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IX. *On the Anatomy of the Sondaic Rhinoceros.*

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[PLATES XXXIII.–XXXVII.]

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Introductory.

THE Society's specimen of *Rhinoceros sondaicus*, which was acquired in 1874 and died in January of this year, has afforded us the material for the present paper. At the time of the animal's death the weather was frosty; we had therefore hoped to be able to study in detail the muscles and nerves as well as the visceral anatomy. The frost, however, broke, and, as the carcass commenced to decay, we were compelled to abandon this attempt. We have endeavoured to describe as accurately as possible the visceral anatomy, the study of which was facilitated by a successful injection of the arterial system; in this way we have been able to note the relations of the vascular system to the alimentary canal. The facts recorded in this part of our paper are new, inasmuch as no previous writer on the anatomy of the Rhinoceros has attempted to deal with the subject.

The only paper known to us which contains any description of the anatomy of *Rhinoceros sondaicus* is one by Prof. Garrod, published in the 'Proceedings' of the Society, 1877, p. 707; it will be referred to in the course of the following description.

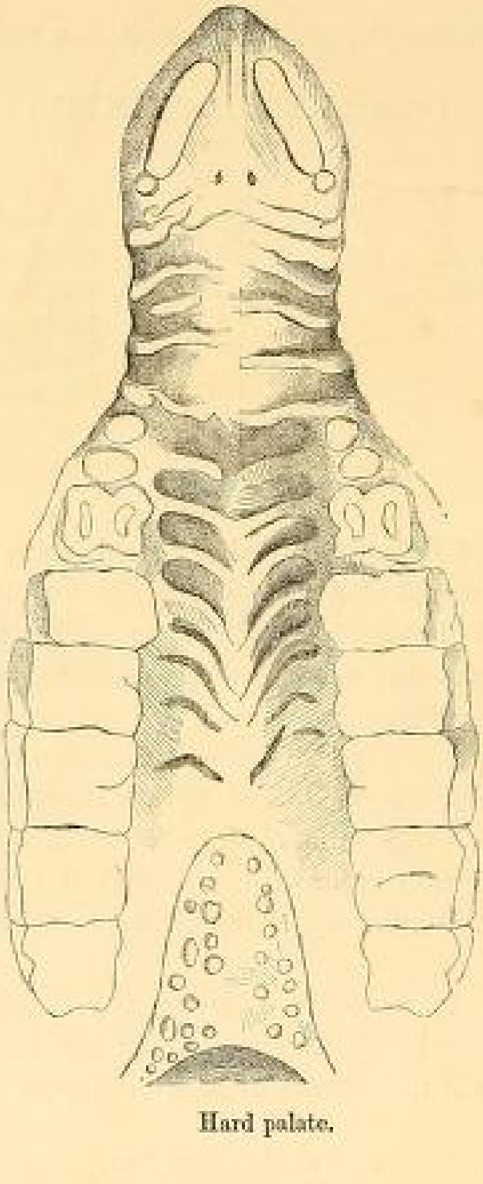
External Characters.

The *external characters* which distinguish this from the other species of Rhinoceros are so plainly shown in the drawings which accompany Mr. Sclater's paper "On the Rhinoceroses living in the Society's Menagerie"[1], that we need not do more than refer to those excellent figures.

[1] Trans. Zool. Soc. ix. p. 645.

One point, however, which appears to have escaped the attention of Prof. Garrod, is worth recording, and that is the presence of hoof-glands; close to the junction of the callous pad which covers the sole of the foot with the integument at the base the apertures of these glands were plainly visible on both fore and hind limbs. A dissection

Fig. 1.



Hard palate.

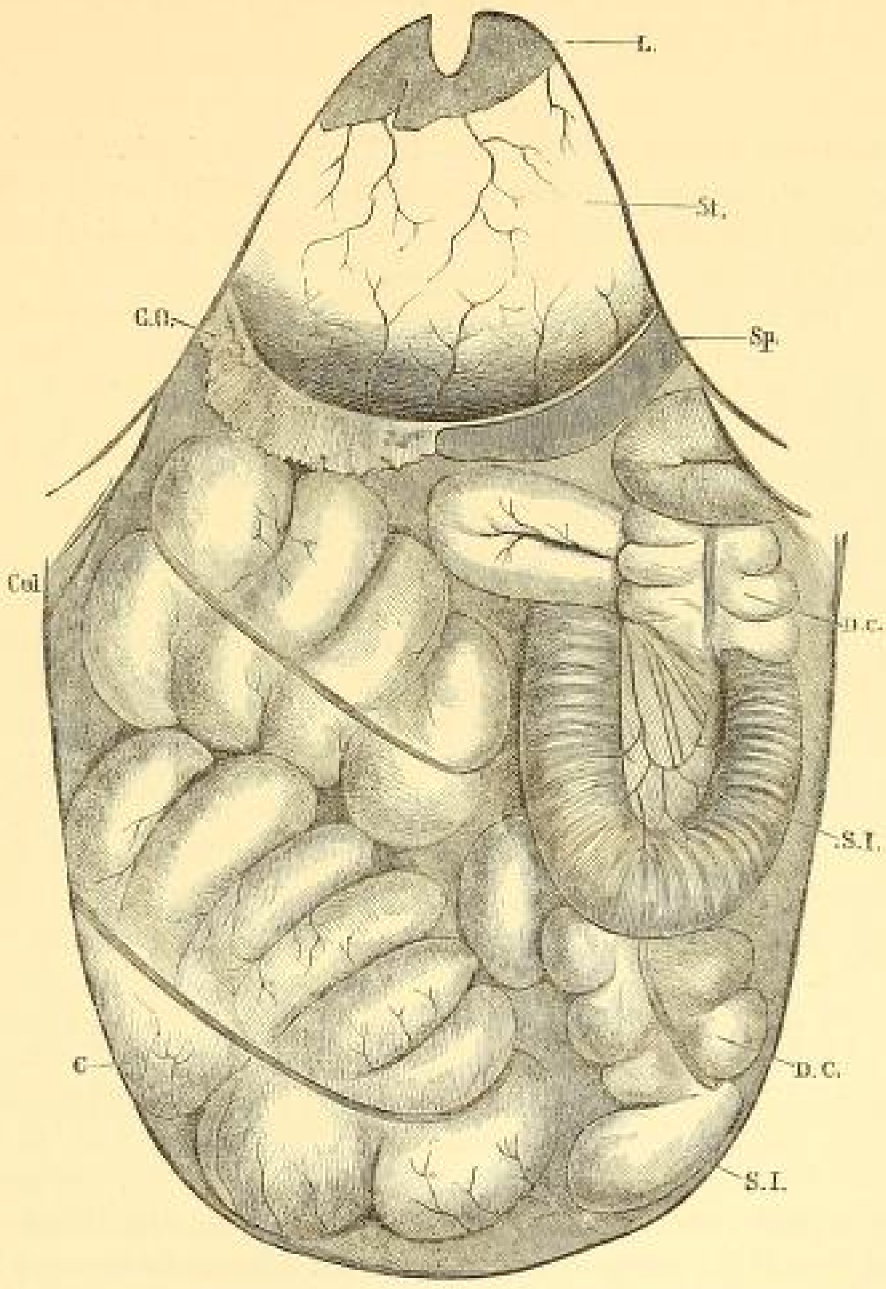
showed that these orifices were, in every case, continuous with a large oval gland situated just beneath the integument. The presence of these glands in *Rh. sondaicus* is worth calling attention to, inasmuch as they are not to be found, according to Garrod, in *Ceratorhinus sumatrensis*; they have been fully described by Sir Richard Owen [1] in

[1] Trans. Zool. Soc. vol. iv.

Rh. indicus; and their presence in *Rh. sondaicus* is another bond of union between these two species, which agree so closely in other particulars.

A pair of mammæ were found, and are inguinal in position, as appears to be the case in all Rhinoceroses.

Fig. 2.



General view of abdominal viscera after removal of ventral abdominal wall.

G.O. Great omentum. St. Stomach. Sp. Spleen. C. Cæcum. D.C. Descending colon. S.I. Small intestine. L. Liver. Col. Colon.

Mouth-cavity.

The accompanying drawing (fig. 1, p. 184) illustrates the ridges upon the hard palate, which have not been figured in any other species, and only described briefly in the Sumatran Rhinoceros by Garrod. These ridges may prove to be distinctive of the species; but in the meantime the material for comparison is so meagre that we prefer to let the figure speak for itself.

Abdomen.

The abdomen was opened within thirty-six hours after death. Previous to the dissection the arterial system had been injected from the right carotid with plaster of Paris. The injection proved to be completely successful, the abdominal arteries being occupied down to their smallest visible branches.

On opening the peritoneal cavity the stomach and intestines were found to be much distended. The stomach contained a fair amount of food, and was the seat of an acute gastritis. The small intestine was moderately and equally occupied, but the whole of the colon was greatly distended, the cæcum especially being very tightly packed with incompletely digested food. It would appear as if, during life, some obstruction in the lower bowel had been brought about by fæcal accumulation.

The following appearance was presented by the viscera when examined *in situ* (fig. 2, p. 185). The hypogastric, right iliac, and right lumbar regions were entirely occupied by the enormous cæcum (C.). It was so placed that its long axis was represented by a line drawn from right to left and from behind downwards and forwards. The apex of the cæcum was found deep in the pelvis. Above the cæcum was another greatly distended segment of the large intestine (Col.); its long axis was parallel with that of the caput coli; it filled a great part of the umbilical and right hypochondriac regions, and was in contact by its upper border with the stomach. Subsequent examination showed that it represented the root of the returning limb of the colic loop or the part where the bowel forming this loop was passing into the descending colon.

The epigastric region was occupied wholly by the stomach (St.) and spleen (Sp.); the latter viscus was lying in contact with the greater curvature of the stomach, and its lower end extended as far as the middle line. The left hypochondriac, lumbar, and iliac regions, and the left side of the umbilical district presented nothing but coils of the small intestine (S.I.) and two loops of the descending colon (D.C.). Some part of the great omentum (G.O.) was exposed to the right of the median line lying between the stomach and the colon; it was rolled up, and took no part in covering the viscera. The pelvis was occupied solely by the end of the cæcum, the rectum, and the bladder.

The Stomach. (Plate XXXIII. and Plate XXXVI. fig. 2.)

The intra-abdominal part of the œsophagus (*œ*) measured 6 inches.

The part of the stomach that most distinctly presented itself was the greater curvature, and it was this part that was most closely in contact with the anterior parietes.

In shape the viscus bore a near resemblance to the stomach of the Horse, a resemblance much more close than that presented by either *R. sumatrensis* or *R. indicus.*

The œsophageal and pyloric orifices were approximated, and a straight line drawn between these openings measured only 6 inches. This narrow interval was occupied by the gastro-hepatic omentum and the coronary artery (*G.a*).

The cardiac portion of the stomach extended 19 inches to the left of a line drawn vertically down across the viscus from the œsophageal opening to the greater curvature. This portion was much more extensive and protuberant than the like part of the stomach of *R. sumatrensis*, as depicted by Professor Garrod (P. Z. S. 1873). It showed a faint indication of a division into two cul-de-sacs (*s.c, i.c*), of which the upper (*s.c*) was the larger.

The superior diverticulum corresponded in position with the conical cul-de-sac noticed by Professor Garrod in the cardiac part of the stomach of *R. sumatrensis.* In the present case, however, the upper cul-de-sac was well rounded, and showed no trace of a conical outline. The separation into two sacs was more pronounced when the viscus was empty than when it was distended. At the pyloric end of the stomach was a globular cul-de-sac (*p.c*), of much smaller size than those met with at the cardiac end. As regards its pyloric segment, the stomach in the present instance bore a closer resemblance to the stomach of *R. indicus* than to that of *R. sumatrensis.* In Professor Garrod's drawing of the viscus of the latter animal the pyloric cul-de-sac is represented as exceeding in size the cardiac diverticulum. The depth of the stomach, as measured along a vertical line extending from the œsophageal orifice to the greater curve, was 24 inches, and its greatest width 37 inches. The latter measurement included both the pyloric and the superior cardiac cul-de-sacs.

Interior of Stomach.—Prof. Garrod has described the gastric mucous membrane of this Rhinoceros as well as of *Ceratorhinus sumatrensis*, and has pointed out that they agree with each other and with the Horse and Tapir in the great extension of the œsophageal lining membrane over the cardiac surface of the organ; in our specimen the white, tough, epithelial lining of the cardiac portion of the stomach was sharply marked off from the reddish, soft, mucous membrane which lined the rest of the stomach; the latter appeared to be extremely thick, and was traversed here and there by furrows, as indicated in the accompanying drawing (Pl. XXXVI. fig. 2). The drawing illustrates the marked difference in colour, as well as in texture, of the cardiac and pyloric membrane.

The Spleen. (Plate XXXIII. and Plate XXXVI. fig. 1.)

The spleen was flat and thin. It was entirely invested by peritoneum, and was connected to the greater curvature of the stomach by the gastro-splenic omentum, that measured on an average 6 inches in width. When placed upon a flat surface it presented an oblong outline, the left extremity of the body being, however, narrower and more pointed than the right. Thus at the right extremity the transverse diameter measured 11 inches, and at the left 9 inches. The entire length of the spleen was 26 inches; its long axis corresponded to that of the greater curvature of the stomach, and it was only in relation with the inferior of the two cardiac cul-de-sacs. Its upper extremity was hidden by the costal cartilages, while its lower end reached to the middle line (woodcut, p. 185). In its upper two thirds it was obliquely directed from above downwards, forwards, and to the right; in its lower third its long axis had almost a horizontal direction. It was folded upon itself in a remarkable manner. The folding took place along the centre of the viscus, and corresponded to the long axis of the gland; it was of such a character that the lateral margins of the spleen were approximated, and a transverse section made of the viscus as it lay *in situ* would have presented the appearance of a partly opened book, the long axis of the gland corresponding to the "back" of the book. The folding was towards the right—that is to say, towards the gastric aspect of the spleen. There was no distinct hilum, but the attachment of the layers of the gastro-splenic omentum was noteworthy. When the spleen was opened up or unfolded and placed upon its outer or parietal surface, it presented the appearance of a flat oblong body, as has been already observed. The two layers of the gastro-splenic omentum were not attached along the median line of the viscus, but were attached to the gastric surface of the spleen in two lines that were parallel with the lateral margins of the gland, and that were actually nearer to those margins than to the median line itself. The arrangement of these two layers is depicted in Pl. XXXVI. fig. 1. It thus happened that when the spleen was unfolded the anterior and posterior layers of the gastro-splenic omentum were separated at their splenic lines of attachment by a wide interval; but when the spleen was folded in the manner described, the two layers came in contact, and the omentum presented the appearance of a simple and comparatively thin connecting membrane. This folding of the spleen and arrangement of the omentum must have afforded facilities for a very ready and considerable enlargement of the viscus. Such enlargement would also have been favoured by the marked elasticity of the capsule and by its somewhat loose connection with the splenic pulp.

The Liver. (Plate XXXV.)

The divisions of the liver were well marked, the least pronounced fissure being that separating the right central from the right lateral lobe. The largest lobe was the left lateral (*L. L.*). It, in common with all the other lobes, was convex upon its diaphragmatic surface. It was also equally convex upon its abdominal aspect. Its measurements were 22 inches by 15½ inches. It was thickest towards its inferior border, near which margin it measured from before backwards 3¼ inches. Within 5 inches of the superior border it measured in the same direction 2 inches. It was separated from the left central lobe by a very pronounced fissure, which extended upwards through the gland as far as the point where the upper third joined the middle third of the liver. The left central lobe (*L.C*) was very distinctly marked off, and was conical at its free extremity; it was convex in front, and of prismatic outline as regards its posterior surface; its measurements were respectively 18 inches and 5 inches, and its greatest thickness 1¼ inch. The fissure that divided it from the right central lobe (*R.C*) extended upwards in front as far as the suspensory ligament, and behind as far as the free margin of the gastro-hepatic omentum. This lobe overlapped the left lateral by its left margin, but was directly continuous with the right central across the line of the suspensory ligament. The right central (*R.C*) and right lateral (*R.L*) lobes were but faintly separated from one another, the intervening fissure separating only about the inferior fourth of this part of the gland. Together they formed a lobe that was convex upon both its surfaces, and that measured 22 inches in length, 9 inches in breadth, and 1½ inch at its thickest part. The base of this double lobe was separated from the root of the left lateral segment by the gastro-hepatic omentum. The caudal lobe (*Ca*) was separated from the rest of the liver by a fissure that extended upwards to within 2 inches of the superior margin of the gland. The lobe was 21 inches in length, 9 in breadth, and 1¾ in thickness; its extremity was pointed; its anterior surface was convex, its posterior marked by a median ridge that followed its long axis. The lobe therefore, like the left lateral, was prismatic in section, the base of the fissure being directed forwards. On the abdominal aspect of the gland it overlapped the upper part of the right lateral lobe.

The Spigelian lobe (*sp*) was small, and represented by a narrow strip of hepatic tissue that measured 5 inches in length and 1½ in breadth. It was shorter, wider, and less pointed than the corresponding lobe in *R. sumatrensis*, as figured by Professor Garrod [1].

The liver was entirely invested by peritoneum, except along the attachment of the suspensory and lateral ligaments and of the gastro-hepatic omentum. The extent to which these folds of the serous membrane were attached to the gland is shown in the Plates. The entire width of the lateral ligament was 16 inches.

The structures at the portal fissure had the same mutual relationship as is observed in the human subject. Thus the hepatic artery was placed upon the same plane as the bile-duct, the vascular canal being to the left and the duct to the right. The portal vein was alone and between the two.

Just before entering the gland the artery and vein broke up into two trunks of equal size, and in like manner the bile-duct was made up of two ducts of equal dimensions

[1] P. Z. S. 1873, p. 102.

that joined to form the common tube within an inch of their points of exit from the liver. A very large plexus of sympathetic nerves accompanied the portal vein to the liver.

The common bile-duct had a diameter of half an inch, the portal vein a diameter of 2¼ inches.

There were three hepatic veins, which entered the vena cava almost immediately after their exit from the liver.

There was no gall-bladder.

The Cœliac Axis.

The arrangement of the branches of the cœliac axis differed in no very essential respect from the corresponding vessels in the Horse. The trunk broke up into three divisions—gastric, hepatic, and splenic. The gastric artery (Pl. XXXIII. *G.a*) ran from right to left, to reach the gullet as it entered the stomach; at this point the vessel broke up into an inferior (anterior) (1) and a superior (posterior) branch (*s*), the former passing in front of the œsophagus and the latter behind (Pl. XXXIII.). The anterior artery followed the line of the lesser curvature, and ended by anastomosing with the pyloric branch of the hepatic; it supplied the greater part of the anterior wall of the stomach with the exception of the pyloric cul-de-sac, and its offshoots ended by anastomosing with offshoots from the posterior artery, from the splenic artery, the gastro-epiploica sinistra and the gastro-epiploica dextra. The posterior vessel (*s*) was of smaller size than the anterior; near its origin it gave off a branch that, running upwards along the posterior surface of the gullet, entered the thorax. The main vessel was distributed to the posterior wall of the stomach after the same manner that its companion vessel was distributed to the anterior surface, with the exception that it did not approach the pylorus so closely; indeed, both walls of the viscus in the vicinity of the lesser curvature were supplied exclusively by the anterior artery. The posterior artery of the stomach anastomosed with the anterior vessel and with branches from the splenic and both of the gastro-epiploic arteries.

The hepatic artery passed directly forwards to the portal fissure. Just before entering the gastro-hepatic omentum it gave off a branch that, passing downwards across the posterior wall of the pylorus divided into two vessels, the superior pancreatico-duodenal (*s.p.d*) and the gastro-epiploica dextra (*G.e.d*). The former artery ran between the layers of the meso-duodenum, and, having supplied the greater portion of the duodenum, terminated by anastomosing with the inferior pancreatico-duodenal from the great mesenteric. The right gastro-epiploic artery, soon after its origin, gave off two pyloric branches—an anterior and a posterior. These were distributed to the region of the pylorus and to the walls of the pyloric cul-de-sac. They anastomosed with branches of the gastric artery and of the right gastro-epiploic vessel; the latter vessel was of large size, and ran in the great omentum at a distance of from 3 to

6 inches from the greater curvature of the stomach. It followed this curvature, and ended about its middle by joining with the gastro-epiploic branch of the splenic. The artery on its way gave off numerous and regular branches to both surfaces of the right half of the stomach, in the vicinity of the greater curve, and supplied at the same time more than one half of the great omentum.

The splenic artery (Pl. XXXVI. fig. 1) adopted a curved course, running first from right to left and then from left to right. On reaching the smaller extremity of the spleen the artery ran in the anterior layer of the gastro-splenic omentum at a distance of about 2 inches from the viscus itself. From its concave side it gave off numerous vessels (the vasa brevia) that supplied both surfaces of the cardiac ends of the stomach, anastomosing at some little distance from the greater curvature with the anterior and posterior gastric arteries. From its convex side branches arose to supply the spleen. These reached the viscus by running in the anterior layer of the gastro-splenic omentum; some on reaching the capsule at once entered the spleen, while others were continued across its gastric surface until the attachment of the posterior layer of the gastro-splenic omentum was reached. At this point they formed arches whence small offshoots were derived for the supply of the hinder layer of the omentum. These vessels in their passage across the spleen gave off numerous branches to its substance.

The Cæcum and Colon. (Plate XXXIV.)

In all general points the disposition of the colon was identical with that described by Professor Garrod as occurring in the Sumatran Rhinoceros. The cæcum was conical in shape, and its outline very closely agreed with Professor Garrod's figure; it was median in position, its long axis was directed backwards and to the left, and its apex occupied the pelvis.

The large intestine immediately beyond the cæcum was thrown into a considerable loop, just as is the case in the Horse. This loop was first of all directed transversely to the left, but soon becoming bent upon itself turned backwards and upwards. The head of the loop was situated in the left iliac region, while the root of its returning limb was found in the right hypochondriac region. It was the returning segment of the colic loop that formed so conspicuous a feature in the abdomen when the viscera were first viewed *in situ* (woodcut, p. 185, *Col*).

From the right hypochondriac region the colon passed transversely across the abdomen from right to left, and, having reached the left side of the body, it passed almost directly backwards to form the descending colon. This transverse portion of the bowel was hidden by the root of the colic loop, while the descending colon was almost entirely hidden from view by the coils of the small intestine. The relations that the cæcum bore to the colic loop would appear to have differed somewhat from those observed in the Sumatran species.

The base of the cæcum covered entirely the inferior aspect of the root of the colic loop, so that when the parts were inspected *in situ* the precise disposition of this root was not evident (Pl. XXXIV. fig. 1). The cæcum had been displaced forwards, as it were, and to some extent bent upon itself. The bending was of such a character that the base of the cæcum concealed from view the root of the loop, while to the inferior aspect of the returning limb of the loop the dorsal wall of the caput coli was adherent. Figs. 1 and 2 show the appearance of parts before and after division of these peritoneal adhesions.

The cæcum (*c*) was about 2 feet in length, and 20 inches in breadth at its base. It presented three longitudinal muscular bands, between which were enormous sacculi. One band commenced at the ileo-cæcal junction and ran to the apex; a second band ran along the inner or left border of the caput, and was in a line with the attachment of the mesocolon at the base of the cæcum; the third band was continued from the superior of the two bands on the outgoing limb of the colic loop. These three bands all met at the apex of the cæcum, and the two first named were proper to the caput coli and were not continued beyond its limits.

Each limb of the colic loop measured 3 feet. Both limbs became greatly narrowed as the bend of the loop (*n*) was approached. The width of the outgoing limb at its root was 12 inches, and of the incoming segment at the same point 14 inches.

At the bend the width of the colon was reduced to 5 inches. Both segments of the loop were deeply sacculated as far as the narrower portion, where the gut became perfectly smooth and presented the appearance of a small intestine (Pl. XXXIV. figs. 1, 2, *n*).

There were two longitudinal muscular bands upon the colic loop, one at the superior and the other at the inferior aspect of the gut. The superior band was continued on to the loop from the cæcum, as already mentioned. The inferior band commenced at the root of the loop, about the base of the cæcum. Both the bands were continued from the incoming segment of the loop on to the transverse and descending parts of the colon (fig. 2, Pl. XXXIV.).

At the points where the wide segments of the loop passed into the narrow segment—at the point, in fact, where the sacculation ceased—the two bands became joined together at an acute angle, and the single band so formed was almost immediately lost upon the smooth bowel at the bend of the loop. Unless some error has crept into the plate that illustrates Professor Owen's account of the colon of *R. indicus*, it is evident that the colic bands have a different disposition in the two species.

The adhesion between the base of the cæcum—or, more correctly, the root of the outgoing limb of the loop—and that part of the bowel where the loop passed in to the transverse colon was exceedingly intimate. Indeed, it would be more precise to say that a muscular septum divided the lumina of these two portions of the large intestine.

At the point where the transverse colon and colic loop joined one another the bowel showed a globular distension (*d*), the transverse diameter of which measured 18 inches.

The transverse and descending parts of the colon were less sacculated than the rest of the large intestine; they presented two muscular bands, which were continued from the two met with on the top of the colon. Upon the inferior aspect of the transverse colon at its commencement was a distinct muscular band, 24 inches in length, that was placed in the long axis of the bowel; it caused no sacculation. The whole length of the colon from the ending of the loop to the anus was 6½ feet. The width of this part of the bowel was, at its upper part, 10 inches; but as the anus was approached, the diameter diminished to 7 inches. The lesser or inferior mesenteric artery entered the bowel 3 feet from the anus.

The length of the bowel from the ileo-cæcal valve to the anus was 14½ feet, a shorter measurement than those given for corresponding parts of the colon in the Indian and Sumatran Rhinoceroses.

The ileum (*S.i*) entered the cæcum obliquely and in a line with the long axis of the outgoing limb of the loop. The ileo-cæcal junction was entirely hidden by the adhesions (normal) that bound the base of the cæcum to the commencement of the transverse colon.

From that margin of the ileum that was most remote from the attachment of the mesentery, a large triangular fold of peritoneum (*p*) passed to the inferior surface of the cæcum (Pl. XXXIV. fig. 2). It represents the ileo-cæcal plica, and contained no visible blood-vessels.

Immediately in front of the ileo-cæcal junction the peritoneum was so arranged as to form a large rounded fossa (Pl. XXXIV. fig. 2, *f*) capable of engaging the entire fist, and surrounded by a very distinct margin. This fossa was not rendered evident until after the adhesions at the base of the cæcum already alluded to had been broken down. This pouch corresponded to the fossa ileo-cæcalis superior, met with in Man and in a large number of the Mammalia, and around its anterior margin ran a blood-vessel corresponding to the "artery of the arch of the cæcum" (4, fig. 2, Pl. XXXIV.) which Chauveau met with in the Horse.

The cæcum and the colic loop were entirely invested by peritoneum. The limbs of the loop were connected together by a simple layer of serous membrane, as in the Horse. The base of the cæcum and the roots of the colic loop were devoid of peritoneum and were closely adherent to the parietes. The transverse and descending parts of the colon were provided with an extensive meso-colon, which was attached in a vertical line along the front of the vertebral column.

The duodenum, which at its commencement was provided with a meso-duodenum, passed transversely from right to left behind the base of the cæcum. The commencement of the small intestine was consequently to the left of the caput coli. The portion of duodenum behind the cæcum was devoid of peritoneum and was in contact with that part of the colon that has been already described as adhering to the parietes. Between the segment of the duodenum and the colon the great or mesenteric artery passed.

The Mesenteric Arteries

in all essential points resembled the corresponding vessels in the Horse. The great mesenteric gave off from its left side the vasa intestina for the small intestine and the colica media.

The former branches each formed a single arch before entering the bowel. The latter artery supplied the transverse colon and upper part of the descending colon and ended by joining with the lesser mesenteric artery.

From the right side of the main trunk were derived the inferior pancreatico-duodenal artery and the two arteries of the colic loop (1 and 2, fig. 1, Pl. XXXIV.). These vessels came off separately from the great mesenteric. On their way to the loop they were buried in the adhesions that connected the base of the cæcum with the root of the incoming limb of the loop. The artery of the outgoing segment (2, fig. 1) ran upon the bowel itself; the corresponding vessel for the other segment (1, fig. 1) ran in a serous membrane that connected the two parts of the loop. The two arteries joined at the bend of the loop and gave off branches at regular intervals of two inches to supply the colon.

A remarkable azygos artery (3, fig. 1, Pl. XXXIV.) ran parallel with the artery of the outgoing limb. It was contained on the free margin of a separate fold of peritoneum, was of the same size from its commencement to its end, and served to connect not only the two colic arteries together but also the respective extremities of those vessels. It gave off no branches of any kind. It would appear that the connecting vessel placed in a special fold would serve the purpose of carrying on the circulation, in the event of the colic arteries becoming occluded by pressure or by reason of extreme bending of the colic loop.

In size this vessel was equal to the ulnar in the human subject. The artery of the arch of the cæcum (4, fig. 2, Pl. XXXIV.) has already been alluded to. The superior cæcal artery had a distribution identical with that of the vessel of the same name in the Horse, and the same observation applies to the inferior cæcal artery (5, fig. 2, Pl. XXXIV.)

With the superior cæcal artery arose the ileo-colic that was distributed to the terminal part of the ileum and ended by joining the last of the vasa intestina.

The lesser or inferior mesenteric artery approached the bowel 3 feet from the anus. Its mode of distribution differed in no respect from the corresponding vessel in the Horse.

Heart.

The heart presented nothing unusual in its structure; the apex was markedly bifid; the right auriculo-ventricular valve has the same structure as has been recorded by

Owen for the Indian Rhinoceros; as in that species, one of the three papillary muscles, corresponding to the "great" or "anterior" papillary muscle of Man, is attached to the free wall of the ventricle. This arrangement is found in many mammals either occasionally or invariably, and is apparently characteristic of the Tapir and the Ungulata generally.

The aortic arch gives off an innominate artery, from which are derived the common carotid and the right subclavian; the left subclavian arises separately from the aortic trunk; each of the two subclavians gives off an internal thoracic artery, which is large, as in *Rh. indicus*. The external and internal iliacs arise separately from the aorta.

The origin of the arteries from the abdominal aorta is precisely like that of Man; the superior and inferior mesenteric arteries are quite separate, the one arising in front of the other behind the origin of the renal arteries. In many of the lower Mammalia there is but one mesenteric artery.

For the account of the smaller branches of the arterial system reference must be made to the description of the abdominal viscera.

Urino-genital Organs.

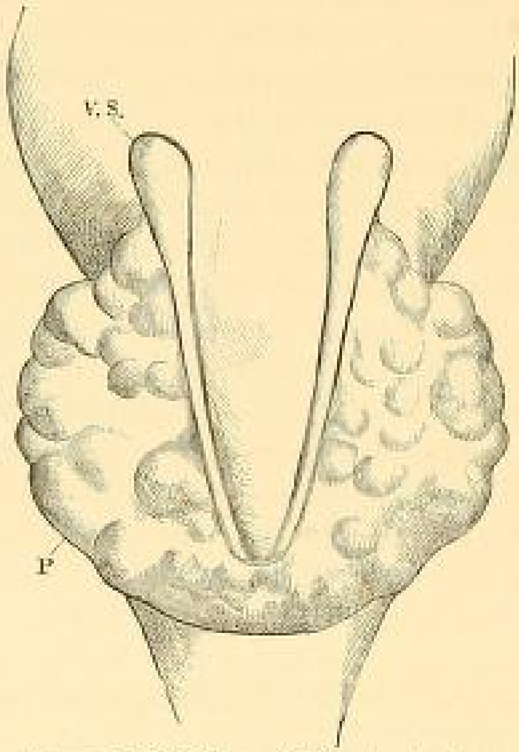
The *kidneys* showed slight indication of lobulation; they were covered below by the peritoneum, which did not extend on to the borders nor on to the dorsal surface.

The urinary bladder had a very distinct urachus; the muscular fibres of the bladder were disposed in two layers; the superficial fibres were arranged in a series of concentric circles round the urachus. The deep fibres passed round the bladder in a direction as nearly as possible at right angles with the superficial fibres. The superficial fibres were extremely conspicuous and distinct from each other by reason of their large size; the deep fibres were much smaller and whiter in colour. Our observations upon the generative organs do not entirely coincide with those of Sir Richard Owen upon the generative organs of the Indian Rhinoceros; it must be borne in mind, however, that the differences which we here record may be actual differences between the two species. The points in which we are at variance concern the structure of the vesiculæ seminales. These organs are described by Sir Richard Owen in the following words:—"The vesicular glands or 'vesiculæ seminales' present an elongate subcompressed pyriform shape, eight inches in length and three inches and a half across the broadest part of the fundus. They have a lobulated exterior and a structure very similar to that of the same bodies in man." On Plate XVI. of his memoir those structures are illustrated, and the figure of the vesicula seminalis (V. S.) is entirely in accord with the description given of them.

We are nevertheless inclined to suspect that what Prof. Owen terms the vesicula seminalis is in reality the vesicula seminalis *plus* a portion, at least, of the prostate gland.

The disposition of this part of the generative system in *Rhinoceros sondaicus* may be understood from the accompanying drawing (woodcut, fig. 3), where the vesicula seminalis is lettered V.S. and the prostate P. Each vesicula seminalis is a comparatively slender tube slightly swollen at its distal cæcal extremity, and is closely adherent to the prostate; it is a matter of no difficulty, however, to separate the two by a careful dissection, and we have assured ourselves that the drawing which illustrates this anatomical fact is an accurate representation. On comparing the vesiculæ seminales and prostates of *Rh. sondaicus* with Owen's figure of the same structures in *Rh. indicus*, it seems very easy to understand how such an error (if we are right in supposing it to be so) may have crept in. The close union between the vesicula seminalis and the prostate of its own side would easily lead to their being confounded, and there is nothing in the figure which would render our interpretation of it impossible. The late Mr. W. A. Forbes has described (Trans. Zool. Soc. vol. xi.) the male generative organs of the Sumatran Rhinoceros, and his account would certainly seem to confirm the accuracy of Sir Richard Owen's:—"The vesiculæ seminales

Fig. 3.



Base of the bladder and adjacent structures.
P. Prostate. V.S. Vesicula seminalis.

resembled in shape those described by Owen: they were 7½ inches long, and 1 inch across at the broadest part. The right vesicula had two, the left four, narrow ducts, 1½–2 inches long, which joined the vasa deferentia just before these entered the urethra." This is the whole description of the organs, but they are not figured, and it is impossible therefore to compare them carefully with Owen's description and with the conditions observed by us in *Rh. sondaicus*; on *à priori* grounds it would seem more likely that the Sumatran Rhinoceroses would differ from both *Rh. indicus* and *Rh. sondaicus* than that the two latter should differ in so remarkable a manner from each other.

The *penis* appears to correspond closely to that of *Rhinoceros indicus*; it is hardly worth while to describe it in detail, as Prof. Owen's description would apply almost word for word to the present species; it is important, however, to record the fact that there is this similarity, since Mr. Forbes has pointed out that the glans penis of *Rh. sumatrensis* is somewhat different in shape from that of *Rh. indicus*.

The penis is provided with two retractores penis and two levatores penis; the latter unite together and are attached to the penis about 10 inches from the end of the bulb by a thick tendon about the size of the thumb. From this point the tendon passes along the dorsal surface of the organ as far as the glans.

The retractores penis are inserted for a space of about 4 inches on to the ventral surface of the penis.

Brain.

The brain of *Rhinoceros sondaicus* is illustrated on Pl. XXXVII. by two figures; one (fig. 2) represents the superior surface of the organ, the other (fig. 1) the inferior surface. It has been already mentioned that the arterial system of the animal was successfully injected: we found on examining the brain that the arteries at its base were likewise filled with a mass of injection and rendered therefore very conspicuous; the figure shows the distribution of the arteries. Both drawings were made after the brain had been hardened in spirit.

The convolutions of the cerebral hemispheres appear to be not very different from those of *Rh. indicus*, and both rather less complicated than what is met with in *Ceratorhinus sumatrensis*, judging from the figures of these two brains which illustrate the papers of Sir Richard Owen and Prof. Garrod; in details, however, the convolutions of the brain of *Rh. sondaicus* are not precisely like *Rh. indicus*; our figure may be compared with Owen's.

EXPLANATION OF THE PLATES.

PLATE XXXIII.

Stomach and spleen, including gastrosplenic omentum; the blood-vessels injected. *œ*, œsophagus; *d*, duodenum; *sp*, spleen; *s.c*, superior cul-de-sac; *i.c*, inferior cul-de-sac; *p.c*, pyloric cul-de-sac; *G.a*, gastric artery (*s*, its superior branch; 1, its inferior branch); *s.p.d*, superior pancreatico-duodenal artery; *G.e.d*, gastro-epiploica dextra artery.

PLATE XXXIV.

Fig. 1. Colon and cæcum from the ventral aspect, the peritoneum undisturbed; the blood-vessels injected. *Co*, colon; *C*, cæcum; *n*, free loop of the colon; 1, 2, arteries of colic loop; 3, azygos artery.

Fig. 2. The same, peritoneum separated. *s.i*, small intestine; *f*, fossa; 4, artery of arch of cæcum; 5, inferior cæcal artery. Other letters as in fig. 1.

PLATE XXXV.

Fig. 1. Liver, posterior (ventral) aspect. *R.L*, right lateral; *R.C*, right central; *L.C*, left central; *L.L*, left lateral; *Ca.* caudate; *sp*, Spigelian lobes; *h.v*, hepatic vein.

Fig. 2. Liver, anterior (dorsal) aspect. Lettering as before.

PLATE XXXVI.

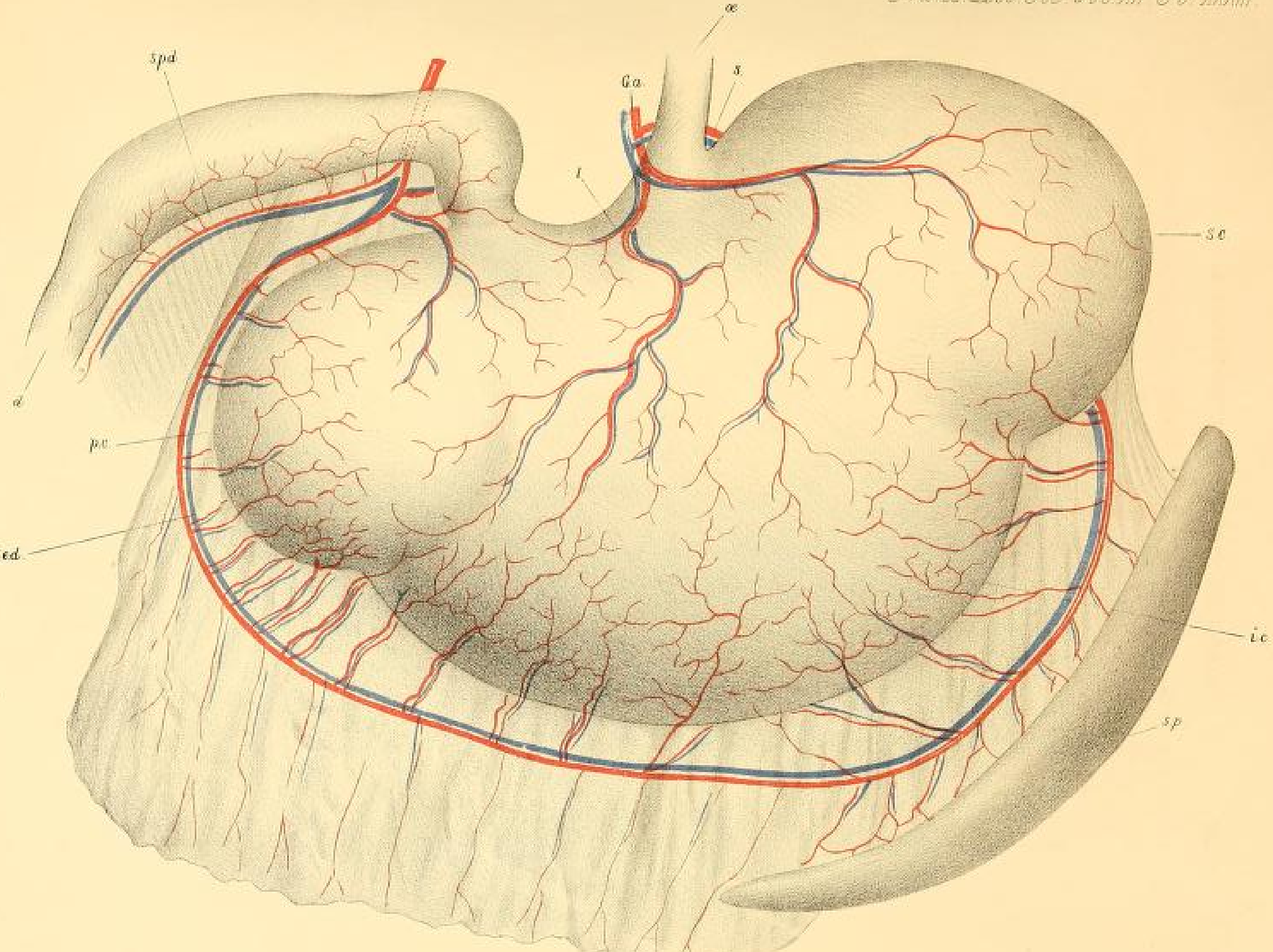
Fig. 1. Spleen, showing the attachment of the gastrosplenic omentum.

Fig. 2. Mucous membrane of interior of stomach.

PLATE XXXVII.

Fig. 1. Brain of *Rhinoceros sondaicus*, ventral aspect, with blood-vessels injected.

Fig. 2. Ditto, dorsal aspect.



J. Smit lith.

Hanhart imp.

SONDAIC RHINOCEROS.

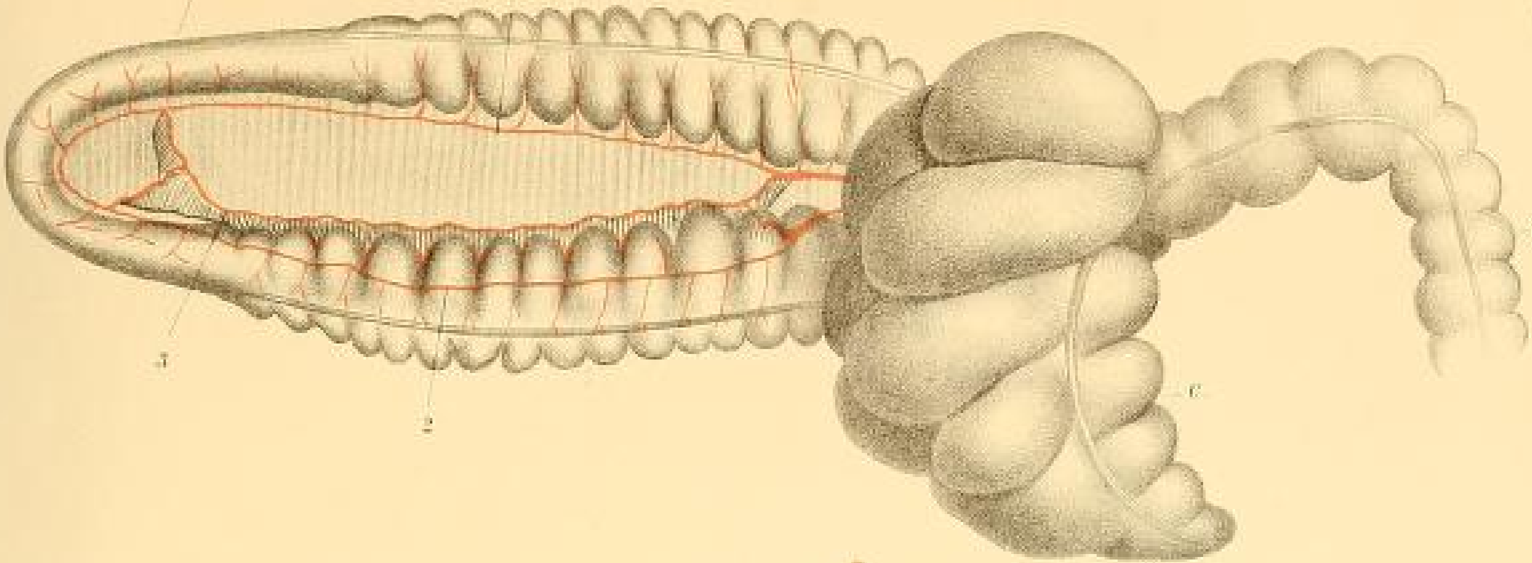


Fig 1

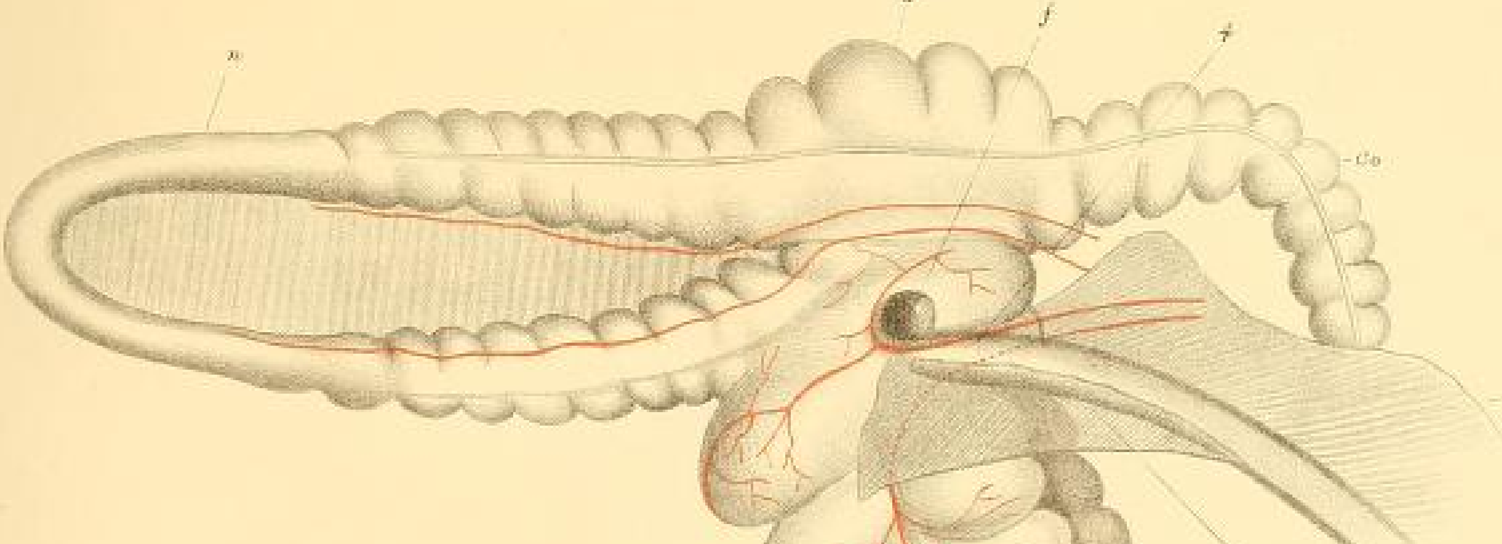
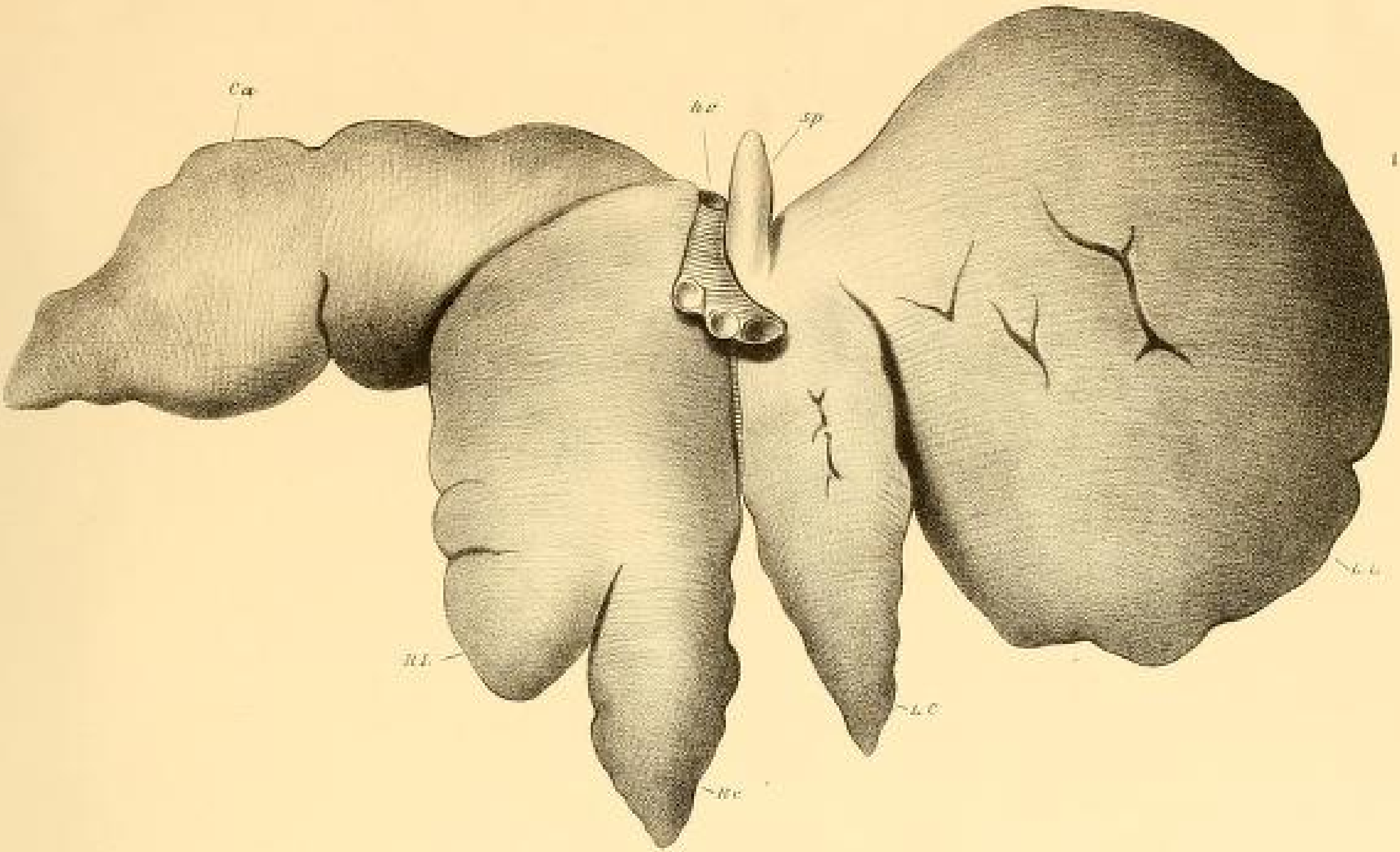


Fig 2

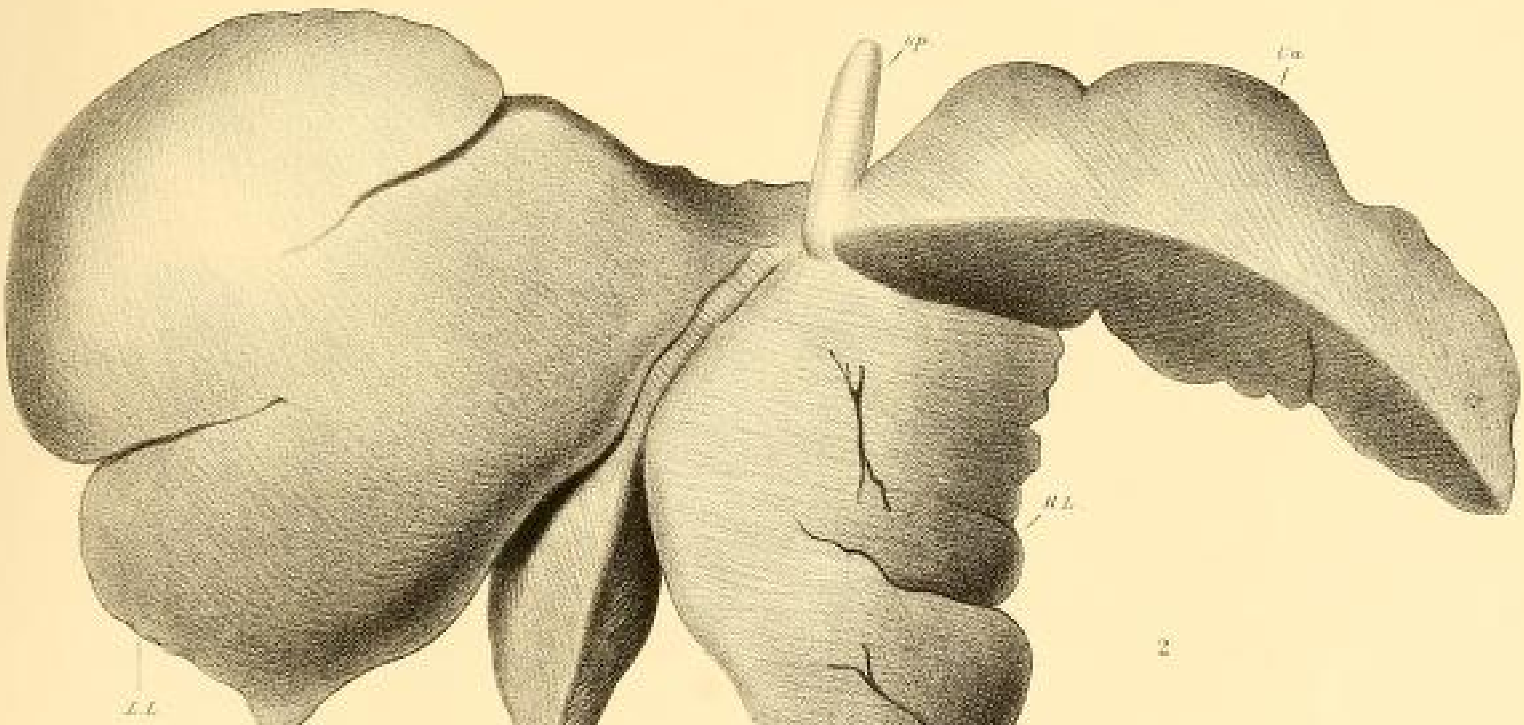
J. Smit lith.

Hanhart imp.

SONDAIC RHINOCEROS



1



2

J. Smit lith.

Hanhart imp.

SONDAIC RHINOCEROS.

Fig. 1

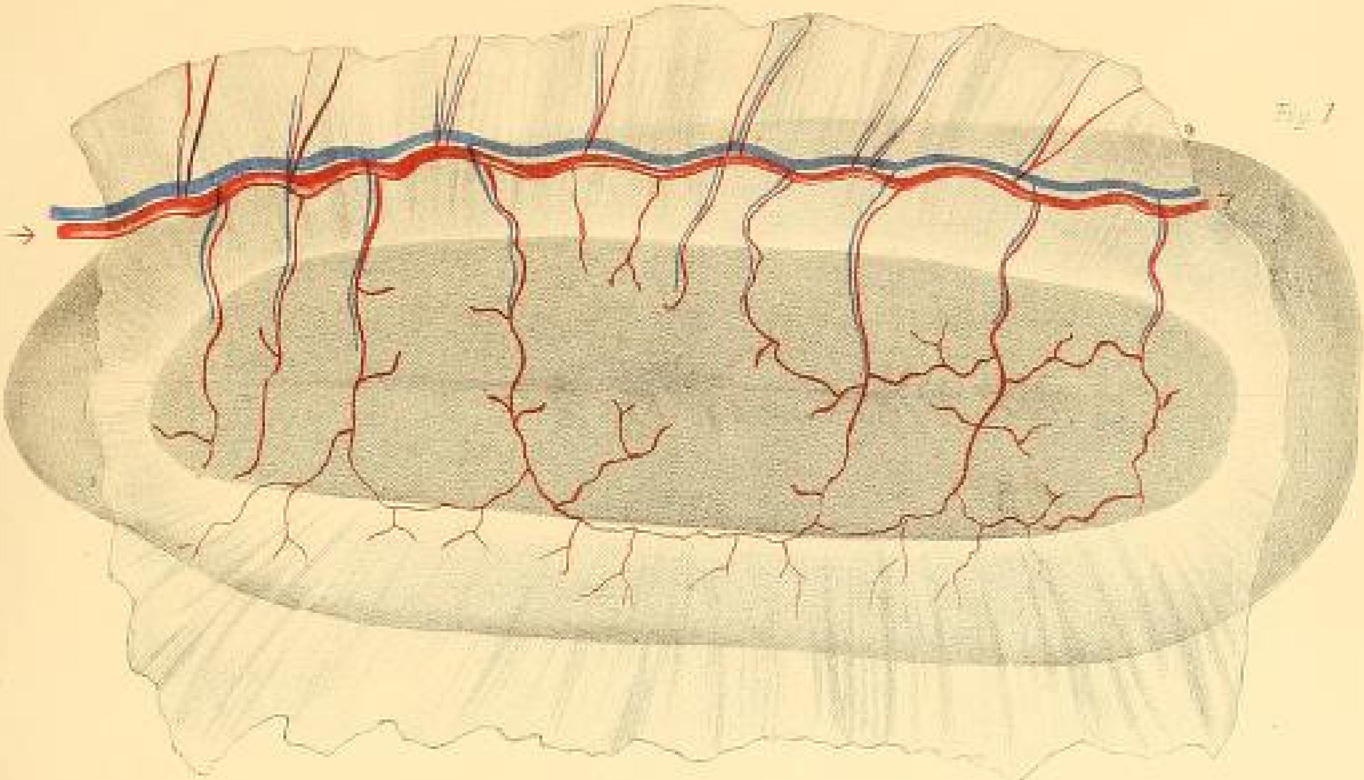
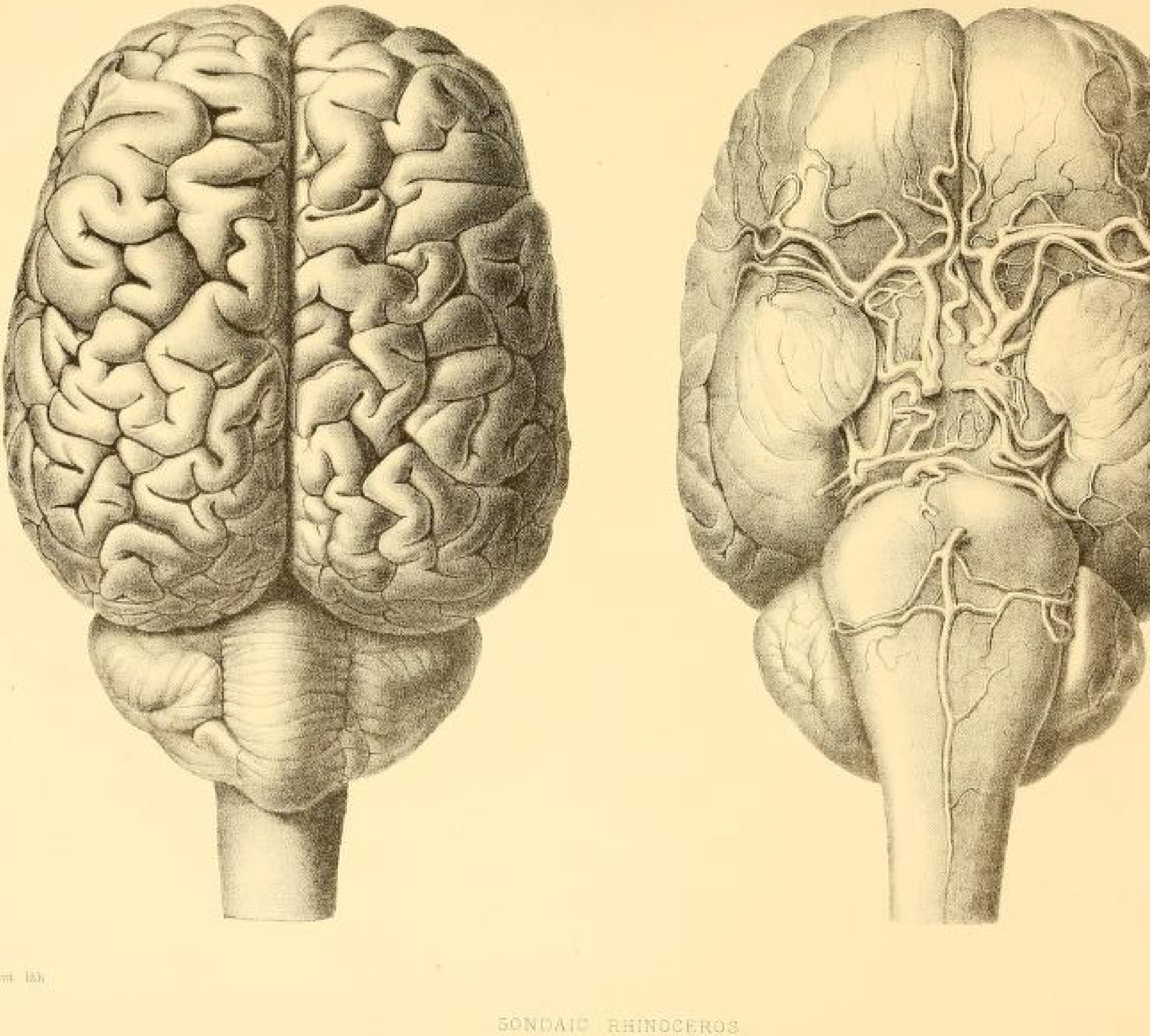


Fig. 2

J. Smit lith.

Hanhart imp.

SONDAIC RHINOCEROS.



J. Smit lith.

Hanhart imp.

SONDAIC RHINOCEROS