enables me to say) may well be

* Catalogue of Snakes in the British Museum (Natural History), London, 1893.

a primitive character. There is no *a priori* objection to deriving the Ophidia from some Lacertilian form in which the characteristic lacertilian "tag" to the heart was absent. In the genus *Varanus*, for example, the gubernaculum is absent, as others as well as I myself have observed; and it may be pointed out that the Ophidia might well have been derived from some form in which, as in *Varanus*, the neck was long, the lungs firmly bound down to the dorsal parietes, the trachea or bronchi continued for a considerable distance through the lung, and the urinary bladder absent.

The fact that in *Eryx* the right and left aortic arches are equal in size at their junction to form the unpaired dorsal aorta seems to me to be undoubtedly a primitive feature. I may furthermore observe that this feature is figured * by Dr. Gadow as characteristic of *Pelophilus* (*Boa*) *madagascariensis*. Apparently, however, *Python bivittatus* has unequal right and left aortæ †. In other serpents it is common for the right aortic arch to be smaller than the left, and this is carried so far in *Zamenis flagelliformis* as to give the impression that the right aorta is a mere inconspicuous forwardly running branch of the left ‡.

§ *Intercostal Arteries.*

The intercostal arteries in *Eryx jaculus* show some interesting features, which are partly indicated in the accompanying drawing (text-fig. 19, p. 109). In the anterior region of the body the arteries in question arise from the left aorta immediately after it has parted company with the anterior vertebral. Anteriorly to this point some arise from the left aorta, but that region of the body is supplied from the vertebral artery. The intercostal arteries which arise from the right aorta and from the first part of the conjoined aortæ are single trunks given off at irregular intervals not corresponding to the individual vertebra. They join above, however, to form a continuous and slender dorsal artery which may be termed the posterior vertebral artery (*P.v.*); from this arise at regular intervals the paired intercostals.

After the end of this vertebral artery the aorta continues to give off the dorsal intercostals which, when they reach the median dorsal line, run along it for a short distance anteriorly and posteriorly, giving off as before paired branches to the intervertebral regions. But there is no formation here of a continuous longitudinal trunk running over more than three or four vertebræ. So far the arrangement is precisely such as I have lately described in another Boid, viz. *Python spilotes* §. But whereas in the last

* Bronn's Klassen und Ordnungen des Thier-Reichs, Bd. vi. Abth. iii. pl. cxxxv. fig. 1.

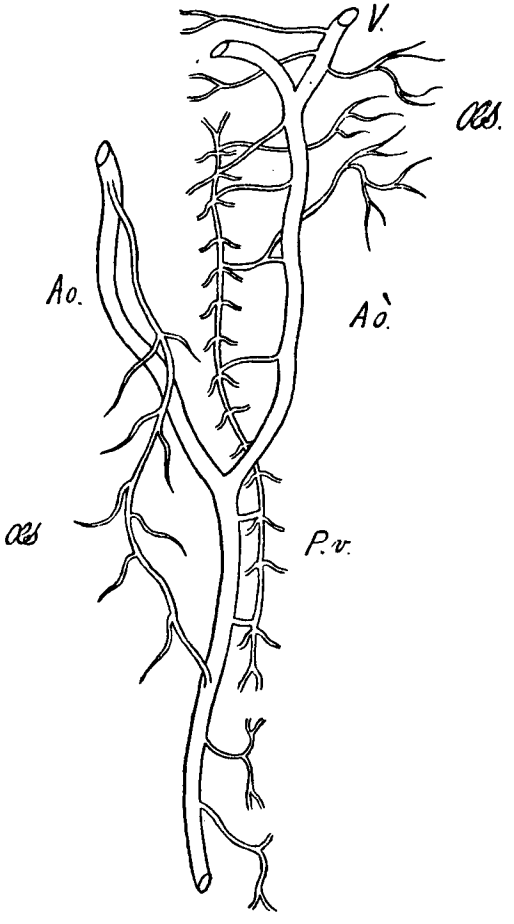
† *Loc. cit.* pl. xxxiv. fig. 2. The figure is copied from Fritsch.

‡ Beddard, "Contributions to our Knowledge of the Vascular System in the Ophidia," P. Z. S. 1904, vol. i. p. 338.

§ "Contributions to our Knowledge of the Circulatory System in the Ophidia," P. Z. S. 1904, vol. i. p. 362.

named snake this arrangement of the intercostals persists to the end of the body, in *Eryx jaculus* another arrangement comes into force further down the body which is displayed in the drawing reproduced as text-fig. 20, p. 110. First of all, *i. e.* anteriorly,

Text-fig. 19.



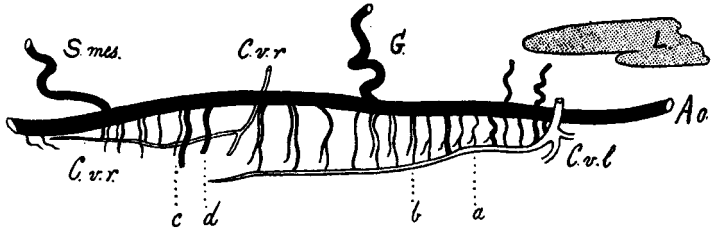
Part of intercostal arterial system of *Eryx jaculus*.

Ao., right, *Aò.*, left aortic arch; *œs.*, œsophageal twigs; *P.v.*, posterior vertebral artery; *V.*, vertebral artery.

the intercostal arteries begin to arise regularly from the aorta, and, when they reach the parietes, do not form short longitudinal vessels which give off paired branches to several successive

vertebræ; but each intercostal bifurcates close to the parietes and supplies but a single intervertebral area. The arrangement in this region of the body in fact is precisely like that figured by Jacquart * for *Python sebæ*, and which I can confirm from my own dissections of the same serpent. In *Python sebæ*, however, this arrangement appears to persist throughout the whole body. In *Eryx*, on the other hand, a little way back, a third mode of arrangement of the intercostal arteries occurs. The point of bifurcation of the single intercostal advances higher up its stem (*a* in text-fig. 20) until (*b*) a right and left intercostal is established arising separately from the aorta. A further differentiation is shown in the case of the intercostals lettered *c* and *d* in the figure referred to. It will be observed that in *c* the left intercostal is much thicker than its fellow and than most of the neighbouring intercostals, while in *d* the vessel has become single owing to the complete disappearance of its fellow. These facts indicate the way in which the irregular intercostal arteries (sometimes right and

Text-fig. 20.



Part of intercostal arterial system of *Eryx jaculus*.

Ao., aorta; *a*, *b*, *c*, *d*, intercostal arteries; *C.v.r.*, *C.v.l.*, right and left posterior cardinals; *G.*, gastric artery; *L.*, end of liver; *S.mes.*, superior mesenteric artery.

sometimes left and at unequal distances) of more modified snakes have been formed. Obliterate in the accompanying drawing (text-fig. 20) the finer intercostals and leave only those of magnified calibre, and the result would be a reproduction of the intercostal system in many Colubrine Snakes. This double series of intercostal vessels in *Eryx* has its counterpart in *Eunectes murinus*. In the Anaconda I find both intercostals arising singly which run for varying distances along the median dorsal line giving off paired branches to the parietes, and regularly paired intercostals arising separately from the dorsal vessel It is important to notice the agreement in these particulars between *Eryx* and *Eunectes* and the difference from *Python*, since the two former belong to the subfamily *Boinæ*, and the latter, naturally, to the subfamily *Pythoninæ*. It is difficult to say which of the

* Ann. Sci. Nat. (4) iv. p. 321.

two arrangements of the intercostals, the Boine or the Pythonine, is the more primitive; perhaps it is the former. In any case it is from the Boine rather than the Pythonine type that the intercostal system of many Colubrine Serpents is derivable.

Eryx conicus differs in detail from *Eryx jaculus* in the arrangement of the intercostal arteries. Anteriorly, the arteries are given off singly and regularly, bifurcating just before their entry into the thickness of the parietes. There is with great regularity one to each vertebra. The only exception that I noticed was in the case of one intercostal arising from the right aorta in front of the junction of the two aortæ, and of another some way behind; these supplied two intervertebral spaces. This apparently is the only trace left anteriorly of the arrangement characterising *Eryx jaculus*. Far back, much further than in *E. jaculus*, the paired arrangement of the intercostals is seen. Still it is evident that the two species do not differ in the type of the arrangement of the intercostals.

Eryx johni again shows a fundamental likeness to, but detailed differences from, the other two species of the genus. The general agreement is that the anterior series of intercostals arise singly from the aorta and bifurcate only just before entering the parietes. They begin to be double in origin shortly behind the liver. In the region where they are double they are frequently asymmetrical in both size and in point of origin from the aorta. Thirteen intercostals arise from the right aortic arch before its union with the left. There is no trace of any formation of an azygos median vertebral artery such as occurs in *Eryx jaculus*. The intercostal system of this species in fact is somewhat intermediate between those of the two other species of the genus.

§ *Some Visceral Arteries.*

Œsophageal arteries.—I have examined these arteries carefully in an injected example of *Eryx jaculus*. It agrees with other snakes and with the Lacertilia in the fact that the intercostals (already described on p. 109) arise from the right aortic arch only. On the other hand, branches to the œsophagus, which are represented in the drawing (text-fig. 19, p. 109), arise either directly or indirectly from both arches. I have not observed this double origin of the œsophageal branches in any other Ophidian; but, as I am not quite in a position to deny its occurrence, I cannot emphasise the fact as a characteristic of the Boidæ. It is, however, I am inclined to think, an anatomical feature not found in the Lacertilia. The œsophageal vessels, or rather vessel (for I only noticed one), arises from the left aorta; it passes back along the œsophagus, giving off branches to that gut, and becomes continuous with the first of the œsophageal arteries arising from the conjoined aortæ. The right aorta does not directly give off œsophageal arteries. But from two of the intercostals of the right aortic arch such arteries arise.

In *Eryx johni* the same series of œsophageal branches arising from intercostals are present. They arise from intercostals partly belonging to the right aortic arch, and partly to those arising from the common trunk. The third intercostal, after the union of the two aortæ, gives off a slender vessel which runs forward and joins a vessel arising from the last but four of the intercostals belonging to the right aorta. This longitudinal trunk gives off several lateral vessels. The third, fourth, and fifth of the intercostals of the right aortic arch also give off single œsophageal vessels.

I have pointed out in another paper* that the Lizard *Pygopus* is unusual by reason of the fact that some of the visceral arteries arise from intercostals instead of directly and independently from the aorta. In *Eryx johni* precisely the same mode of origin occurs not only for œsophageal arteries, but for a fat-body artery. This springs from the right-hand intercostal of the seventh pair after the posterior renal artery.

I observed the exact converse of this state of affairs in *Tropidonotus fasciatus*. The right aorta gives off intercostal branches, but no twigs to the œsophagus that I could find. On the other hand, a single parietal vessel, accompanied closely by a vein, enters the parietes a good way to the left of the middle dorsal line and arises unmistakably from the left aortic arch, which also, of course, gives off several branches to the œsophagus.

Gastric arteries.—The fact that in *Eryx* there are only two† and in *Python spilotes* only three gastric arteries, appears to me to be an archaic point of structure in these Boid snakes. Among the Ophidia generally there is frequently a large number of gastric arteries. For example, in the genus *Coluber* I have found as many as ten or eleven. The reduplication of these and other arteries, so characteristically Ophidian, seems therefore obviously to mark the more specialised members of the group. The absence of, or less, reduplication is not therefore inconsistent with the less modified, more archaic, structure.

Ovarian arteries.—It is at least rare among snakes‡ for the arteries supplying the gonads to arise from the aorta opposite to each other. As a rule one spermatic or ovarian artery follows the other in relation to the asymmetrically placed gonads. Nevertheless in a female *Eryx conicus* the two arteries arose side by side. They immediately follow, as is usual, the superior mesenteric. The paired condition of these arteries seems to me to be a primitive feature in the organisation of this snake.

Renal arteries.—It is the general rule among the Ophidia for each kidney to be supplied with a considerable number of arteries. There are, for example, as many as eight in *Coluber catenifer*. Among such Boidæ as I have examined, the number is invariably one or two arteries only to each kidney. In *Python sebæ*, *Eunectes*

* Above, p. 12.

† I could find only one in *Eryx johni*.

‡ I have not myself observed a single instance in the Ophidia except in the case mentioned above.

murinus, *Eryx johni*, and *Eryx conicus* each kidney had only one renal artery. In *Eryx jaculus* there was some variation in the two examples studied. In one there were two renal arteries for each kidney; in the other the left kidney had two arteries, the right only one. Here, it may be remarked in passing, is an apparent difference between the two species of *Eryx* investigated by me, which I shall refer to again later.

Now, as the kidneys of *Eryx* are very short * and those of *Coluber catenifer* long, as they are in the majority of snakes, it might be held that the arterial blood-supply had merely a relation to length. That the character is one peculiar to the Boidæ seems to be shown by the case of *Eunectes murinus*, for in this serpent there is only one renal artery to each kidney; and yet those organs, in the individual which I dissected, measured respectively $15\frac{3}{4}$ and $12\frac{1}{2}$ inches in length.

§ *Veins of the Posterior Abdominal Region in* Eunectes.

The *caudal* vein emerges from the thickness of the parietes some way behind the cloaca. When it reaches the level of the cloaca, two veins, asymmetrically placed with regard to one another, join it. I suppose that these are the equivalents of the *ischiadic* veins of Lizards. Further forward, between the cloaca and the very anteriorly situated kidneys †, the caudal vein divides at once into three branches. The middle one of these is the *right* and larger *anterior abdominal* vein. To the left of this arises the *afferent renal* vein of the left kidney, and to the right of the anterior abdominal a vein which runs over the viscera to the dorsal surface of the body, where it enters the parietes to the left of the middle line, after running both forwards and backwards for a short distance. I am inclined to regard this vein as the equivalent of the *lateral abdominal* vein of its side in the Lacertilia. Its place of origin agrees with such an homology, and the shortness of its course within the body-wall is no reason against the comparison, since it is of varying length among the Lacertilia. It might be held that this vein is in reality only the proximal end of the left afferent renal which has lost its connection with the remainder of that vein, were it not for the conditions observable in *Eryx* to which I recur later (see p. 114). There is, in fact, no afferent renal on this side of the body springing from the caudal vein and corresponding in origin to the fully developed afferent renal, whose origin on the other side of the anterior abdominal has been already referred to. It rises, I presume, from the caudal vein further back.

* In *Eryx johni*, which measured 26 inches from snout to vent, the kidneys were respectively $\frac{3}{4}$ inch (right kidney) and 1 inch (left kidney) in length. In *E. jaculus* of $15\frac{3}{4}$ inch length to vent, the kidneys were proportionately larger, *i. e.* $\frac{7}{8}$ inch and 1 inch, and in *E. conicus* of 27 inches this was also the case; they measured $1\frac{1}{8}$ and $1\frac{1}{4}$ inch.

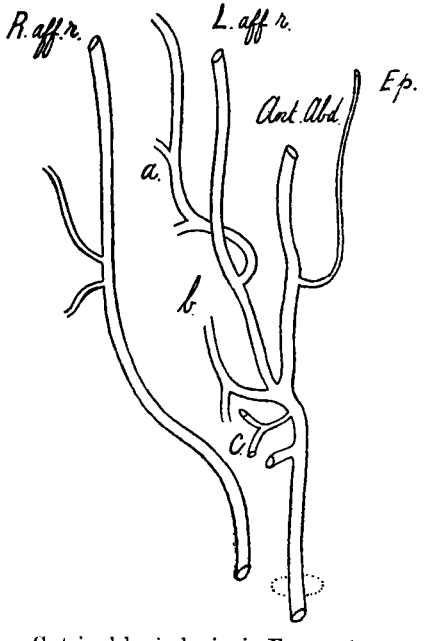
† The kidneys are well known to occupy a very anterior position in the Boidæ. It has not, I think, been noted that *Eryx* as well as *Eunectes* agrees in this with *Python* and *Boa*.

The *anterior abdominal* vein is double, but the right vein is very considerably larger than the left, especially posteriorly. The two join far forward in the immediate neighbourhood of the pancreas. They are here more nearly equisized. Posteriorly there is another and the only other junction between these paired veins not far in front of the trifurcation of the caudal vein. After this point the left anterior abdominal vein receives a branch from the body-wall and ceases. It is not directly connected, as already mentioned, with the caudal vein. Just after its origin from the caudal vein the anterior abdominal gives rise to the single *median epigastric* vein, which runs forward at least as far as the liver, to which it gives off several branches.

§ *Veins of the Posterior Abdominal Region in* Eryx.

It is remarkable that differences occur in these veins between the two species *Eryx jaculus* and *E. conicus*, if, that is to say,

Text-fig. 21.



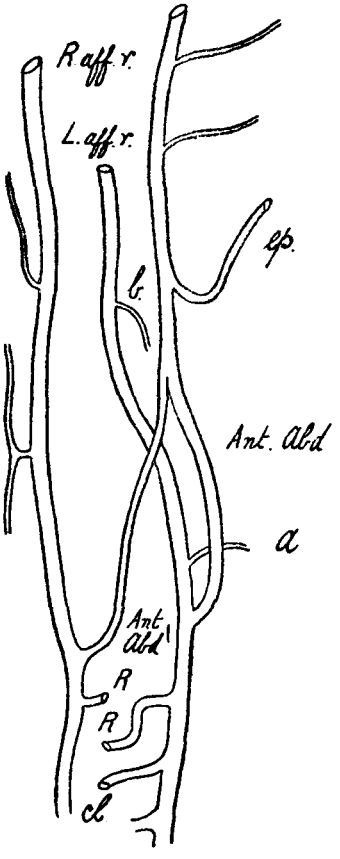
Certain abdominal veins in *Eryx conicus*.

a, *b*, *c*, parietal veins; *Ant.Abd.*, anterior abdominal; *Ep.*, epigastric; *L.aff.r.*, left afferent renal; *R.aff.r.*, right afferent renal.

the single example of *E. jaculus* which I have examined represents the normal state of affairs. The veins in question in *Eryx conicus*

(text-fig. 21, p. 114) are disposed as follows:—The caudal vein gives off first the right afferent renal; after the cloaca (*i. e.* in front of that aperture) it gives off two branches to the dorsal parietes and then divides into three veins as in the Anaconda. Shortly after its origin, the anterior abdominal gives rise to the single epigastric vein. The arrangement of veins in this snake is in

Text-fig. 22.



Certain abdominal veins in *Eryx jaculus*.

R, branches to rectum; *cl.*, branches to cloaca. Other letters as in text-fig. 21.

fact precisely as in *Eunectes*. In *Eryx jaculus*, on the other hand, there are differences which are illustrated in the accompanying figure (text-fig. 22). The caudal vein apparently divides into two—but I am a little uncertain—and each of these vessels

gives off at least one branch to the rectum. A little further forward each vein certainly divides into two branches. These branches are, on each side, a renal afferent and a component of the anterior abdominal vein. Both afferent renals receive, as usual, branches from the dorsal parietes. The two roots of the anterior abdominal vein are unequal in size, that of the right hand being considerably the less. It is important to note this fact, since in *Eryx conicus* the left root of the anterior abdominal vein is the only one which persists. The epigastric vein arises from the anterior abdominal shortly after the junction of its two roots. *Eryx johni* agrees with *E. jaculus*.

It is a peculiarity of Snakes as contrasted with Lizards, that the anterior abdominal is occasionally partly double, whereas in Lizards it is single after the fusion of its two roots. In the Colubrine and Viperine snakes, so far as my experience goes, the anterior abdominal is usually single except at its extreme posterior end. In *Zamenis gemonensis* the vein bifurcates posteriorly, and after a very short course ends in minute branches in the fat-body. In *Causus rhombeatus* the extent of the bifurcate region of the anterior abdominal is not much greater; for 8 inches intervene between the opening of the anterior abdominal into the portal and its bifurcation posteriorly, which is $2\frac{7}{8}$ inches from the vent. In *Boa constrictor*, on the other hand, there are 23 inches between the vent and the fusion of the two anterior abdominals anteriorly, which point is 10 inches behind the liver, and therefore less from the point of union of anterior abdominal and portal *.

In the Anaconda the double character of the anterior abdominal vein has been already referred to. In one specimen of *Eryx conicus* it was single throughout. In another it was partly double, as was also the case with two individuals of *Eryx jaculus*. In *Python sebæ* (where it is figured as partly double by Jacquart †) the fluctuation of this vein between the single and double condition was more plainly seen. Just in front of the gall-bladder the vessel communicates with the gastric portal vein; from this point to two inches behind the gall-bladder it is single. Then for a distance of $4\frac{1}{2}$ inches it is formed of two tubes lying side by side; these reunite, and finally again separate to form two tubes.

In *Eryx johni* the vein appears to be single after the union of its two posterior roots.

Jacquart figures a somewhat different state of affairs in *Python*. The anterior abdominal bifurcates posteriorly and communicates with only one afferent renal directly as in the Anaconda. The other branch only communicates indirectly (by means of small veins) with the left renal afferent. Hochstetter ‡ observes that in *Tropidonotus natrix* and *Coluber æsculapii* there is no direct connection between the abdominal and the renal afferent veins. I can quite confirm this by the conditions observable in *Zamenis*

* I did not ascertain this measurement.
† Ann. Sci. Nat. (4) vi. p. 321. ‡ Morph. Jahrb. xix. p. 489.

gemonensis. I take it that the posterior bifurcation of the anterior abdominal vein in the last-mentioned Colubrine snake (and possibly in *Causus* and other forms) is a reminiscence of its former origin by two roots from the renal afferent veins as in the less modified Lacertilia, and, as I have already shown, in the especially "Saurian" *Eryx jaculus* and *Eryx johni*.

It is clear from the foregoing, that the somewhat divergent opinions of previous authors are partly due to actual differences in the abdominal and afferent renal veins of different Ophidia, to our knowledge of which I have been able to add something. It is furthermore clear that the Boidæ contrast with other Ophidia, so far as observation has gone, in their greater approximation to the Saurian type of organisation; they are, in fact, more primitive than other Ophidia. In these Ophidia alone is the anterior abdominal vein connected with one or both of the afferent renals, and in them there is generally doubling of the anterior abdominal vein in front of the junction of its constituent veins. Of all the Boidæ whose anatomy is known, *Eryx jaculus* (not *E. conicus*) comes nearest to the Saurian type in that its anterior abdominal vein arises from two distinct roots, one from each of the renal afferent veins.

§ *Remains of Cardinal Veins.*

In comparing the venous system of the adult *Tropidonotus* with that of the adult *Lacerta*, Dr. Hochstetter* arrived at the conclusion "dass das Venensystem der Lacerta auf einer etwas niedereren Entwicklungsstufe strehen geblieben ist als das von Tropidonotus. Bei Lacerta ist das System der Vertebralvenen noch erhalten, während es bei Tropidonotus nahezu völlig geschwunden ist." Hochstetter's statements are also accurate when applied to other Colubrine snakes. I have examined *Lioheterodon madagascariensis* with some care from this point of view. In that snake there is hardly any development of vertebral veins, such as I shall describe immediately in the Boidæ. About halfway down the liver, however, is a longitudinal vessel running for a short distance, from which arises a tributary to the hepatic portal system. Another Colubrine snake, viz. *Zamenis gemonensis*, showed an interesting persistence of a portion of the posterior cardinal vein precisely comparable to what is to be found in the Chamæleon† and in *Pygopus*‡. The afferent renal artery in front of the left kidney, instead of ending, as is usual, towards the anterior end of that gland, passes beyond it and imbeds itself in the body-wall to the left of the median dorsal line. I could find nothing to correspond on the right side. If really absent—and I am convinced that there is at least nothing really conspicuous—this is another example of the asymmetry of Ophidian

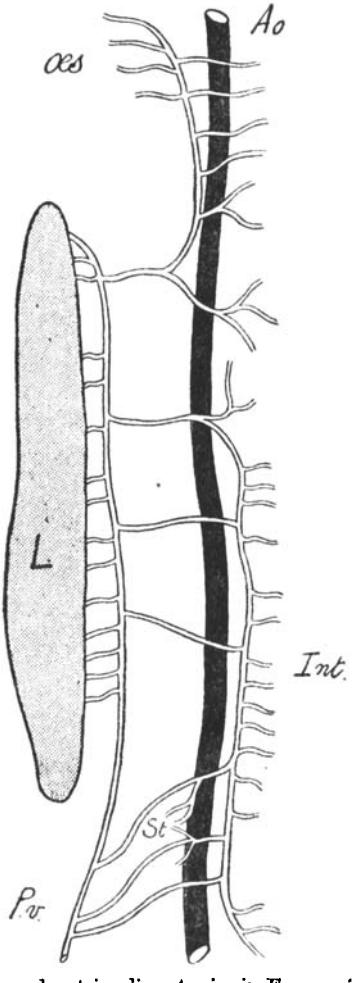
* Morph. Jahrb. xix. p. 493.

† Hochstetter, *loc. cit.* p. 462, and Beddard, *loc. cit. infrà*.

‡ Beddard, "Contributions to the Anatomy of the Lacertilia, No. 3," P. Z. S. 1904, vol. ii. p. 12.

structure. The discovery of this prerenal portion of the posterior cardinal in an Ophidian removes another point of dissimilarity between the Ophidia and the Lacertilia.

Text-fig. 23.



Liver and certain adjacent veins in *Eryx conicus*.

Ao., aorta; *œs.*, œsophageal branches of longitudinally running left posterior cardinal; *Int.*, intercostal branches of the same; *L*, liver; *P.v.*, portal vein; *St.*, branches to stomach.

The *Azygos* vein is admittedly a vestige of the posterior cardinal

of its side. This vessel appears to be well developed in some Boid serpents, and that fact appears to me to indicate the retention of a primitive feature*. In *Eryx jaculus*, for example, the vein, which is on the right side, extends back over no less than twelve intercostal spaces and nearly reaches the junction of the two aortæ. This contrasts with the same vein in *Coronella getula*, which only extends over four of these spaces. In a specimen of *Eryx conicus* the azygos vein extended only over ten vertebræ. In both specimens of *Eryx conicus* the azygos, after a break, reappeared in the region of the liver, where its course is shown in the accompanying drawing (text-fig. 23, p. 118). It will there be seen that the vertebral vein with one gap near the anterior end of the liver runs continuously to a point some little distance behind the liver. It gives off branches on the one hand to the dorsal parietes, and on the other to the portal vein. Anteriorly to the liver the branches go to the œsophagus. In *Eryx jaculus* (text-fig. 20, p. 110, *C.v.l.*, *C.v.r.*) there were conspicuous traces of *both* posterior cardinals behind the liver. As will be seen in the drawing referred to, the left posterior cardinal is continued anteriorly beyond its junction by a conspicuous branch with the portal trunk in the immediate neighbourhood of the liver; posteriorly it ends near to the commencement of the right-hand vein, the two being therefore supplementary to each other. The left is considerably the longer. The right extends back a little way beyond the origin of the superior mesenteric artery from the aorta. In *Python sebæ* a corresponding vein occurs in the region of the liver, but it extends both further forward and backward than I have observed in *Eryx*. Anteriorly it extends beyond the junction of the two aortæ, and posteriorly it reaches very nearly to the gall-bladder. I do not for the present suggest that these longitudinal vessels are more developed in the Boidæ. I simply call attention to their arrangement.

§ *On the Specific Differences between* Eryx jaculus, E. johni, *and* E. conicus.

These species can be readily separated by external characters, as Boulenger plainly sets forth in the British Museum 'Catalogue of Snakes.' They also, however, differ in other points besides the obtuse or pointed tail, the absent or present mental groove, and the form of the rostral scale, &c.

There are differences, in the first place, in the form of the liver. In *Eryx jaculus* and *E. johni* the lobes are unequal, and the right lobe extends further down the body than the left, to the extent of about half an inch. In *Eryx conicus* they are as near as possible exactly equal. As these results depend upon the examination of two examples of each of the species *E. jaculus* and

* As I have pointed out in a preliminary account of some of the facts detailed in the present communication (Ann. & Mag. Nat. Hist. (7) xiii. p. 233).

E. conicus, the character may, I take it, be regarded as a genuine, if small, difference.

Secondly, the right lobe of the lung extends further back in *Eryx jaculus* and *E. johni*. In those species it reaches the gall-bladder; in *Eryx conicus* it falls short of the gall-bladder by at least an inch.

The superior mesenteric artery arises in *Eryx jaculus* and *E. johni* distinctly in front of the gall-bladder. In *Eryx conicus* its point of origin is as distinctly behind the gall-bladder. This character is perhaps less likely than some others to prove of value as an absolute mark of distinction.

More important are other differences in the vascular system. In *Eryx jaculus*, though it is the smaller species, there are apparently, as a rule, two arteries supplying each kidney; in *Eryx conicus* there is but one to each kidney: and here apparently *E. johni* agrees with *E. conicus*. The intercostal arteries have a different arrangement in the two species. In *E. jaculus* there is a well-developed posterior vertebral artery formed by the junction of irregularly arising intercostals; in *E. conicus* this does not exist (except as the merest rudiment). The paired intercostals commence further forward in *E. jaculus* than in *E. conicus*. *E. johni* in these particulars is somewhat intermediate. In *E. jaculus* there is a double connection of the anterior abdominal vein with the afferent renals posteriorly; in *E. conicus* this occurs only on one side. *E. johni* agrees with *E. jaculus*. In relation to these anatomical differences, which appear to me to be fully as great as those which distinguish either species from *Eunectes*, I would draw attention to the restricted range of *E. conicus* and to the wider distribution of *E. jaculus* and *E. johni*.

Résumé of principal facts.

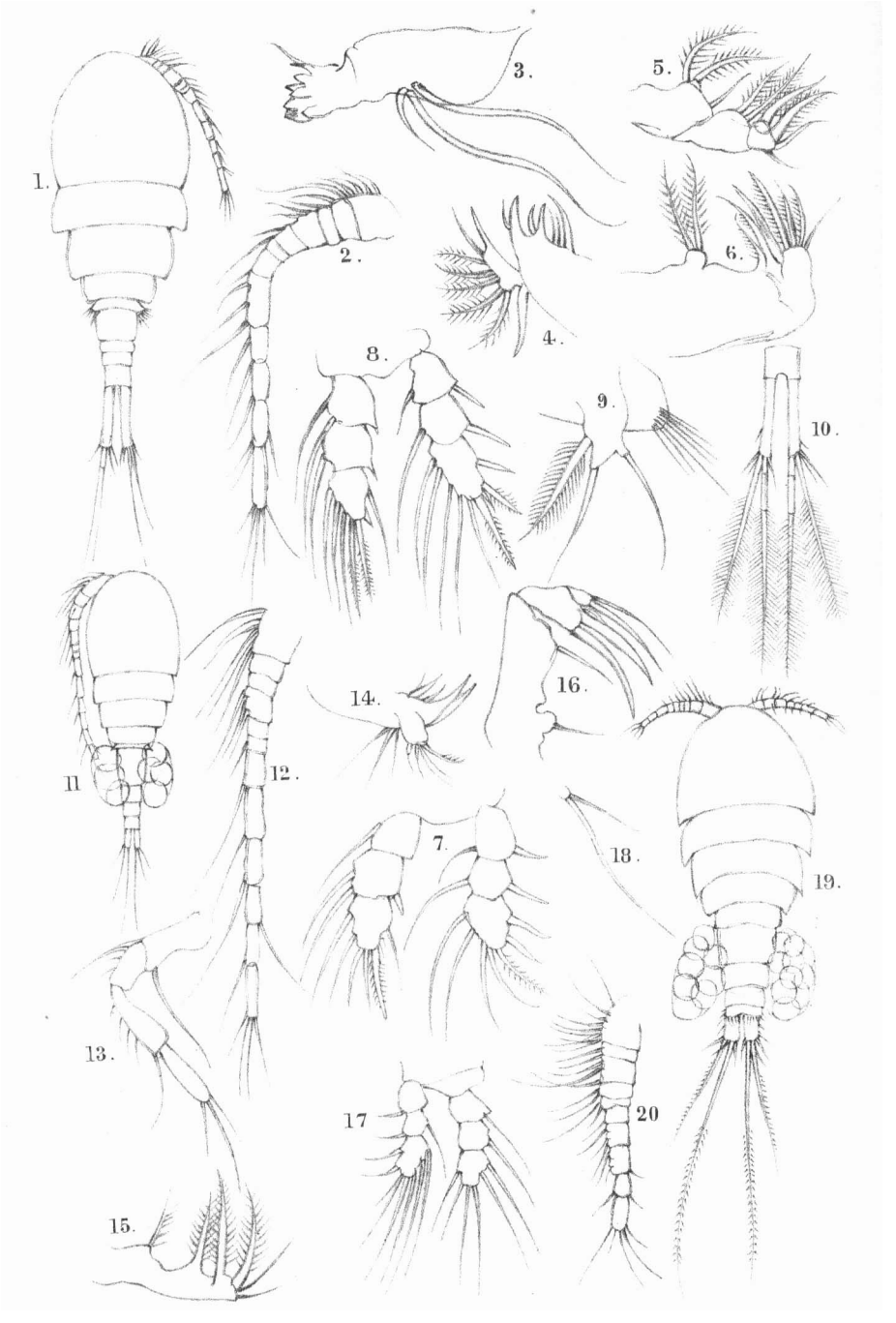
It may be convenient to deduce from the foregoing pages the main facts in the vascular system of the Boidæ examined; such may be divided into two heads, *i. e.*, those which appear to argue a basal position among the Ophidia, and those which are of systematic importance in the group. As to the former it may be noted that

(1) The heart is always without the least trace of a gubernaculum cordis.

(2) The two aortæ are usually equisized at their point of union to form the dorsal aorta.

(3) The renal and gastric arteries are much fewer in number than in other Ophidia, the former consisting generally of only one artery to each kidney. This distribution has no relation to the size of the kidney.

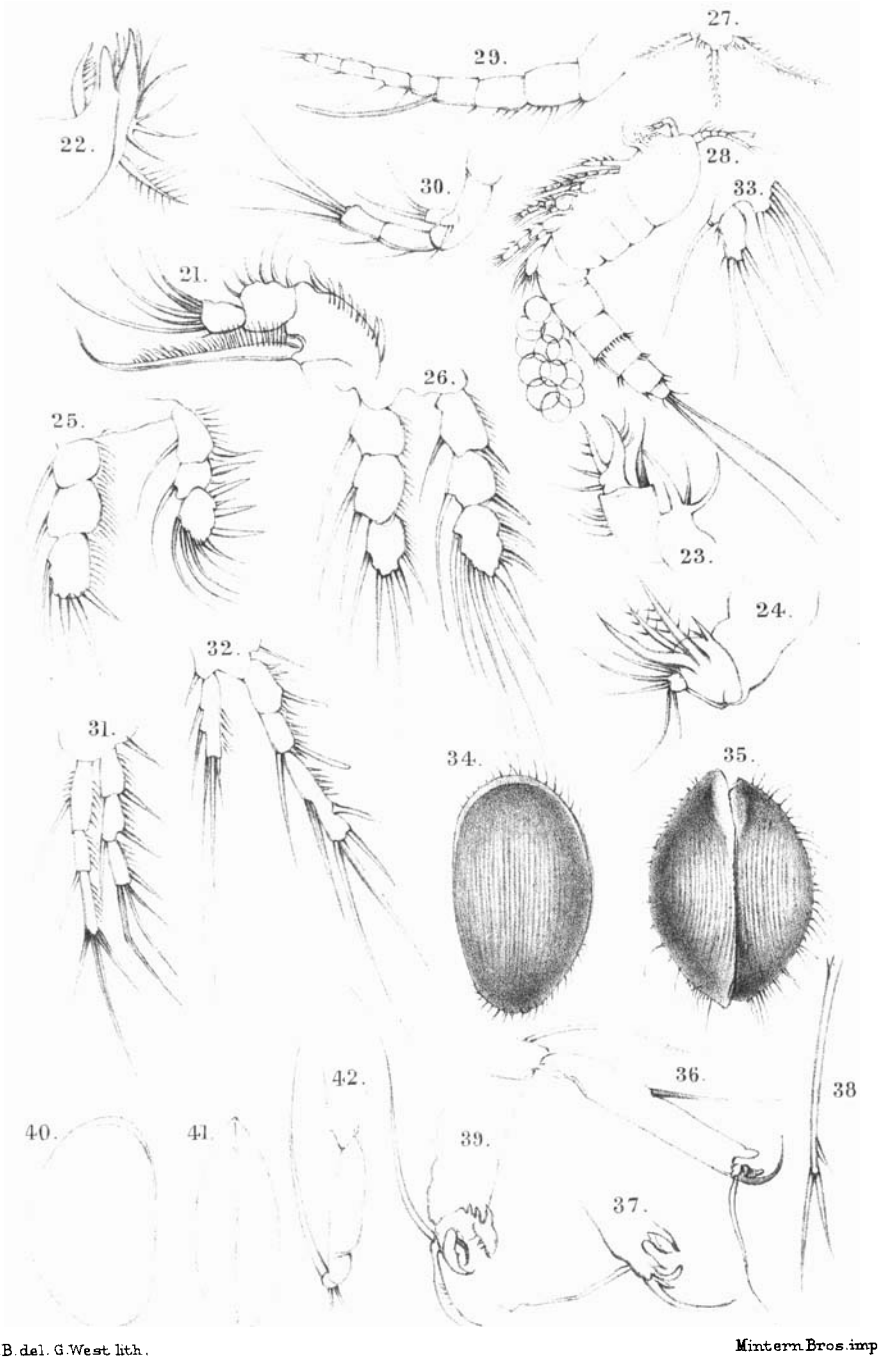
(4) The intercostal arteries are always symmetrical and for the most part regular in their arrangement, frequently in regular pairs.



G.S.B. del. G.West lith.

Mintern Bros. imp.

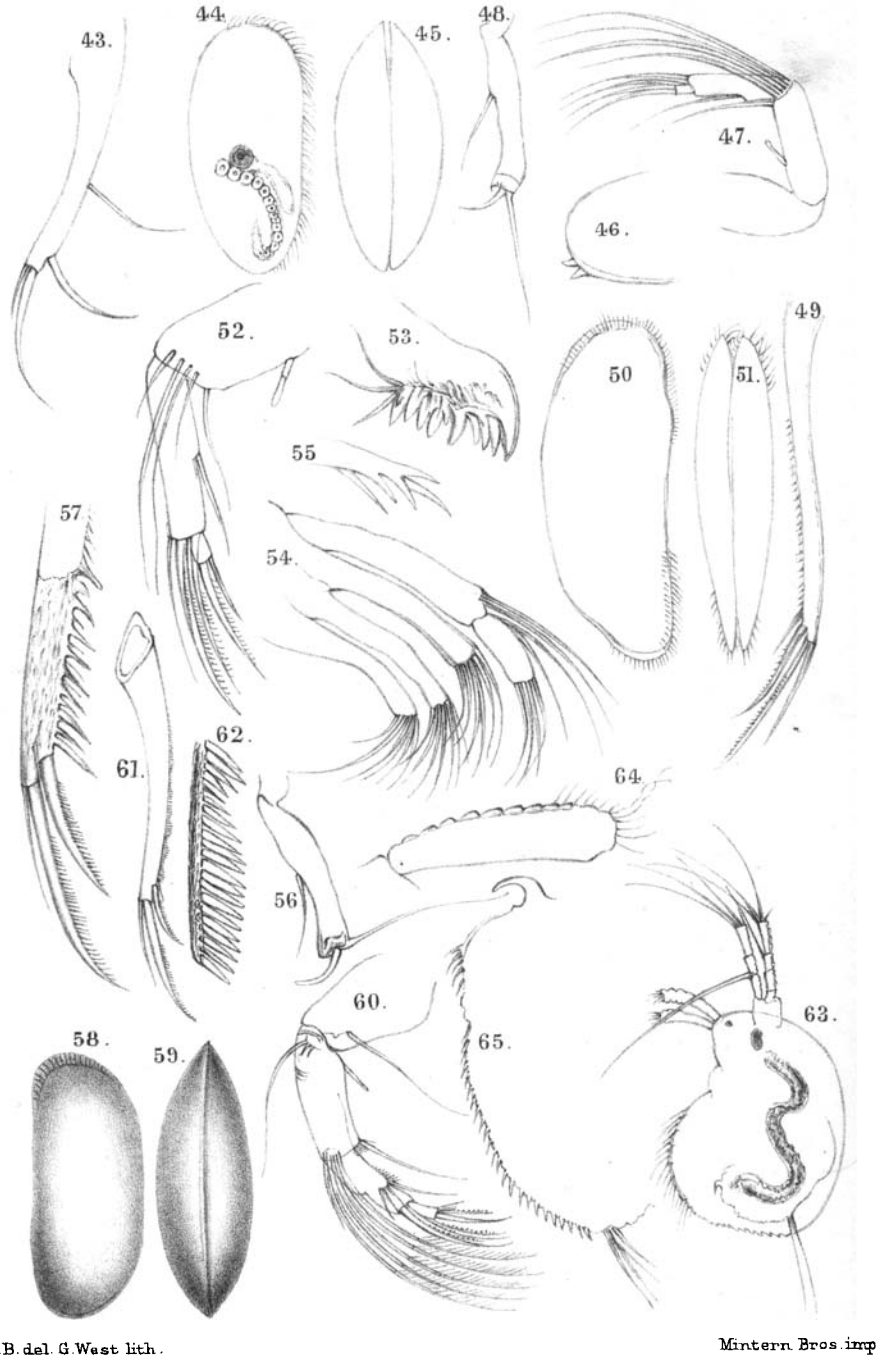
ENTOMOSTRACA FROM NATAL.



G.S.B. del. G. West lith.

Mintern Bros. imp.

ENTOMOSTRACA FROM NATAL.



G.S.B. del. G. West lith.

Mintern Bros. imp.

ENTOMOSTRACA FROM NATAL.

(5) The anterior abdominal vein always arises from one afferent renal, rarely from both as in the Saurians. Frequently, also, it is double.
(6) The existence of veins continuing the azygos posteriorly is usual.

Facts which are of importance for the systematic arrangement of genera and species within the family Boidæ :—

(1) The Boinæ (*Eunectes* and *Eryx*) differ from the Pythoninæ (*Python*) in that the intercostals are posteriorly paired arteries, while in the Pythoninæ a single median artery divides into two close to the median dorsal line throughout the series.
(2) The three species *Eryx conicus*, *E. johni*, and *E. jaculus* differ from each other in a large number of anatomical features.

Besides these points several other anatomical features are of interest as new or rare among Ophidia. Such are

(1) The continuation of the afferent renal of the left kidney in *Zamenis gemonensis* beyond the kidney into the parietes, as in *Chamæleon* and *Pygopus*.
(2) The origin of œsophageal arteries not only from the left aortic arch but from some of the intercostals of the right half arch.
(3) The fusion of some of the anterior intercostals in *Eryx jaculus* (and *Python spilotes*) to form a continuous longitudinal trunk lying dorsally of the aorta.
(4) Representatives of the lateral abdominal vein of Lizards appear to exist in certain snakes (e. g. *Eunectes* and *Eryx*).
(5) Origin of a fat-body artery in *Eryx johni* from an intercostal.

4. On Entomostraca collected in Natal by Mr. James Gibson. By G. Stewardson Brady, M.D., LL.D., D.Sc., F.R.S., C.M.Z.S.

[Received March 25, 1904.]

(Plates VI.–VIII.*)

For the opportunity of examining and describing these species I am indebted to the kindness of Mr. James Gibson, Resident Magistrate at Greytown, by whom they were collected in the summer of 1902. All are freshwater species, and were found in pools in the neighbourhood of Greytown, Natal. The identity of some of them with European forms is a point of considerable interest, and indeed the general aspect of the gatherings is quite

* For explanation of the Plates, see p. 127.