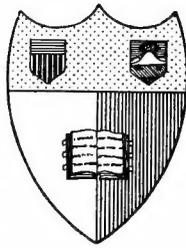


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· ATLAS
OF THE
VISCERA, IN SITU, OF THE
DAIRY COW

By GRANT SHERMAN HOPKINS
New York State Veterinary College, Cornell University, Ithaca, N. Y.

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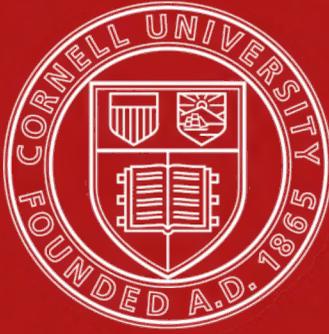
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BY
GRANT SHERMAN HOPKINS
New York State Veterinary College, Cornell University
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PREFACE

A GENERAL and widespread interest in all questions pertaining to the maintenance of healthy herds of dairy cattle through physical and other forms of examination is evident to anyone at all conversant with the subject. In all physical examinations an accurate knowledge of topographic anatomy, especially of the location and relations of the digestive, respiratory and genito-urinary organs, is becoming daily more essential to the Veterinarian and stock owner. To meet the needs of Veterinarians for a concise and graphic exposition of the relations of these organs the present atlas has been prepared. All of the drawings were made from photographs supplemented by direct observations and measurements of the specimens themselves.

In order to minimize as far as possible the liability to displacements of the organs from their normal position the animal was first placed in a canvas sling and then killed, with very little struggling, by chloroform injected into the jugular vein. The carotid artery was then immediately opened and a very strong solution of formalin injected in order thoroughly to harden and fix the organs in situ. Displacements due to the postmortem accumulation of gas in the rumen, from fermentation of its contents, were avoided by inserting a canula into this organ immediately after death. That the viscera were fixed in their normal position or at least in their position at the time of death, is shown by the fact that upon opening the body cavities no appreciable unoccupied space was found, *i.e.* the abdominal organs, for example, were everywhere in contact with the abdominal parietes as they are in the living animal. Further evidence that no appreciable displacements have occurred is shown by the fact that in four other cows similarly prepared and photographed the relations of the parts were practically identical with those in the present specimen. From the moment the live animal was placed in the canvas sling to the final completion of the dissections and drawings, the body was maintained in its natural upright position, thus minimizing displacements of organs due to handling or moving the body. In all physical examinations of the live animal a knowledge of the normal location and relations of the various organs is essential, especially the relations of those organs that are accessible to percussion, palpation, or auscultation either from the surface of the body or per rectum. Any satisfactory conclusion as to the soundness of an animal from a physical

examination also necessitates an accurate knowledge of the location and normal size of the accessible lymph glands.

It should be kept clearly in mind that identical relations of parts in any two specimens are not to be expected. Variations in the relations of many of the organs may be due either to differences in relative or absolute size of these organs or to their varying extent of repletion at the time the specimen was prepared and hardened. For example, in one of the specimens used the caudal extremity of the caecum was in the pelvic cavity, Pl. VI, 31, but in the other four specimens it did not project into this cavity. In two of the specimens, also, the pelvic cavity was occupied by a considerable mass of the small intestine, whereas in the other cows a much smaller portion of the pelvic cavity was thus occupied. The few measurements that are given are of individual cases and not averages unless so stated. It should be kept in mind that the respective lymph glands vary considerably in size in normal healthy animals. Identical conditions as to size and number of these glands are not to be expected.

My thanks are due Dr. Earl Sunderville for assistance in the dissections and in photographing the same. To the Dean of the College, Dr. V. A. Moore, and to Dr. R. R. Birch thanks are due also for their coöperation in securing the necessary anatomical material.

The Abdominal Viscera

IN Pl. I are shown the parts that are visible upon the removal of the right lateral wall of the abdomen and the intercostal muscles, as shown in the drawing. The right kidney, however, is visible only after the peritoneum and surrounding fat have been removed. In this specimen a much smaller portion of the pancreas showed through the peritoneum than was visible in the specimen from which Pl. X was made.

The greater omentum conceals all of the small intestine, on the right side, with the exception of a portion of the duodenum and some of the coils of the small intestine caudal to the free or unattached caudal border of the greater omentum, Pl. I. The omentum is not a delicate lacelike structure as in the horse, but is comparatively thick and strong and contains a relatively large amount of fat. The greater omentum forms a kind of double-walled sac-like structure interposed between the abdominal viscera and the ventrolateral walls of the abdomen, Pl. I. It may be divided into a parietal or superficial and a visceral or deep portion, each of which is made up of two layers or thicknesses of peritoneum, Pl. II, 19; Pl. III, 35, 36. The parietal or superficial portion extends from the left face of the rumen, a little dorsal to the left longitudinal groove, ventrally between the ventral sac of the rumen and the abdominal floor, to the right side, where it turns dorsally and is attached to the duodenum as far back as to the pelvic (caudal or iliac) flexure, Pls. I, III; this part of the omentum is also attached to the greater curvature of the abomasum. The visceral, inner, or deep portion of the greater omentum is attached to the right or visceral face of the rumen, 4 to 6 cm. ventral to the right longitudinal groove, Pl. IV. From here it extends ventrally between the rumen and the intestines to the floor of the abdomen, where it turns to the right and then passes dorsally and has these further attachments (*a*) to the duodenum for a short distance proximal to its pelvic or caudal flexure; (*b*) to the medial layer of the mesoduodenum; (*c*) to the first part of the large intestine as far caudal as to the point where it begins to turn cephalad; (*d*) to the visceral surface of the liver.

The lesser omentum is attached to the visceral surface of the liver, to the right face of the omasum, near and approximately parallel to the groove between the omasum and the reticulum, to the pyloric portion of the lesser

curvature of the abomasum and to the duodenum as far as to the point of entrance of the bile duct, Pl. III, 26.

The foramen epiploicum is described in connection with the pancreas.

The stomach occupies approximately three fourths of the abdominal cavity. It fills all of the left half of the cavity, exclusive of the small space occupied by the spleen, and projects considerably to the right of the median plane. The stomach of ruminants consists of four clearly defined compartments or divisions, viz., the rumen (paunch), the reticulum (honeycomb), the omasum (manifold or manyplies) and the abomasum (rennet or reed), Pls. IV, V, VI, VII.

In the adult animal the rumen is by far the largest of the four compartments. It occupies nearly all of the left half of the abdominal cavity; its middle and ventral portions project somewhat to the right of the median plane. The rumen extends from opposite the ventral half or third of the eighth intercostal space to the edge of the pubis or within a short distance of it. The parietal or left face of the rumen is related to the diaphragm, the spleen and the left abdominal parietes, Pls. V and VI. The visceral or right face of the rumen is related to the omasum, abomasum, large intestine, liver, pancreas, aorta and vena cava, Pl. IV.

The dorsal surface is in contact with the diaphragm and sublumbar muscles. Dorso-medially the rumen is closely attached to the left crus of the diaphragm and to the sublumbar muscles as far caudal as to the fourth lumbar vertebra. Normally it has no other attachments to the abdominal parietes than those just mentioned. The ventral face of the rumen is in contact with the abomasum and the floor of the abdomen, Pls. IV, V, VI. The cephalic end of the rumen is in immediate contact with the reticulum, Pls. VII and VIII. The parietal and visceral surfaces of the rumen are marked by longitudinal grooves, one on either face, which indicate the partial subdivision of this compartment into dorsal and ventral sacs. At either end of the rumen the two longitudinal grooves become continuous with each other and are here much deeper than elsewhere. The caudal or pelvic extremities of the dorsal and ventral sacs of the rumen are marked off from the remainder of it by the dorsal and ventral coronary grooves. From the relations of the rumen to the left abdominal wall it is very evident that palpation and auscultation of this organ, the introduction of a trocar or the operation of rumenotomy are readily accomplished. The visceral or right face of the rumen can be palpated per rectum only, Pl. IV.

The reticulum is the most cephalic and the smallest of the four divisions of the stomach. It extends from opposite the sixth rib to the cephalic edge of the eighth rib, Pl. VII. The median plane of the body divides the reticulum

into two nearly equal portions, the left portion, however, being somewhat the larger of the two. The cephalic surface is in contact, to the left, with the diaphragm and, to the right, with the visceral surface of the ventral portion of the liver, Pls. VII and III. The reticulum is separated from the pericardium of the heart by an interval of only two to four centimeters, Figs. 4 and 7. The left surface of the reticulum is related to the diaphragm and the ventral extremity of the spleen. The caudal surface is in contact with the rumen, omasum and abomasum, Pls. IV, VIII. The close proximity of the reticulum to the heart and its relation to the fifth and sixth intercostal spaces deserve particular attention for the reason that sensitiveness here points to the possibility of an injury to the reticulum and the diaphragm from some sharp-pointed foreign body that has become lodged in the reticulum and has penetrated these structures.

The oesophageal groove begins at the cardiac or gastric end of the oesophagus, extends ventrally on the medial wall of the reticulum and ends at the reticulo-omasal orifice. Its average length is from 15 to 20 cm. Its direction is nearly dorso-ventral but inclines slightly cephalad (sometimes caudad) and somewhat medially in its ventral part. In this specimen the ventral or omasal end of the groove was a little caudal to the vertical plane of the dorsal or oesophageal end. More commonly, however, just the reverse of this obtains, *i.e.* the ventral or omasal end lies a little cephalad of the vertical plane of the dorsal or oesophageal end of the groove.

The rumino-reticular orifice (ostium rumino-reticulare). The reticulum is partially separated from the cephalic end of the dorsal sac of the rumen by a nearly vertical fold formed by the apposition of the walls of the two compartments. This rumino-reticular fold is opposite the space between the seventh and eighth ribs. The free edge of the fold forms the ventral and lateral boundaries of the large oval rumino-reticular orifice, Pl. VIII. The relation of this orifice to the oesophagus is such that it is clearly apparent that food or water may readily pass from the oesophagus directly into the rumen.

The omasum is very clearly defined from the other compartments. The greater portion of it is situated to the right of the median plane. It extends from opposite the cephalic edge of the seventh rib, near the middle of the rib, to opposite the caudal edge of the eleventh rib at its costo-chondral junction, Pl. IV. The parietal, or right, surface is in contact with the diaphragm, liver, gall-bladder, abomasum and the beginning of the duodenum. Opposite the eighth and ninth intercostal spaces, for a distance of

about 8 cm. dorsal to the costo-chondral junction, the diaphragm and omentum are the only structures that intervene between the omasum and the abdominal wall. The visceral or left surface of the omasum is related to the rumen, reticulum and abomasum, Pls. IV and VIII. Dorsally the omasum is related principally to the liver, pancreas, small and large intestines. The ventral surface of the omasum is in contact with the abomasum and abdominal floor, Pl. VIII. The cavity of the omasum is occupied largely by a series of longitudinal folds or laminae which depend from the dorsal and lateral walls of the compartment. One hundred and sixty of these folds or laminae were counted. They vary in width from a few millimeters to 20 or 25 cm. Of these one hundred sixty laminae, sixty-four were from 2 to 4 mm. up to 1 cm. or 1.5 cm. in width; fifty-six were from 1.5 cm. to about 3.5 cm. in width; twenty-eight were from about 3.5 cm. to 14 cm. in width; and twelve were from 14 cm. to 22 cm. in width.

The abomasum or fourth compartment of the stomach is an elongated, piriform structure sharply flexed toward its smaller or pyloric extremity. It lies on the floor of the abdomen to the right of and somewhat ventral to the rumen. Its cephalic end is opposite the costo-chondral junction of the seventh rib. From here it extends in a direction more or less obliquely to the right, some distance along the floor of the abdomen, and then makes a sharp flexure of about 180 degrees and extends cephalo-dorsad to opposite the ventral part of the tenth (or ninth) intercostal space on the right side, Pls. II, III, IV, also Pl. VIII. The most caudal point of the greater curvature reaches a transverse vertical plane through the umbilicus. The larger portion of the abomasum is situated to the right of the median plane, but a portion of it lies to the left of this plane. In the specimen from which Pls. I to VII were made the abomasum was visible on the left side nearly as far back as the umbilicus, Pls. V to VII. In other specimens the abomasum was visible upon removal of the left wall of the abdomen, but not to so great an extent as shown in plates V to VII. The parietal (ventro-dextral) surface of the abomasum for the most part lies upon the floor of the abdomen, a small part only being in contact with the right abdominal wall. The visceral (dorso-sinistral) surface is in contact with the ventral sac of the rumen, the omasum and the small intestine. The cephalic end is closely attached to the reticulum. The abomasum has two curvatures — greater and lesser. The greater curvature is ventro-caudal and to it are attached the greater omentum and the cephalic end of the ventral sac of the rumen. The greater part of the lesser or dorso-cephalic curvature of the abomasum is attached by connective tissue and peritoneum to the

omasum; the lesser omentum is attached to the remaining pyloric portion of the lesser curvature.

The small intestine. Upon cutting the greater omentum near its attachment to the duodenum, large intestine and the greater curvature of the abomasum and turning it ventrally, and after removing the liver and pancreas, the greater portion of the small intestine is exposed, Pls. II, III. The small intestine lies almost wholly to the right of the median plane and mainly in the ventral part of this portion of the abdominal cavity, Pls. II, III. Its principal relations are as follows: superficially, to the greater omentum which intervenes between the mass of small intestine and the right abdominal wall; to the ventral and lateral walls of the pelvis and to the pelvic organs, to the liver, pancreas, caecum, large intestine and right kidney. More deeply, the small intestine is related to the visceral or right face of the rumen and to the omasum. The duodenum begins at the pylorus opposite the tenth intercostal space and extends dorsally to the visceral surface of the liver. Between its place of origin from the abomasum and the visceral surface of the liver the duodenum forms an S-shaped or sigmoid flexure, Pl. III. From here the duodenum extends caudally to near the coxal (or external) angle of the ilium, where it turns and extends cephalad alongside of the terminal part of the large intestine and, ventral to the right kidney, is continued by the mesenteric portion (jejunum and ileum) of the small intestine, Pls. III, IV. The bile duct opens into the duodenum immediately distal to the sigmoid flexure, Pl. III, 26. The pancreatic duct opens from 20 to 35 cm. farther caudad, Pl. III, P; Pl. X, 21. The mesenteric portion of the small intestine is arranged in numerous close coils or loops which form a kind of festoon at the ventral border of the mesentery. The terminal portion of the small intestine lies between the caecum and the large intestine, to both of which it is adherent for a short distance (4 to 8 cm). The small intestine occupies the space bounded medially by the ventral sac of the rumen; ventro-laterally, by the abdominal wall; dorsally, by the caecum and large intestine; cephalad, by the omasum and the pyloric portion of the abomasum. The length of the small intestine of an adult Holstein cow, measured while perfectly fresh, was 135 feet.

The caecum. The caecum of the cow from which these drawings were made was 65 cm. in length, somewhat shorter than the average, which is about 75 cm. Its position and general relations to the large and small intestines are shown in Pls. II, III, X. The caecum is directly continued cephalad by the large intestine, the conventional demarcation between the

two being the terminal end of the ileum. From this ileo-caecal junction, which is on the medial side and usually near the ventral end of the last rib, the caecum extends caudo-dorsally and its rounded blind end more commonly lies at the right side of the pelvic inlet; sometimes, however, it lies within the pelvic cavity. In the cow from which plate X was made the caecum was flexed so that its caudal or free extremity was situated ventral to the transverse process of the fourth lumbar vertebra. The caecum is closely attached along its medial side to the mesentery, except the caudal third, which is free and hence liable to some variation in position. As may be seen from Pl. II, the two portions of the omentum, parietal and visceral, separate the caecum from the abdominal parietes of the right flank.

The large intestine. The greater portion of the large intestine is arranged in double elliptical coils between the layers of the mesentery in the right dorsal part of the abdominal cavity, Pls. II, III. The large intestine is related to the dorso-lateral portion of the right abdominal wall, to the greater omentum, the first portion of the duodenum, the caecum and to the pancreas. On its medial side it is related principally to the rumen and the left kidney, Pl. IV. Unlike those of the horse, the caecum and large intestine have no muscle-bands and are not sacculated. In cattle the relations of the large intestine, particularly to the mesentery of the small intestine, are such that torsion of the large intestine is practically impossible. From the caecum the large intestine extends cephalad for a short distance (10 cm.) and then turns abruptly dorso-caudally near the ventral ends of the last two ribs. It then extends caudally (25 to 30 cm.) along the dorsal surface of the caecum, to the caudal part of the sublumbar region. Here it turns dorsally and extends cephalad, parallel to the portion just mentioned but separated from it by intervening portions of the large intestine, as far as to the second (or first) lumbar vertebra, where it turns ventro-caudally and is continued by the spiral portion of the large intestine. The coiled portion of the intestine makes two complete turns in a direct or clockwise course (centripetal coils) and two complete turns in a retrograde or counter-clockwise direction (centrifugal coils). The length of the large intestine of an adult Holstein cow, measured in a fresh condition, was 27 feet, somewhat shorter than the average length. Palpation per rectum of the caecum and the caudal portions of the small and large intestines is easily effected.

Costal attachment of the diaphragm. The costal attachment of the diaphragm in cattle should be specially noticed. In a cow one year of age the costal attachment of the diaphragm was as follows: Beginning at the ven-

tral end of the eighth rib the line marking the most ventral limit of attachment crossed the asternal ribs at the following respective distances dorsal to the costo-chondral junction: the tenth rib, 3.8 cm.; the eleventh rib, 6.3 cm.; the twelfth rib, 12 cm.; and the thirteenth rib, 16.5 cm. dorsal to the costo-chondral junction. The extent of diaphragmatic attachment to each rib was as follows: to the costicartilage and slightly to the ventral end of the eighth rib; to the ninth rib the diaphragm was attached for a distance of 3.8 cm. from the costo-chondral junction; to the tenth rib, a distance of 5 cm.; to the eleventh rib, a distance of 6.4 cm.; to the twelfth rib, a distance of 5.7 cm.; and to the thirteenth rib, a distance of 2 cm. The line of reflection of the costo-diaphragmatic pleura was at a greater distance from the ventral ends of the ribs than the extreme dorsal limit of muscle attachment and varied from 2.5 cm. at the eighth rib to 6 cm. at the twelfth rib. The pleura did not touch any portion of the thirteenth rib. From the above measurements, but especially from Pls. III, IV, VI, VII, X, it may be seen that the size of the thoracic cavity is surprisingly small. Not only is the diaphragm attached at some considerable distance from the ventral ends of the asternal ribs, but its central portion extends as far cephalad as opposite the sixth rib. Auscultation or percussion over that portion of the thoracic parietes formed by the ventral half or two thirds of the asternal ribs, *i.e.* below the line of diaphragmatic attachment to the ribs, would obviously relate to abdominal organs and not to those of the thorax.

The liver lies almost wholly to the right of the median plane. Its long axis extends from the cephalic end of the right kidney to opposite the ventral end of the sixth or even the fifth rib, Pls. II, III. Its parietal or diaphragmatic surface is for the most part in contact with the diaphragm, but a small portion of its dorsal extremity touches the dorsal end of the last one or two ribs and a small portion of the adjoining wall of the abdomen. The visceral surface is concave and irregular. This surface is related to the reticulum, gall bladder, duodenum, pancreas, right kidney and adrenal, portal lymph glands and the portal vein, Pls. II, III. This surface is marked by the portal fissure and by impressions of the reticulum, omasum, gall bladder and duodenum. The dorsal border is short and thick and is marked by the deep renal fossa made by the cephalic end of the right kidney and adrenal; at this border also is the large, thick, quadrilateral-shaped caudate lobe of the liver. The ventral border is short, thin and unbroken. The right border contains the umbilical fossa. On the left border, almost directly opposite the umbilical fossa, is the oesophageal notch. The area for percussion of the liver is shown in Pls. II, III.

The cholecyst or gall bladder is a large pear-shaped sac from 10 cm. in length in one specimen to 16 cm. in another. It lies opposite the ventral part of the ninth and tenth intercostal spaces, Pls. II, III, X. In an adult Holstein cow the most dependent portion of the gall bladder was 7 cm. dorsal to the costo-chondral junction of the tenth rib. In a second specimen its most dependent part was only 2.5 cm. dorsal to this point, Pl. X. The gall bladder is in contact with the visceral surface of the liver, to which it is closely attached; it is also in contact with the abdominal surface of the diaphragm, Pls. II, X. The cystic, hepatic and common bile ducts and the place of communication of the latter with the duodenum are all shown in Pl. III.

The pancreas, Pls. I, II, III, X, is approximately triangular in shape, one of the angles being a right angle and the other two very blunt or rounded. It has two surfaces, dorsal and ventral, and three borders — right, left and cephalic. In this specimen the right border was 16 cm. in length; the cephalic border was 17 cm. in length, and the left border 21 cm. The left border is broken by a deep incision, at the bottom of which are the portal vein and hepatic artery; several lymph glands also are present in this pancreatic incision. The dorsal surface of the pancreas is related to the liver, right kidney, crura of the diaphragm, vena cava, anterior mesenteric artery and vein and the left adrenal. The dorsal face of the organ is attached to the liver, at the dorsal part of the portal fissure, and to the portion of liver adjacent to the fossa venae cavae. Between these two areas of attachment the pancreas is free and forms the ventral boundary of the foramen epiploicum. The dorsal opening of this foramen was 6 cm. in width; the ventral opening was 2.5 cm. wide; and the distance between these two orifices was 7 cm. The ventral surface of the pancreas is related to the dorsal sac of the rumen, to the omasum, the duodenum and the large intestine, Pls. III, VIII. The pancreatic duct leaves the gland at its caudal angle (or extremity) and enters the duodenum from 20 to 35 cm. caudal to the bile duct, Pls. III, X. The caudal portion of the pancreas lies between the two layers of the mesoduodenum. This part of the gland is wide and thin and is often divided into two branches, Pl. X. From the relations of the pancreatic duct as shown in Pls. III and X, it is apparent that no great difficulty would be encountered in opening this duct to collect the pancreatic secretion for physiologic or experimental purposes.

The spleen is situated at the left side of the cephalic extremity of the stomach, as shown in Pl. V. It has the form of an elongated ellipse, both ends being rounded, thin and approximately of the same size. This organ varies con-

siderably in size in different individuals. In the present specimen it was 49 cm. in length and 15.5 cm. in width. In another case it measured 62 cm. by 18 cm. The dorsal extremity lies under the vertebral ends of the last two ribs; sometimes this end of the spleen extends back as far as to the middle of the first lumbar transverse process. The ventral extremity is opposite the costo-chondral junction of the eighth rib; not infrequently, however, this extremity does not extend so far ventrad. The parietal surface of the spleen is convex and is in contact with the diaphragm only, except possibly a very small part of its dorsal portion. The visceral surface is concave and is related principally to the rumen, Pl. VI, 27. Its ventral end is usually in contact with the reticulum for a distance of 5 cm. more or less. The dorsal part of the spleen is attached to the left crus of the diaphragm and to the rumen by connective tissue and reflected peritoneum. The ventral end is free or unattached for a distance of 12 to 15 cm. About one half of the visceral surface of the spleen is attached directly to the rumen by connective tissue and is not covered with peritoneum, Pl. VI. Similarly there is a non-peritoneal area of two to three centimeters average width on the parietal surface along the dorsal half of the cephalic border of the spleen. The area for percussion of the spleen is well shown in Pl. V. In this connection it should be noted that the spleen is overlapped to about one half of its width by the left lung, the diaphragm intervening between the two organs.

The kidneys of the cow are distinctly lobulated. The lobules are of unequal size and vary in number from eighteen to twenty-three, more or less. The right kidney is elongated and flattened dorso-ventrally. Its average dimensions are 21 cm. in length, 12 cm. in width and 4 to 6 cm. in thickness. It commonly lies ventral to the last rib and the transverse processes of the first two lumbar vertebrae; in some cases it extends as far as the transverse process of the third lumbar vertebra. The dorsal surface is in contact with the sublumbar muscles. The ventral surface is related to the liver, pancreas, right adrenal, duodenum and the large intestine. The right kidney did not touch the rumen; the aorta, vena cava and crura of the diaphragm intervene between the two.

The left kidney in adult cattle and sheep occupies an unexpected position. Instead of lying wholly to the left of the median plane as it does in non-ruminant mammals and in the young (calf and lamb) of ruminants, it is situated either partially or wholly to the right of the median plane, Pl. IV, 27; Pl. VIII, 14. This is apparently dependent upon the extent of repletion of the rumen. The left kidney is situated considerably farther caudal than the right. It extends from opposite the caudal edge of the

transverse process of the second lumbar vertebra to opposite the corresponding border of the transverse process of the fifth lumbar vertebra. The left kidney also is situated farther ventrally than the right. The ventral surface of the right kidney was 9 cm. ventral to the transverse processes of the lumbar vertebrae, while that of the left kidney was 16 cm. ventral to these processes. The left kidney is more or less regularly three sided, with medial, dorso-lateral and ventral surfaces, Pl. VIII, 14.

The medial surface is in contact with the visceral or right face of the rumen. The dorso-lateral surface is in contact with the sublumbar muscles and the large intestine. The ventral surface is related to the large intestine.

The hilus of the left kidney opens almost directly to the right, while that of the right kidney opens to the left. Palpation per rectum of the left kidney is easily effected.

The adrenals. The right adrenal is molded to the medial surface of the cephalic end of the right kidney. It is somewhat pyramidal in form, having three faces, medial, lateral and ventral, also an apex and a base. The medial surface of the right adrenal is in contact with the right crus of the diaphragm. The cephalic portion of the lateral surface is related to the liver; the remaining portion of this surface is marked by a fossa which is occupied by the cephalic end of the right kidney. The ventral surface is marked by a shallow groove for the vena cava. The ventral surface was 6 cm. in length by 2 cm. in greatest width. The dorsal border was 5.5 cm. long and the base was 5 cm. in length. The average thickness of the right adrenal was about 1 cm. The left adrenal is approximately medial in position. It lies on the medial surface of the vena cava immediately caudal to the anterior mesenteric artery. Its form and position are shown in Pl. VIII. Its greatest length was seven and three quarter centimeters and its width was four and one quarter centimeters; its thickness was a little over one centimeter. The right surface of the left adrenal is closely attached to the vena cava. The left surface was in contact with the pancreas and the anterior mesenteric artery. The left adrenal was situated 3 cm. cephalad of the left kidney, Pl. VIII.

The thoracic cavity.

Attention has been called to the costal attachment of the diaphragm and the consequent diminution in size of the thoracic cavity as compared to that of the horse. In the live animal the size of the cavity varies with each inspiration and expiration. In expiration the peripheral portion of the diaphragm lies directly against the thoracic wall, Pl. I, X. When the diaphragm contracts in inspiration, it is drawn away

from the inner wall of the thorax and the length of the thoracic cavity is correspondingly increased. This increased thoracic space is immediately occupied by the expanding lungs whose sharp borders then extend caudally as far as the reflected costo-diaphragmatic pleura. In consequence of this alternate contraction and relaxation of the diaphragm the lateral borders of the lungs are continually moving backward and forward, the extent of such movement varying from 10 to 20 cm., Pl. X. In expiration the caudal border of the lung is approximately indicated by a line drawn from the dorsal end of the twelfth rib to the costo-chondral junction of the sixth rib. In inspiration the border of the lungs extends from 10 to 20 cm. caudal to this line.

The lungs. In connection with the lungs the following special points may be noted: (a) The apex of the right lung, unlike that of the left, extends a little distance cephalad of the first rib, Pl. II. (b) The extra bronchus to the apical lobe of the right lung arises from the trachea opposite the third rib, Pls. III, IV, 17. (c) The bifurcation of the trachea into right and left bronchi is opposite the fifth rib, Pl. IV. (d) The cardiac notch of the left lung is larger than that of the right so that a greater area of the pericardium is left uncovered by the lung on the left side than on the right, Pls. V, II. (e) On the left side the caudal portion of the lung overlaps the spleen and on the right side it overlaps the liver, the diaphragm only intervening, Pls. V, II.

The pericardium and heart.

The pericardium is covered by the middle or pericardiac portion of the mediastinum and is crossed on either lateral side, near the base of the heart, by the phrenic nerves. There are several small orifices in the fibrous layer of the pericardium through which several of the cardiac nerves pass to the walls of the heart. The lateral surfaces of the pericardium, in a strict sense, are related only to the mediastinal layers of the pleura. Commonly, however, these surfaces of the pericardium are described as though they were in direct contact with the lungs and the thoracic walls. On the left side the area of contact of the pericardium with the thoracic wall is considerably larger than it is on the right side. In the specimen, a large Holstein, from which these measurements were taken, this area (cardiac notch of the lung) extended from the second rib to near the caudal edge of the fourth rib. The area is approximately quadrilateral; its height, at the second rib, was 10 cm. and at the fourth rib 15 cm. dorsal to the respective costo-chondral articulations. On the right side the cardiac notch of the lung is smaller and consequently a smaller area of the peri-

cardium touches the thoracic wall. The area extended from the second rib to the fourth. Its height at the second rib was 8.5 cm. and at the fourth rib 10.5 cm. dorsal to the respective costo-chondral articulations.

The heart, in this specimen, was opposite the second, third, fourth and fifth ribs and the second, third and fourth intercostal spaces. The cephalic border or surface, as a whole, is strongly convex; the apical portion, however, is nearly parallel to the sternum. The caudal border or surface is shorter, straighter and was approximately parallel to the fifth rib. A plane passed lengthwise of the fifth rib and about midway between its two borders would mark the caudal boundary of this border of the heart. The apex of the heart was opposite the ventral portion of the fifth interchondral space. The close proximity of the heart to the diaphragm and to the reticulum is apparent from Pls. III, IV, VI, VII. The pulmonary valve was opposite the second intercostal space at a point 8 cm. dorsal to the costo-chondral articulation of the second rib. The ligamentum arteriosum left the pulmonary artery opposite the fourth rib at a point 24 cm. dorsal to its costo-chondral articulation. It will be noticed that the relation of the heart to the ribs and intercostal spaces, as above described, differs by about the width of one rib from similar relations found in another specimen and figured in Pls. III, IV, VI, and VII.

The pelvic organs.

The position of the pelvic organs, particularly of the uterus and the urocyst, are subject to considerable variation. The urocyst or bladder when empty and contracted forms a small piriform mass lying on the floor of and almost wholly within the pelvic cavity, Pl. IX. In the female the urethra is about 10 cm. in length and is closely connected dorsally to the wall of the vagina. The external urethral orifice is about 10 to 12 cm. from the ventral commissure of the vulva. The relations of the empty bladder to the uterus and vagina are shown in Pl. IX.

The general form, location and relations of the internal genital organs of the cow are shown in Pl. IX, Figs. 1, 2. In Fig. 2 a portion of the small intestine has been removed from the pelvic cavity. In neither of these specimens was the uterus or its cornu in contact with the rumen. In Fig. 1 is shown an abnormal form of the uterine cornu. The cow from which the drawing was made was sterile. But whether this form of the cornu is at all characteristic of the condition of sterility I am unable to state. Such form of the cornu, however, is common in sterile cattle. Figure two shows the uterus and cornu in, approximately at least, their normal form. In both of these figures the broad ligament of the uterus has been removed.

Its line of attachment to the uterus coincides with that of the uterine blood vessels, a part of which are shown in Pl. IX, Fig. 2. The accessibility of all parts of the internal genital organs to palpation per rectum is quite obvious.

The gravid uterus at the beginning of the eighth month of gestation. The contrast in size, position and relations of the gravid uterus to the non-gravid organ is very striking, as may be seen by comparing plates IX and X. Plate X was made from a cow which was bred April 12, 1917, and killed on the fifteenth of Nov. 1917, a period of 216 days of gestation. The most marked features of this drawing are the enormous increase in size of the gravid right cornu of the uterus; its relation to the broad ligament of the uterus and to the ventro-dextral wall of the abdomen; the correlative displacement of the small intestine and certain other viscera, especially the right ovary.

The broad ligament of the uterus (Lig. latum uteri). The anatomical relations of the broad ligament of the uterus, especially in breeding and dairy cattle, are of special interest. Displacement or torsion of the gravid uterus sometimes occurs in cattle and sheep as well as in other animals. This accident, in cattle, is largely determined by the anatomical relations of the broad ligaments of the uterus. The parietal attachment of the broad ligament in the present specimen began at a point 8 cm. ventral to the transverse process of the fourth lumbar vertebra. From here it extended caudally and slightly ventrally, and crossed the shaft of the ilium at a distance of 4 cm. dorsal to the edge of the cotyloid cavity. At a point directly ventral to the coxal or external angle of the ilium, the distance between the parietal attachment of the broad ligament and the ventral edge of this angle of the ilium was 18 cm. The gravid uterus extends far cephalad of its ligamentous attachment to the abdominal wall, Pl. X. In consequence of this, rotation of the uterus upon its long axis frequently occurs. Notwithstanding the great cephalic extension of the gravid uterus, the ovary and the ovarian extremity of the cornu of the uterus are not greatly displaced from their normal position in the non-gravid animal. In the present case the ovary was situated 4 cm. cephalad of a vertical plane through the coxal angles of the ilium and 27 cm. ventral to a horizontal plane through these angles; or to put it another way, the ovary was 26 cm. in a direct line, cephalad of the pubis. It could be palpated easily per rectum. The adjacent extremity of the right cornu of the uterus was situated a little ventral to the ovary, Pl. X. In Pl. X the fimbriated extremity or infundibulum of the oviduct was turned back sufficiently to show the abdominal or peritoneal

orifice of the oviduct — ostium abdominale tubae uterinae, Pl. X. At this period of gestation the gravid cornu had extended cephalad to within 2.5 cm. of the omasum, or, in this case, opposite to the sternal end of the tenth rib. This cephalic extension, measured in a straight line, was 100 cm. from the ischial tuberosity. The greater part of the small intestine was crowded from its normal position, as shown in Pls. II, III, to a position dorso-cephalad of the anterior half of the gravid cornu, Pl. X. Not more than six to eight feet of the small intestine intervened between the genital organs and the floor of the abdomen immediately cephalad of the pubis, Pl. X. By far the greater portion of the gravid organ was situated to the right of the median plane but it also projected considerably to the left of this plane. The relations of the genital organs at this period of gestation, the beginning of the eighth month, were as follows: ventrally to the bladder, a short portion of the small intestine and to the floor of the abdomen cephalad as far as opposite the ventral end of the tenth rib, P X. The greater omentum intervenes between the uterine cornu and the abdominal floor. On the right side the gravid cornu was related to the broad ligament of the uterus, to the right ovary and the right wall of the abdomen, with the greater omentum interposed between the cornu and the abdominal wall, Pl. X. Dorsally, the organ was in contact with the rectum, large intestine, caecum, the small intestine and partially with the ventral sac of the rumen. The left or visceral surface of the gravid cornu was related to the left cornu but almost wholly to the ventral sac of the rumen which also partially covered the dorso-sinistral surface of this cornu. The portion of small intestine connecting the large mass at the dorso-cephalic extremity of the cornu and the smaller portion at the ventral side of the genital organs, just in front of the pelvic inlet, passed between the gravid cornu and the adjacent surface of the rumen. As already mentioned, the gravid cornu extended cephalad nearly to the ventro-caudal surface of the omasum, being separated from it and from the pyloric portion of the abomasum by loops of the small intestine, Pl. X.

The superficial lymph glands.

The accessibility of these glands to palpation obviously is dependent upon a number of considerations, as, for example, the physical condition of the animal, whether in poor or good flesh; whether the skin is thin and pliable or thick and unyielding; the size of the glands and the experience and skill of the person making the examination. Varying degrees of manipulative skill and acuteness of touch doubtless account for discrepancies of statement as to the possibility of palpating certain lymph glands in the healthy animal. Some of the lymph glands which

are palpable only with difficulty and uncertainty in the healthy animal are easily felt if enlarged as a result of disease.

The mandibular lymph glands (submaxillary or intermaxillary) are two in number, one on either side. The gland is situated about midway between the angle of the mandible and the vascular groove where the artery and vein maxillaris externa and the parotid duct cross the ventral border of the mandible. The gland lies between the muscle sterno-cephalicus (sterno-mandibularis) and the submaxillary salivary gland. The muscle forms the ventro-lateral boundary of the gland and the submaxillary salivary gland forms its medial boundary. Dorsally, it is related to the V. maxillaris externa and the ventral border of the mandible. Sometimes the submaxillary salivary gland forms both the medial and ventral boundaries of the lymph gland. The gland is oval shaped and was 4 cm. long by 2.5 cm. wide and 1.3 cm. greatest thickness. (Average size, 3-4.5 cm. by 2-3 cm. by 1-1 $\frac{3}{4}$ cm., Baum.)

The parotid lymph gland is situated a little ventral to the temporo-mandibular articulation between the masseter muscle and the dorsal end of the parotid salivary gland, Pl. III, 40, Pl. IV, 30. The gland is partially, sometimes wholly, covered by the parotid salivary gland. The more common condition, however, is shown in Pls. III, IV, VI, VII, where a portion of the lymph gland is uncovered by the salivary gland. When this relation obtains the lymph gland usually can be distinctly palpated in the healthy animal. The size of this gland in a large Holstein was 4.7 cm. long by 2 cm. wide and 1 cm. in thickness. (Average size is 6-9 cm. long by 1.5-3 cm. wide by $\frac{3}{4}$ -1 cm. thick, Baum.)

The lateral retro-pharyngeal lymph gland (atlantal or sub-atlantal). This gland is situated on the caudo-lateral wall of the pharynx and is covered laterally by the dorsal end of the submaxillary salivary gland. The dorsal end of the lymph gland lies 2 cm. ventral to the caudal portion of the wing of the atlas. The larger portion and sometimes the whole of the gland is situated caudal to a transverse vertical plane between the atlas and the axis. The gland is immediately dorsal to the common carotid artery. Its dimensions, in an adult Holstein, were 4.5 cm. long by 2.5 cm. wide by $\frac{3}{4}$ cm. thick. (Average size, 4-5 cm. by 2-3.5 cm. by $\frac{3}{4}$ -1 $\frac{1}{4}$ cm., Baum.)

Anterior cervical lymph glands are situated in the vicinity of the thyroid body along the course of the common carotid artery. They vary in number, 3 to 5, and in size. In the present case three were present, of which the largest was 2.3 cm. by 1.2 cm. In the healthy animal these glands certainly could not be satisfactorily palpated.

The prescapular lymph gland (superficial cervical) is situated at the cephalic border of the supraspinatus muscle a little dorsal to, or above, the point of the shoulder. The gland is covered, in large part, by the muscle omo-transversarius which is here only about one half centimeter in thickness. Its ventral portion is covered by the muscle brachio-cephalicus which is somewhat thicker than the preceding muscle. The lymph gland is large, 8.7 cm. by 3.2 cm. by 1.9 cm., and can be readily palpated in the live animal. In addition to this large gland there are often several additional small nodules scattered along the cephalic border of the supraspinatus muscle and covered by the omo-transversarius and the very thin trapezius. The small glands, of a dark red color, vary in number from 5 to 10 and in size from 4 mm. up to 1.9 cm. (Average size of the prescapular lymph gland, 7-9 cm. by 1.5-2 cm. by 1-1.5 cm., Baum.)

The precrural lymph glands (prefemoral or subiliac), one on either side, are situated on the aponeurosis of the muscle obliquus abdominis externus in the region of the flank, Pl. IX. The gland lies at the cephalic edge of the tensor fasciae latae and from 20 to 30 cm. ventral to the coxal or external angle of the ilium; or from 15 to 20 cm. dorsal to the free edge or border of the fold of skin at the flank. The gland is covered by the skin and the thin aponeurosis of the muscle cutaneus trunci and can be palpated easily in the healthy cow. The size of the gland varies considerably. In one specimen it was 7.5 cm. long by 2.5 cm. wide; in another case it was 10.5 cm. long by 3 cm. wide. (Average size, 6-11 cm. by 1½-2½ cm. by 1 cm., Baum.) Usually it forms a single structure as shown in Pl. IX, Fig. 2, but sometimes there are accessory glands as shown in Pl. IX, Fig. 1.

The superficial inguinal lymph glands differ in their relations in the two sexes. "In the male they are situated in a mass of fatty tissue immediately caudal to the spermatic cord. Superficially, they are covered by the skin and partially by the retractor muscle of the prepuce. More commonly only one gland on either side is present but there may be two or three and in exceptional cases even as many as four glands on a side. Occasionally an unpaired gland is found between the penis and the ventral abdominal wall. The largest of the superficial inguinal lymph glands, in the adult male, are from 3-6 cm. in length and from 2-3 cm. in width." Baum.

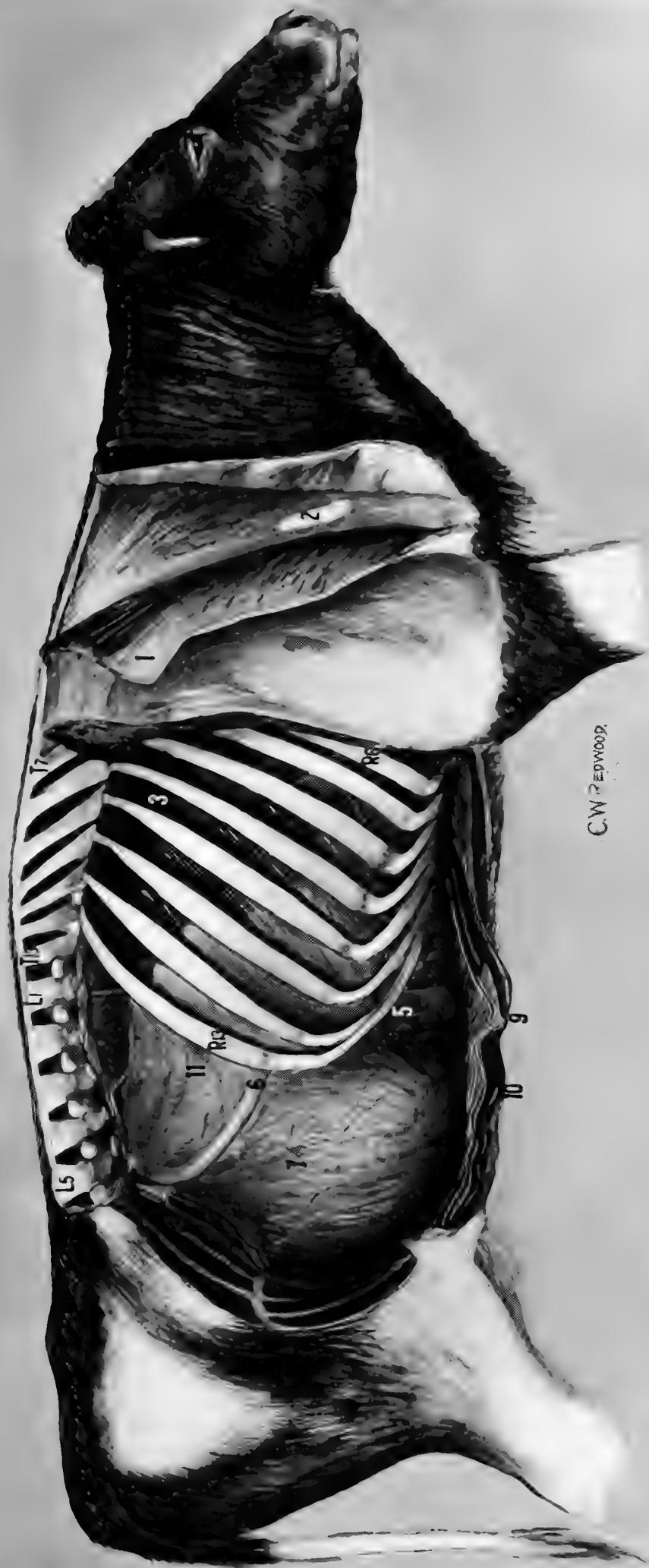
In the female these glands are often termed the **supramammary** or **retromammary lymph glands**. Usually there are two of these glands present on either side. Exceptionally a third gland may be present on one side and one gland only on the other. The largest glands are in apposition, or nearly so, medially, and are sometimes united along their medial borders.

The glands are situated between the hind quarters of the udder and the ventral surface of the pelvis but at some little distance, 12 cm. more or less, from it, Pls. IX, X. Of the three glands shown in Pl. IX, Fig. 2, the largest one was 5.5 cm. long and 3.5 cm. wide. (Average size, 6–10 cm. long by 1–4 cm. wide by $\frac{3}{4}$ –1.5 cm. thick, Baum.) The supramammary lymph glands, in many cases at least, may be readily palpated in the healthy dairy cow.

The thoracic duct. In all mammals, so far as known, except the New World monkeys, the lymphatic system communicates with the venous system by two main trunks, the thoracic duct and the right lymphatic duct (or right tracheal duct). The thoracic duct opens into the veins at, or close to, the angle of junction of the left external jugular and axillary veins, Pls. VI, VII. The right lymphatic duct (or right tracheal duct) opens at a corresponding point or points, on the right side. The thoracic duct begins at the cisterna chyli which is situated between the aorta and the right crus of the diaphragm at the first and second lumbar vertebrae. The duct passes through the hiatus aorticus of the diaphragm into the right pleural cavity, Pl. IV, 35. It extends forward between the aorta and the vena azygos to the fifth, sixth or seventh thoracic vertebra where it inclines ventrally, and crosses obliquely over to the left side of the oesophagus and trachea, Pl. VII, 29. From here the duct extends along the left side of the oesophagus to the inlet of the thorax where it inclines ventrally and opens by one or more orifices into the veins at, or near, the junction of the left external jugular and the axillary veins, Pl. VII, 28. The thoracic duct drains approximately three fourths of the body, viz., the hind quarters, the abdominal viscera, portions of the thoracic viscera, the left side of the head and neck and the left thoracic limb. The remainder of the body is drained by the right lymphatic duct.

PLATE I

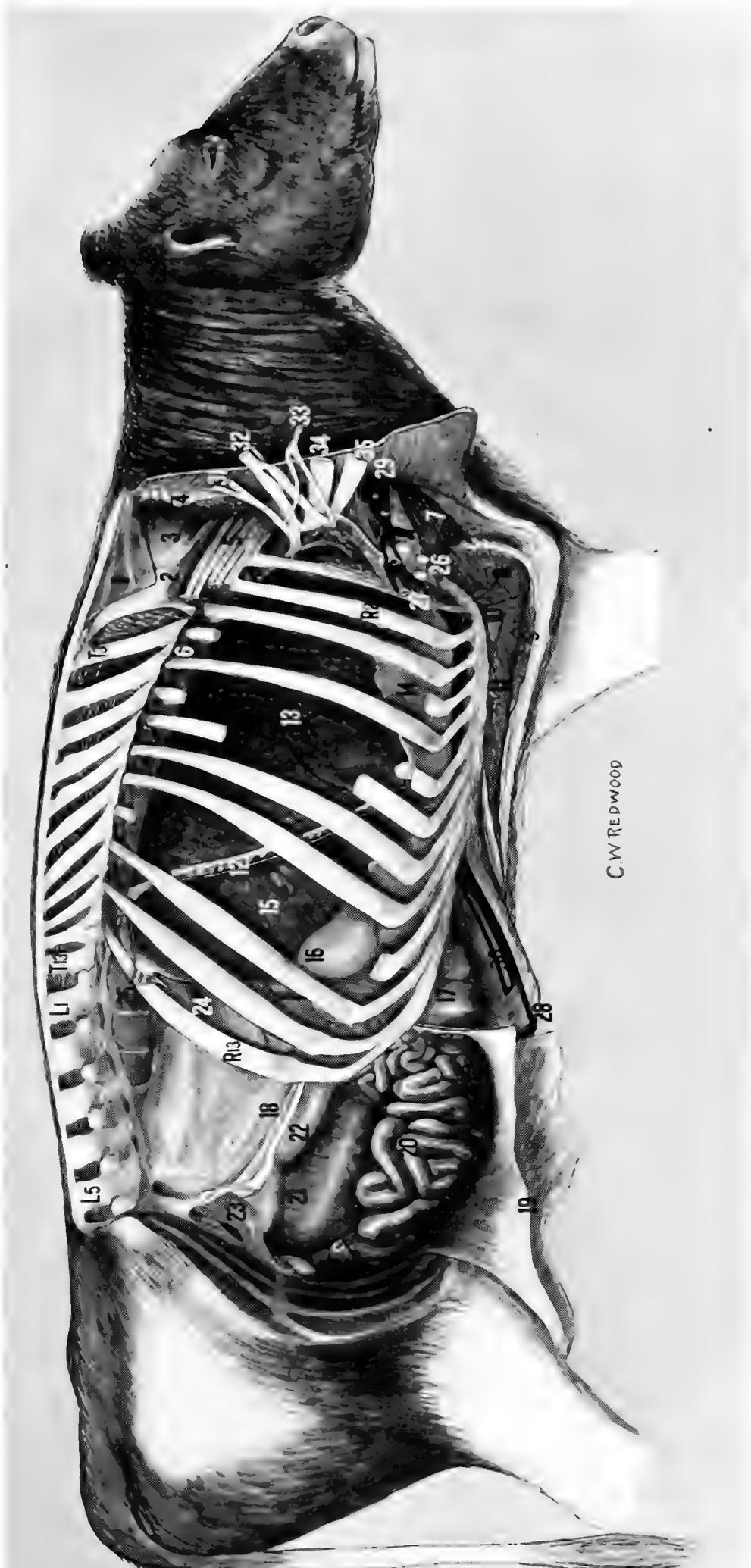
- T 7. Seventh thoracic vertebra.
- T 13. Thirteenth thoracic vertebra.
- L 1. First lumbar vertebra.
- L 5. Fifth lumbar vertebra.
- R 6. Sixth rib.
- R 13. Thirteenth rib.
- 1. M. trapezius.
- 2. Prescapular or superficial cervical lymph gland.
- 3. Lung.
- 4. Diaphragm.
- 5. Pyloric extremity of the abomasum.
- 6. Duodenum.
- 7. Greater omentum.
- 8. Right kidney.
- 9. A. epigastrica anterior (anterior abdominal).
- 10. V. epigastrica anterior (subcutaneous abdominal).
- 11. Small portion of pancreas.



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PLATE II

- T 3. Third thoracic vertebra.
- T 13. Thirteenth thoracic vertebra.
- L 1. First lumbar vertebra.
- L 5. Fifth lumbar vertebra.
- R 2. Second rib.
- R 13. Thirteenth rib.
- 1. M. trapezius.
- 2. M. longissimus dorsi.
- 3. M. splenius.
- 4. M. serratus ventralis below and M. rhomboideus above.
- 5. M. longissimus dorsi and costarum. The latter not clearly separated from the longissimus dorsi.
- 6. M. levator costarum.
- 7. M. sterno-cephalicus (sterno-mandibularis).
- 8-11. Pectoral muscles.
- 12. Cut edge of diaphragm.
- 13. Lung. Note the apex of the lung cephalad of the first rib.
- 14. Heart, covered by the mediastinum and pericardium.
- 15. Liver.
- 16. Gall bladder.
- 17. Duodenal extremity of the abomasum.
- 18. Duodenum.
- 19. Greater omentum, cut and turned down. The other cut edge is shown between the numerals 18 and 22.
- 20. Small intestine.
- 21. Caecum.
- 22. Large intestine.
- 23. Terminal portion of large intestine.
- 24. Pancreas, covered with peritoneum.
- 25. Right kidney.
- 26. Axillary and other lymph glands.
- 27. A. axillaris.
- 28. A. epigastrica anterior.
- 29. V. jugularis externa.
- 30. V. epigastrica anterior.
- 31-35. Brachial plexus.
- 32. Median and ulnar nerves.
- 34. N. radialis.
- 35. N. prescapularis.

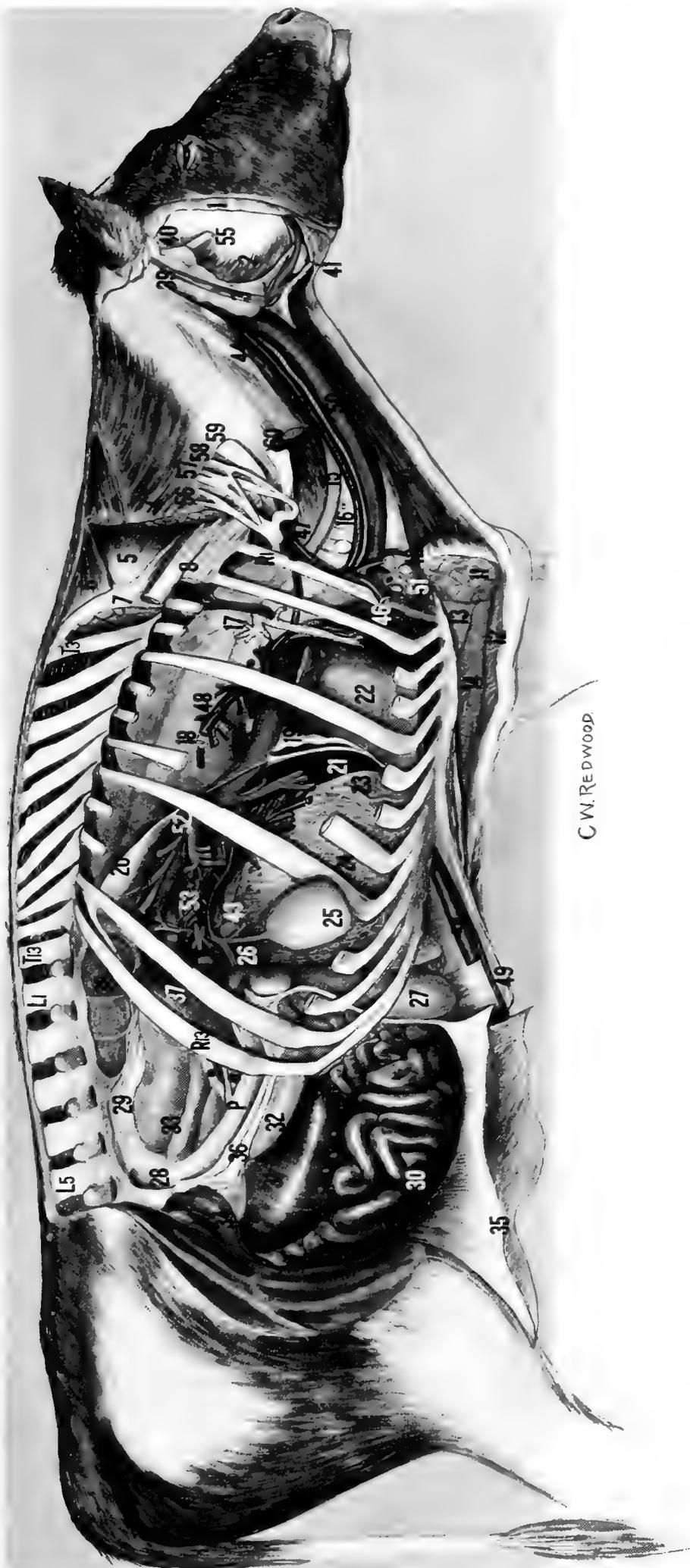


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PLATE III

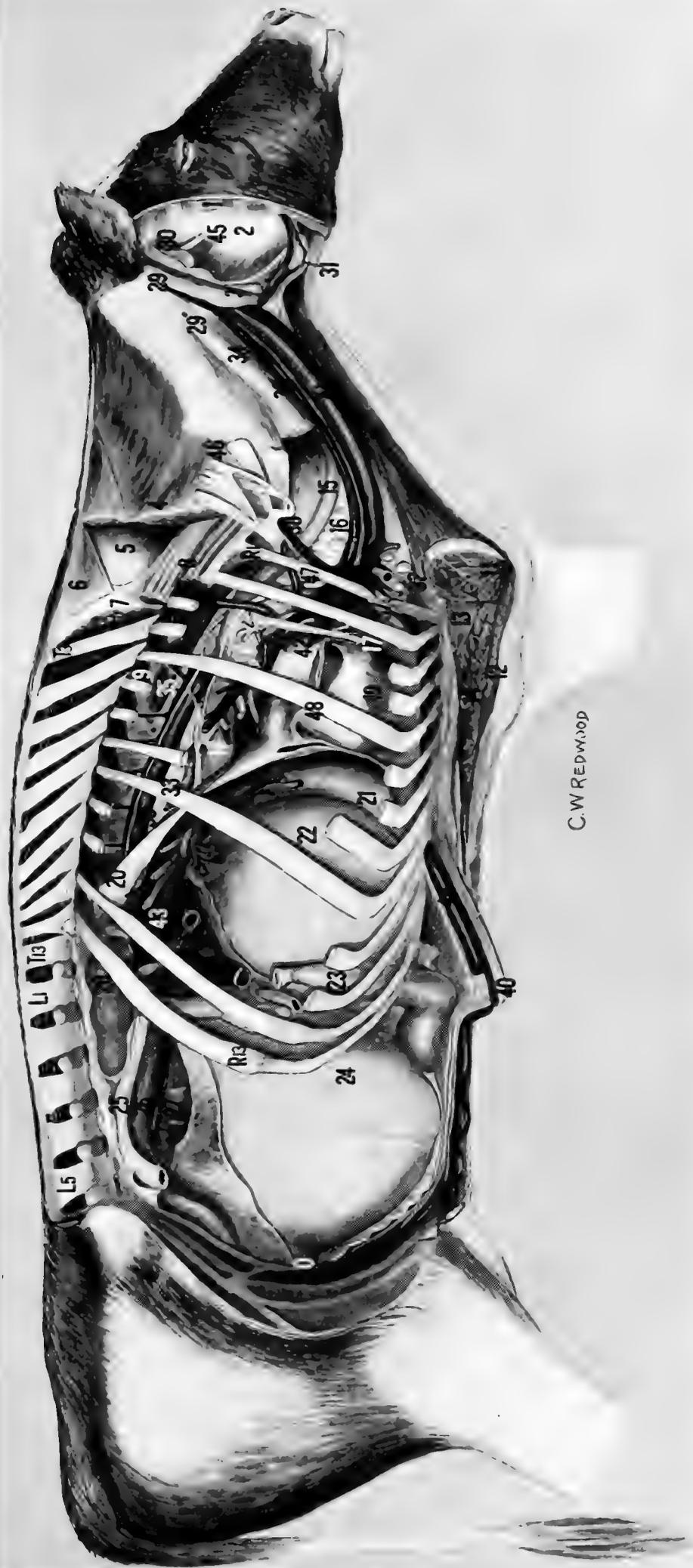
- T 3. Third thoracic vertebra.
- T 13. Thirteenth thoracic vertebra.
- L 1. First lumbar vertebra.
- L 5. Fifth lumbar vertebra.
- R 1. First rib.
- R 13. Thirteenth rib.
 - 1. M. cutaneus faciei.
 - 2. M. masseter.
 - 3. M. parotido-auricularis.
 - 4. Cervical portion of M. serratus ventralis.
 - 5. M. splenius.
 - 6. M. trapezius; the portion covering the rhomboideus has been removed.
 - 7. M. longissimus dorsi.
 - 8. Mm. longissimus dorsi and costarum.
 - 9. M. levator costarum.
 - 10. M. sterno-cephalicus (sterno-mandibularis).
- 11-14. Pectoral muscles.
- 15. Oesophagus.
- 16. Trachea.
- 17. Bronchus of the right apical lobe of the lung.
- 18. Right bronchus.
- 19. Fold of pleura around the vena cava.
- 20. Cut edge of diaphragm.
- 21. Small portion of the ventral end of the liver; the greater part has been scraped away.
- 22. Pericardium.
- 23. Reticulum.
- 24. The omentum, covering the omasum.
- 25. Gall bladder, drawn aside somewhat.
- 26. The common bile duct above, and the cystic duct to the right of the numeral, 26.
- 27. Pyloric end of abomasum.
- 28-29. Duodenum.
- 30. Small intestine.
- 31. Caecum.
- 32. Large intestine.
- 33. Large intestine.
- 34. Terminal portion of large intestine.
- 35. Greater omentum, turned down. Shows the two portions, parietal and visceral.
- 36. Cut edge of omentum.
- 37. Pancreas.
- P. Pancreatic duct opening into the duodenum.
- 38. Right kidney.
- 39. Parotid salivary gland.
- 40. Parotid lymph gland.
- 41. Mandibular lymph gland (submaxillary).
- 42. Axillary and inferior cervical lymph glands.
- 43. Portal or hepatic lymph glands.
- 44. Right tracheal lymph duct.
- 45. A. carotis communis.
- 46. A. axillaris.
- 47. A. vertebralis.
- 48. Right branch of pulmonary artery.
- 49. A. epigastrica anterior (anterior abdominal).
- 50. V. jugularis externa.
- 51. V. axillaris.
- 52. Vena cava and hepatic veins.
- 53. Vena portae.
- 54. V. epigastrica anterior.
- 55. N. facialis.
- 56-60. Brachial plexus.
 - 57. Median and ulnar nerves.
 - 59. N. radialis.
 - 60. N. prescapularis.



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PLATE IV

- T 3. Third thoracic vertebra.
- T 13. Thirteenth thoracic vertebra.
- L 1. First lumbar vertebra.
- L 5. Fifth lumbar vertebra.
- R 1. First rib.
- R 13. Thirteenth rib.
- 1. M. cutaneus faciei.
- 2. M. masseter.
- 3. M. parotido-auricularis.
- 4. Cervical portion of M. serratus ventralis.
- 5. M. splenius.
- 6. M. trapezius; the portion covering the M. rhomboideus has been removed.
- 7. M. longissimus dorsi.
- 8. Mm. longissimus dorsi and costarum.
- 9. M. levator costarum.
- 10. M. sterno-cephalicus (sterno-mandibularis).
- 11 14. Pectoral muscles.
- 15. Oesophagus.
- 16. Trachea.
- 17. Bronchus of right apical lobe.
- 18. Right bronchus, pulmonary artery and vein.
- 19. Heart.
- 20. Cut edge of diaphragm.
- 21. Reticulum.
- 22. Omasum.
- 23. Pyloric extremity of abomasum.
- 24. Rumen.
- 25. Duodenum.
- 26. Terminal part of large intestine.
- 27. Left kidney.
- 28. Right kidney.
- 29. Parotid salivary gland.
- 29'. Dorsal end of the submaxillary salivary gland.
- 30. Parotid lymph gland.
- 31. Mandibular lymph gland (submaxillary).
- 32. Axillary and inferior cervical lymph glands.
- 33. Posterior mediastinal lymph gland. The duct from it opens into the thoracic duct at 35.
- 34. Right tracheal lymph duct.
- 35. Thoracic duct.
- 36. A. carotis communis.
- 37. A. axillaris.
- 38. A. vertebralis.
- 39. Aorta.
- 40. A. epigastrica anterior.
- 41. V. jugularis externa.
- 42. V. cava anterior.
- 43. V. cava posterior and several hepatic veins opening into it.
- 44. V. epigastrica anterior (subcutaneous abdominal).
- 45. N. facialis.
- 46. Nerves of the brachial plexus.
- 47. N. vagus.
- 48. N. phrenicus.
- O. Cut edge of the greater omentum.



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PLATE V

- R 1. First rib.
- R 13. Thirteenth rib.
- 1. Coxal or external angle of the ilium.
- 2. Ischial tuberosity.
- 3. Great trochanter of the femur.
- 4. Sacro-sciatic ligament.
- 5. Coccygeal fascia reflected and section of muscle removed to show coccygeal vertebrae.
- 6. M. splenius.
- 7. M. longissimus dorsi.
- 8. M. levator costarum.
- 9-12. Pectoral muscles.
- 13. Cut edge of diaphragm.
- 14. M. gluteus medius.
- 15. M. biceps femoris.
- 16. M. gemellus.
- 17. Lung.
- 18. Heart, covered by the mediastinum and pericardium.
- 19. Spleen.
- 20. Dorsal sac of rumen.
- 21. Ventral sac of rumen.
- 22. Abomasum.
- 23. Cut edge of omentum.
- 24. Sternal lymph gland.
- 25. Lateral sacral lymph gland.
- 26. Ischiatic lymph gland.
- 27. A. axillaris.
- 28. A. thoracica interna.
- 29. A. glutea anterior.
- 30. Artery to biceps femoris.
- 31. Artery to Mm. biceps femoris, semimembranosus and semitendinosus.
- 32. A. & V. epigastrica anterior.
- 33. N. prescapularis.
- 34. N. radialis.
- 35. Nn. medianus and ulnaris.
- 36. N. ischiadicus.
- 37, 37'. Nerves to M. biceps femoris.



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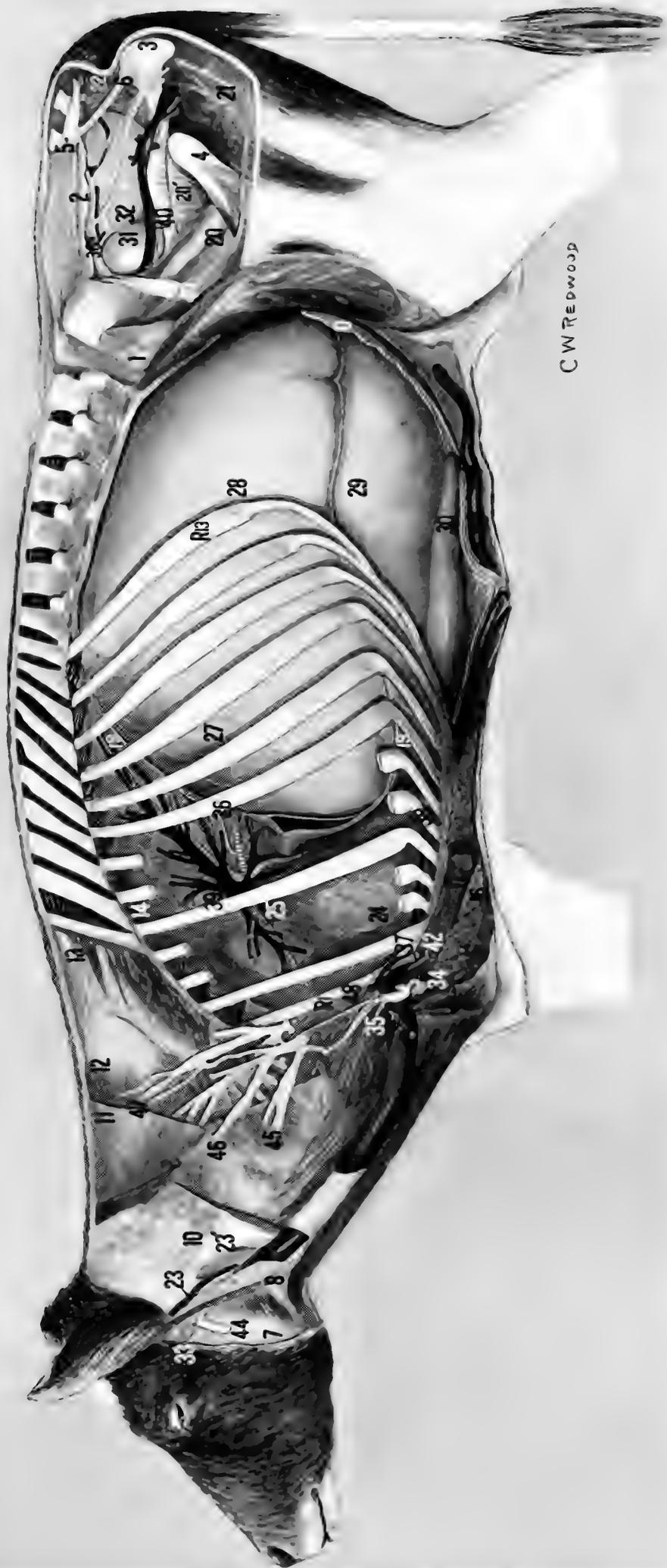
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PLATE VI

- R 1. First rib.
R 13. Thirteenth rib.
1. Coxal or external angle of the ilium.
2. Lateral border of sacrum.
3. Ischial tuberosity.
4. Great trochanter of femur.
5. Coccygeal fascia turned down.
6. Caudal portion of sacro-sciatic ligament.
7. M. masseter.
8. M. parotido-auricularis.
9. M. sterno-cephalicus (sterno-mandibularis).
10. M. brachio-cephalicus.
11. M. trapezius (the rhomboideus was transected beneath the trapezius and therefore does not show).
12. M. splenius.
13. M. longissimus dorsi.
14. M. levator costarum.
15-18. Pectoral muscles.
19, 19'. Cut edge of diaphragm.
20. M. gluteus medius.
20'. M. gluteus profundus.
21. M. biceps femoris.
22. M. coccygeus.
23. Parotid salivary gland.
23'. Dorsal end of submaxillary salivary gland.
24. Heart, covered by mediastinum and pericardium.
25. Left bronchus.
26. Terminal portion of oesophagus from which a portion of the pleura has been removed.
27. Area of rumen to which the spleen is attached.
28. Dorsal sac of rumen.
29. Ventral sac of rumen.
30. Abomasum.
31. Caudal or blind end of caecum, within the pelvic cavity.
32. Rectum.
33. Parotid lymph gland.
34. Axillary lymph gland.
35. Terminal end of thoracic duct.
36. Rectal lymph glands.
37. A. axillaris.
38. A. thoracica interna.
39. Left pulmonary artery.
40. A. and V. pudenda interna.
41. V. jugularis externa; a portion of it is left covered with fascia.
42. V. axillaris.
43. V. epigastrica anterior.
44. N. facialis.
45. N. prescapularis.
46. N. radialis.
47. Nn. medianus and ulnaris.
48. N. phrenicus, showing its two roots of origin.
49. N. ischiadicus.
O. Cut edge of omentum.



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PLATE VII

- R 1. First rib (the middle portion has been removed).
R 9. Ninth rib.
R 13. Thirteenth rib.
1. M. masseter.
 2. M. parotido-auricularis.
 3. M. sterno-cephalicus (sterno-mandibularis).
 4. M. brachio-cephalicus.
 5. M. trapezius (the rhomboideus was transected beneath the trapezius).
 6. M. splenius.
 7. M. longissimus dorsi.
 8. M. levator costarum.
 - 9-12. Pectoral muscles.
 - 13, 13'. Cut edge of diaphragm.
 14. Parotid salivary gland.
 15. Submaxillary salivary gland.
 16. Trachea.
 17. Oesophagus.
 18. Heart.
 19. Reticulum.
 20. Pillar of oesophageal groove. The groove is immediately to the right.
 21. Vertical fold formed by the adjacent walls of the rumen and reticulum. The rumino-reticular orifice is just to the left of 21.
 22. Cavity of rumen.
 23. Abomasum.
 24. Parotid lymph gland.
 25. Mandibular lymph gland.
 26. Left tracheal lymph duct.
 27. Axillary and inferior cervical lymph glands.
 28. Terminal end of thoracic duct.
 29. Thoracic duct.
 30. A. carotis communis.
 31. A. axillaris.
 32. A. thoracica interna.
 33. A. vertebralis.
 34. Aorta.
 35. Pulmonary artery. The ligamentum arteriosum is immediately dorsal to 35 and the left pulmonary artery just to the right of it.
 36. V. jugularis externa.
 37. V. hemiazygos.
 38. V. epigastrica anterior.
 39. N. facialis.
 40. N. prescapularis.
 41. N. radialis.
 42. Nn. medianus and ulnaris.
 43. N. phrenica as it crosses the heart.
 44. Vagus nerve, dividing into dorsal and ventral oesophageal branches.
 45. N. sympathicum.



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PLATE VIII

- L 5. Fifth lumbar vertebra.
- 1. M. psoas magnus.
- 2. M. psoas parvus.
- 3, 3. Cut edge of abdominal wall.
- 4. Portion of dorsal sac of rumen.
- 4'. Rumino-reticular orifice.
- 5. Reticulum.
- 6. Lip of oesophageal groove.
- 7. Omasum.
- 8. Groove from reticulum through the omasum to abomasum.
- 9. Muscular pillar.
- 10. Omaso-abomasal orifice.
- 11. Abomasum.
- 12. Beginning of duodenum.
- 13. Cut end of large intestine.
- 14. Left kidney.
- 15. Loop of large intestine.
- 16. Left adrenal.
- 17. Pancreas.
- 18. Lymph glands.
- 19. Aorta, one centimeter cephalad of the origin of the right external iliac artery.
- 20. Left external iliac artery.
- 21. Dorsal branch of omaso-abomasal artery.
- 22. Common trunk of the left external and internal iliac veins.
- 23. Common trunk of the right external and internal iliac veins.
- 24. V. epigastrica anterior, one on either side.
- 25. Cut end of the ureter; the other ureter shows to the left of the cut end of the large intestine, 13.

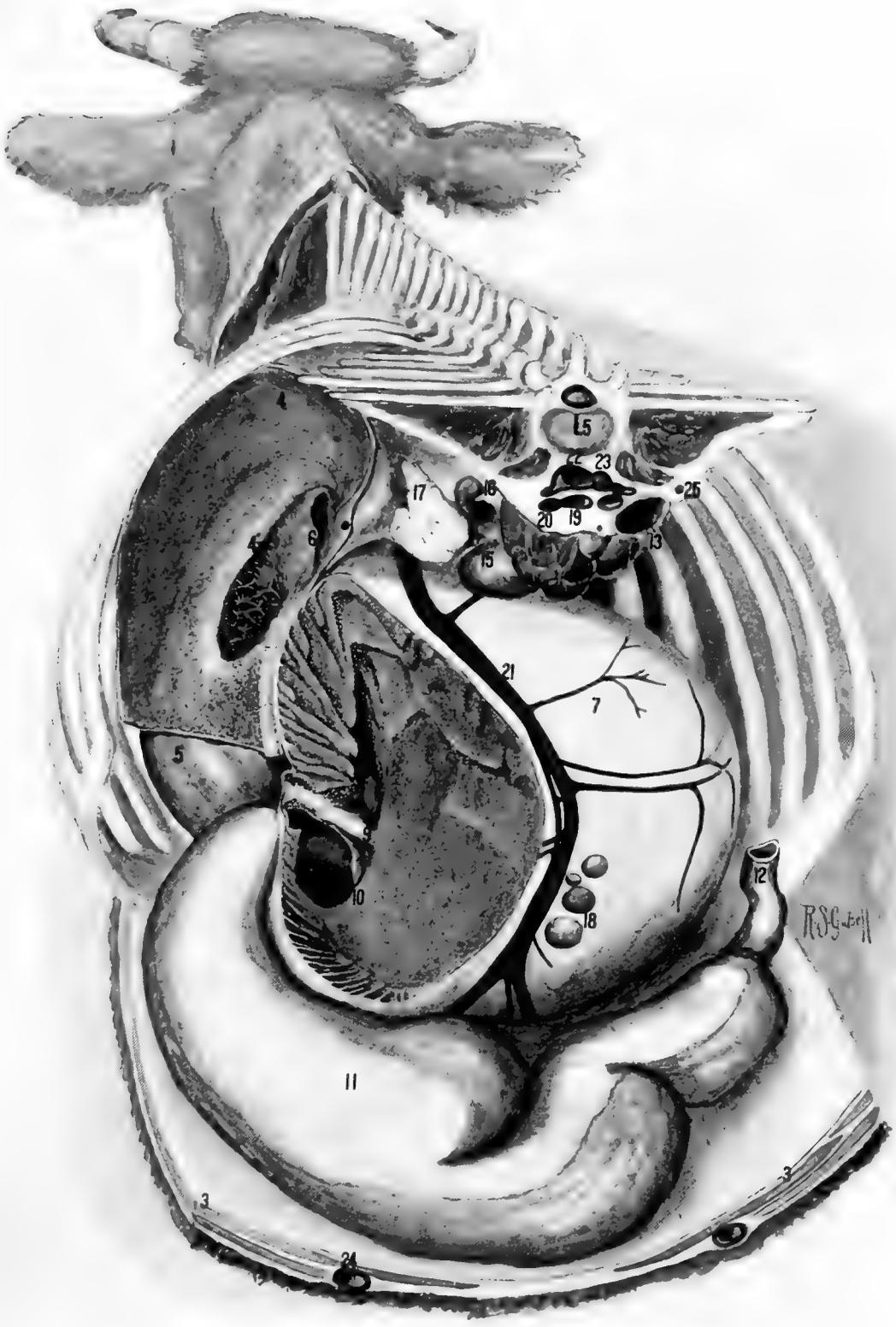


PLATE IX

1. Coxal angle of ilium.
2. Sacral angle of ilium.
3. Cut surface of shaft of ilium.
4. Sacrum.
5. Ischium.
6. Cut surface of pelvic symphysis.
7. *M. obliquus abdominis externus*.
8. Inguinal ligament.
9. *M. cutaneus trunci*.

Fig. 1.

10. *M. coccygeus*.
11. *M. retractor ani*.
12. Portion of sacro-sciatic ligament.
13. Rectum.
14. Cornu of uterus.
15. Urocyst.
16. Ureter.
17. Ovary.
18. Precurral lymph gland.
19. Rectal lymph glands.
20. Supramammary lymph gland, turned up somewhat.
21. Udder, or mammary gland.
22. Posterior branch of circumflex iliac artery.
23. *A. femoralis*.
24. *A. pudenda externa*.
25. *A. profunda femoris*.
26. *A. mammaria*.
27. *A. pudenda interna*.
28. *A. uterina posterior*.
29. *V. femoralis*.
30. *V. mammaria*.
31. *V. mammaria posterior*.
32. *V. epigastrica anterior*.
33. *V. pudenda interna*.
34. *N. femoralis*.
35. *N. ischiadicus*, turned aside.
36. Third sacral nerve.
37. Fourth sacral nerve.

Fig. 2.

10. Portion of *M. tensor fasciae latae*.
11. *M. iliacus*.
12. Portion of *M. sartorius*.
13. *M. coccygeus*.
14. Rectum.
15. Uterus.
16. Urocyst.
17. Ovary, partially covered by the broad ligament of the uterus.
18. Oviduct.
19. Portion of broad ligament of the uterus.
20. Ureter.
21. Portion of sacro-sciatic ligament.
22. Rectal lymph glands.
23. Supramammary lymph gland.
24. Precurral lymph gland.
25. *A. to the rectum*.
26. *A. pudenda interna*.
27. *A. uterina media*.
28. *A. femoralis*.
29. *A. femoris profunda*.
30. *A. mammaria*.
32. Posterior branch of circumflex iliac artery.
33. *V. pudenda interna*.
34. *V. femoris*.
35. *V. mammaria*.
36. *V. mammaria posterior*.
37. *N. ischiadicus*.
38. Third sacral nerve.
39. Fourth sacral nerve.
40. *N. femoralis*.

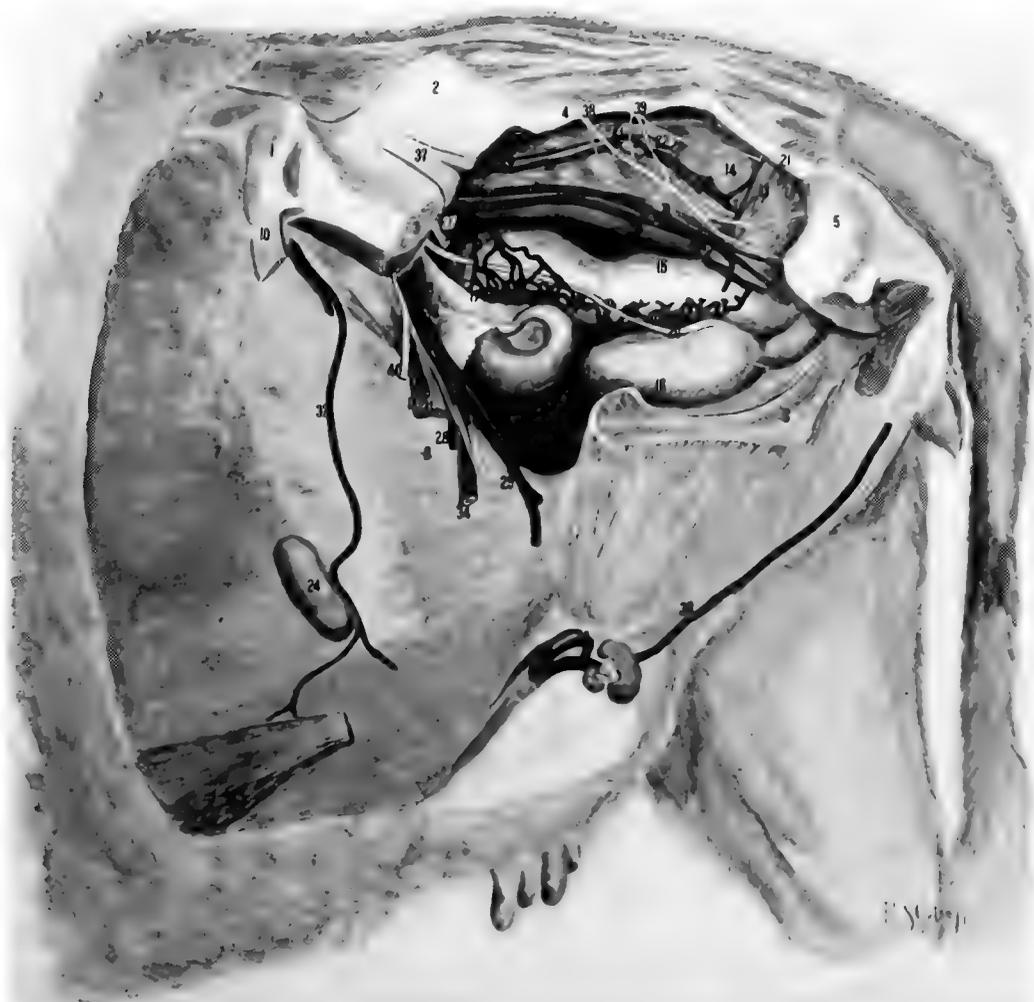
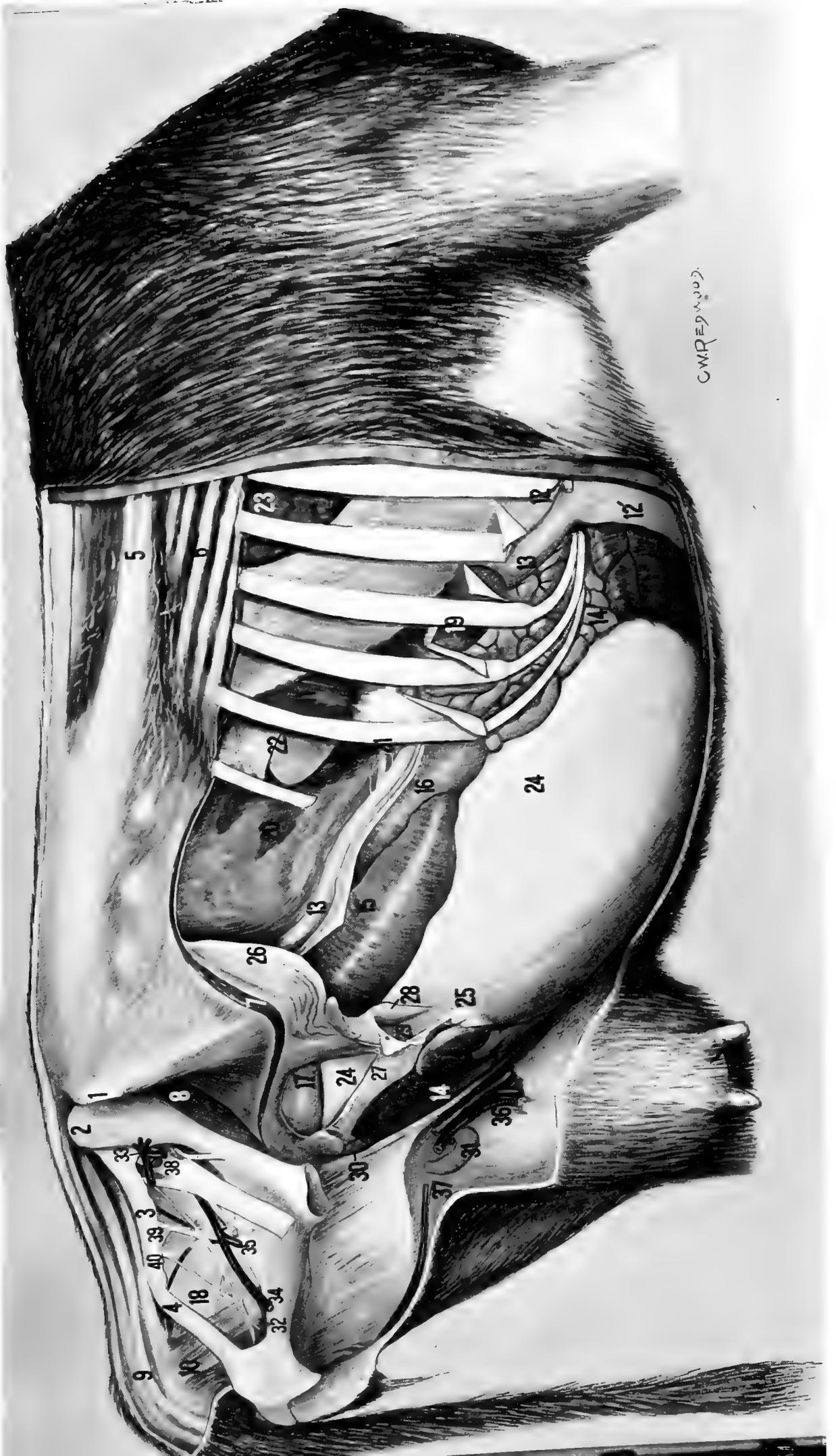


PLATE X

1. Coxal angle of ilium.
2. Sacral angle of ilium.
3. Sacrum.
4. Portion of sacro-sciatic ligament.
5. M. longissimus dorsi.
6. M. longissimus costarum.
7. Cut edge of lateral abdominal wall.
8. M. iliacus cut and a portion of it removed.
9. Coccygeal muscles.
10. M. coccygeus.
11. Diaphragm.
12. Omasum, only a very small portion visible.
- 12'. Pyloric extremity of abomasum.
- 13, 13'. Duodenum.
- 14, 14'. Small intestine.
15. Caecum.
- 16, 17. Large intestine.
18. Rectum.
19. Gall bladder.
20. Pancreas.
21. Pancreatic duct.
22. Liver.
23. Lung.
- 24, 24'. Gravid cornu of the uterus.
25. End of the right cornu of the uterus.
26. Broad ligament of the uterus. A triangular portion has been cut out; through this opening are seen the numerals 17 and 24.
27. Cut edge of broad ligament of the uterus.
28. Right ovary.
29. To the left of 29 is the oviduct and above the numeral is the abdominal orifice of the oviduct, ostium abdominale.
30. Urocyst.
31. Supramammary lymph gland.
32. Ischiatic lymph gland.
33. A. glutea anterior.
34. A. pudenda interna.
35. A. uterina posterior.
36. A. mammaria.
37. V. mammaria posterior (perineale or posterior mammary vein).
38. N. ischiadicus.
39. Third sacral nerve.
40. Fourth sacral nerve.



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