

EXPLANATION OF PLATE XLIV.

Which represents the arteries, veins, and lymphatics of the different layers of the stomach, and the lymphatics of the layers of the small intestine of the dog. (From Franklin P. Mall.)

FIG. 1.—"Reconstruction of a Small Portion of the Middle Zone of the Stomach. The long diameter of the drawing is in the direction of the longitudinal muscle fibres. It was built up from thirty-six drawings, and each drawing is an exact representation of a specimen." Enlarged about 10 times. (a) Mucosa; (b) muscularis mucosae; (c) submucosa; (d) circular muscular layer; (e) longitudinal muscular layer. Arteries, red; veins, blue; lymphatics, brown.

As shown in the drawing the arteries and veins form a coarse network in about the middle of the thickness of the submucosa, and from this meshwork branches pass directly through the circular muscular layer on one side and through the muscularis mucosae on the other. Between the muscular layers another meshwork of vessels is formed, but after passing through the muscularis mucosae the arteries in the dog extend directly into the mucosa and break up into capillaries between and around the glands. In the cat a network of arteries is formed after traversing the muscularis mucosae, and from this network twigs pass into the mucosa and break up into capillaries.

The veins form a network near the free surface of the mucosa. From this first meshwork branches pass down to the muscularis mucosae and there form a somewhat coarser network at the base of the gastric glands. From this mucosal network the vessels penetrate the muscularis mucosae and accompany the arteries.

The lymphatics begin by blind, branched, finger-like vessels between the gastric glands. These finger-like beginnings unite and form a meshwork between mucosa and muscularis mucosae.

Another meshwork is formed on the opposite side of the muscularis mucosae and from that point a coarse network is formed in the submucosa and between the muscular layers. Valves appear in the lymphatics as they penetrate the muscularis mucosae. The vessels penetrate the walls of the stomach and pass to lymphatic glands along the greater or lesser curvature as shown in Plate XLIII.

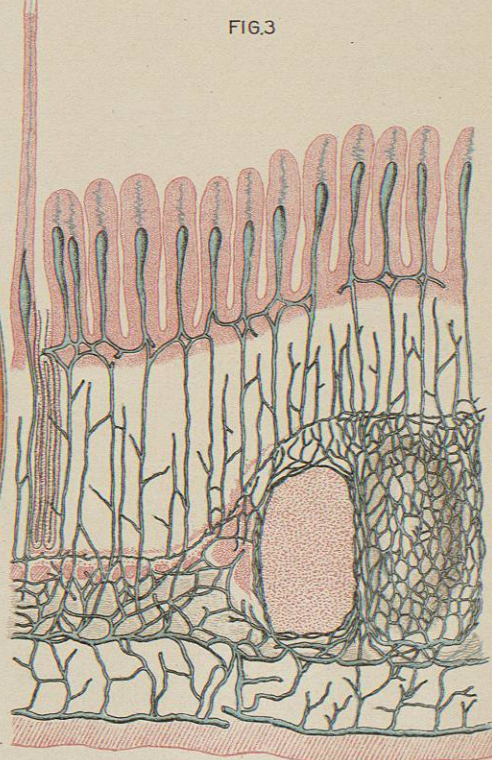
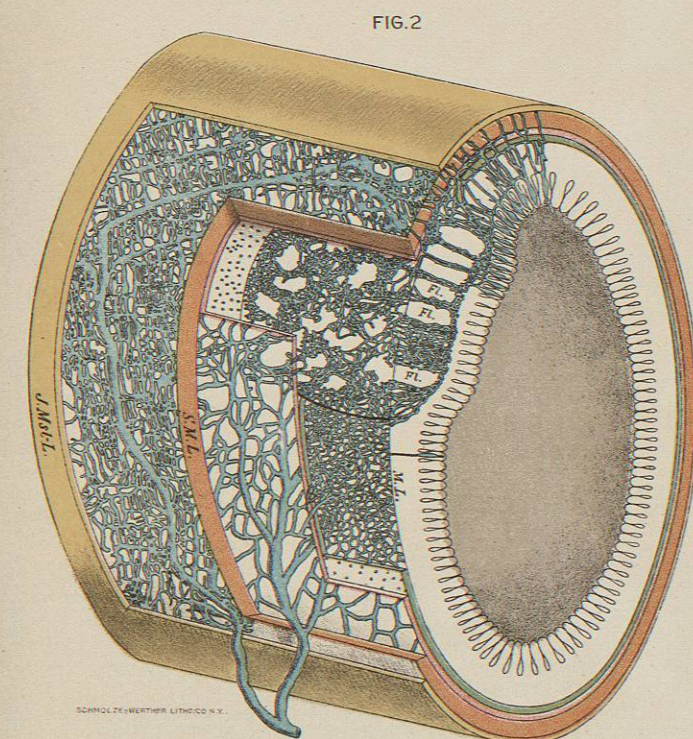
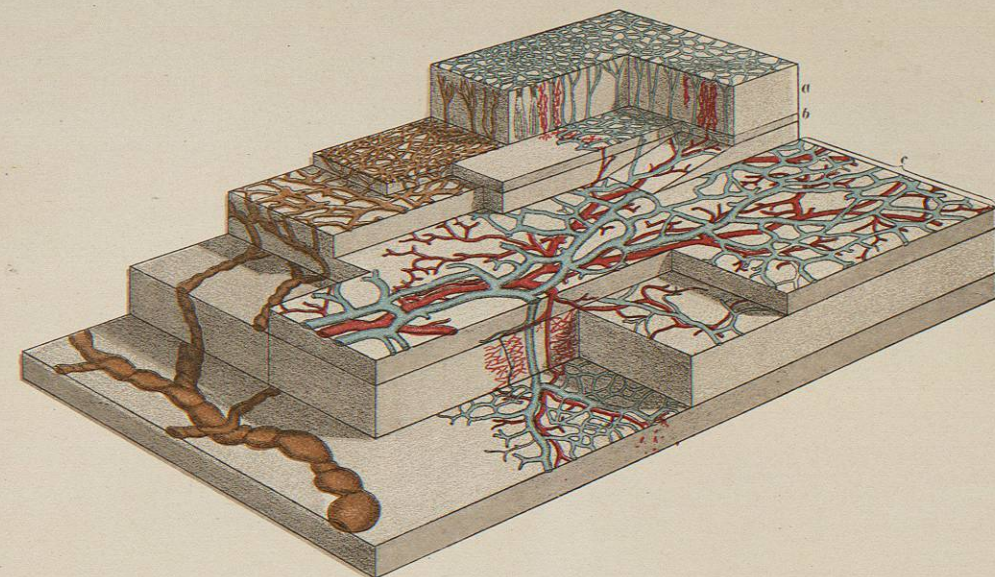
FIG. 2.—Segment of the Small Intestine of a Dog to Show the General Distribution of the Lymphatic Vessels. Mucosa and villi, white; muscularis mucosae, rose green; submucosa, pink; circular muscular layer, orange; longitudinal muscular layer, yellow; lymphatic vessels, blue. (F) Lymph follicles in the mucosa (cf. Fig. 3); (M.L.) mucosal lymphatic network; (S.M.L.) submucosal lymphatic network; (J-M-L) intermuscular lymphatic network. The efferent lymph vessels from the submucosal and intermuscular networks are shown below at the mesenteric side of the mucosa. From this point they pass to the lymphatic glands (cf. Figs. 3272, 3273, 3274).

Some of the villi are represented with the club-shaped central lacteal or lymphatic. It will be noticed also that at the base of the villi there is a lymphatic network, and that in passing from one layer to another at the villi the vessels pursue a nearly straight course (cf. Fig. 3). The passage through the muscularis mucosae is indicated by blue dots, thus giving it a sieve or punctate appearance.

FIG. 3.—Section of the Small Intestine of a Dog to Show the Arrangement of the Lymphatics in the Villi and in the Different Layers. Lymphatics, blue; villi, two crypts of Lieberkühn, muscularis mucosae, a lymph follicle and the longitudinal muscular layer, pink; mucosa and circular muscular layer, white; submucosa and one lymph follicle, gray. One of the villi is shown in an uncontracted condition. The others were strongly contracted by the use of ten-per-cent. nitric acid.

In this figure it well shows the club-shaped central lacteal or lymphatic with a slender, spiral projection extending nearly to the end of the villus (cf. Fig. 3274). In the second villus from the left two central lacteals are shown.

From the network at the base of the villi the vessels extend directly to the mucosal network (Fig. 2, M.L.). From this point on they possess valves. Surrounding the lymph follicles is a dense lymph network. The figure shows also that the muscularis mucosae is not present over the lymph follicles.



Blood Vessels and Lymphatics of the Dog's Stomach
and Lymphatics of the Dog's Small Intestine.
(FROM FRANKLIN P. MALL.)

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any vessels on the surface quickly enter the substance of the organ and accompany the ental blood-vessels. With the horse, ox, and pig, however, there is a true ectal network extending over the entire surface. The collecting trunks pass to the hilus of the organ and terminate in the numerous glands there situated. The efferent trunks from these glands pass to the celiac glands and the intestinal lymphatic trunk, or some may enter the chylocyst directly.

Liver.—The lymphatics of the liver were very early seen, and the efferent trunks from the hilus were, for a long time, supposed to be the continuation of the lacteals to the liver. It has been found that the lymphatic system of the liver is quite as remarkable as the blood supply. In general there are both ectal and ental lymphatic vessels, and the ducts and gall bladder possess a rich supply. The collecting trunks form three great groups and take three main courses, following the portal

or extend to the glands around the postcava as it enters the thorax. On both sides of the suspensory ligament the trunks collect in great numbers, and extend between the folds of the suspensory ligament to the diaphragm, which they penetrate, and enter two or three glands whose efferents join the sternal plexus (14 of Fig. 3275, and 13 of Fig. 3276). Still farther to the left, a group passes round to the postcava as it enters the thorax on the right, still others penetrate the triangular ligament and enter the glands around the oesophagus. Many of the apparently superficial lymphatics of this lobe penetrate the substance of the liver and join the ental lymphatics as with the right lobe. In fact, in most animals this is the normal condition, and a true ectal set of lymphatics is not present. On the concave surface of the liver, many of the surface lymphatics penetrate the liver substance and join the ental lymphatics, but the greater number join the glands in the hilus and thus mingle with

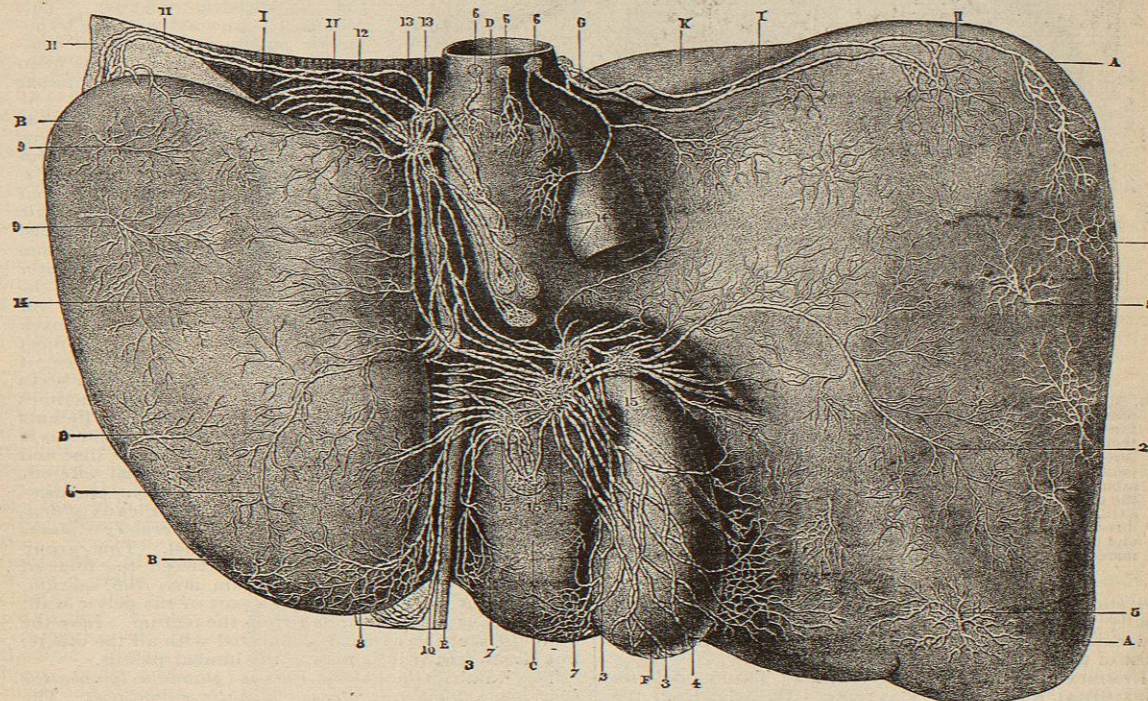


FIG. 3273.—Lymphatics and Lymphatic Glands on the Concave Aspect of the Liver of Man. (Sappey, Atlas.) A, A, Right lobe of the liver; B, B, left lobe; C, quadrate lobe; D, Spigelian lobe; E, round ligament or remnant of umbilical vein; F, cholecyst or gall bladder; G, postcava receiving the hepatic veins just as it traverses the diaphragm; H, left triangular ligament of the liver; I, diaphragm; K, the most projecting part of the convex surface of the liver. 1, 1, Two trunks near the cephalic edge of the right lobe extending to the glands on the postcava just within the thorax; 2, single trunk from the middle of the right lobe to the lymphatic glands in the hilus of the liver by the neck of the cholecyst; 3, 3, trunks upon and at the border of the cholecyst to the glands in the hilus; 4, two vessels having the same origin and termination, but covered by the cholecyst; their course is indicated by the dotted lines; 5, 5, trunks arising on the surface of the right lobe, but penetrating the substance of the liver to accompany the ental vessels; all the vessels from the surface take this course in most animals; 6, 6, 6, trunks from the Spigelian lobe, and the glands around the postcava receiving them; 7, 7, vessels belonging to the quadrate lobe; 8, 8, principal trunks of the left lobe; 9, 9, vessels arising on the surface, but soon entering the liver to join the deep lymphatics like 5 of the right lobe; 10, trunks from the convex surface of the liver following the round ligament and finally entering the glands at the hilus; 11, 11, 12, several trunks from the convex surface of the left lobe, winding over to the concave surface and entering glands in the fissure of the ductus venosus; 13, 13, lymphatic glands in the fissure of the ductus venosus, their efferent vessels extend to the glands in the hilus; 14, glands corresponding to the terminal end of the oesophagus; 15, 15, lymphatic glands receiving the lymphatics from most of the concave surface of the liver and the ental lymphatics following the portal vein.

vessels to the hilus, the hepatic vessels to the postcava, and the suspensory ligament to the diaphragm. The ectal or superficial lymphatics of the convex surface extend in four directions, according to their position. Most of those near the caudal or inferior border penetrate the surface and join the ental lymphatics. In the right cephalic (superior) part, they wind round the border and join the glands at the head of the pancreas,

the ental lymphatics (Fig. 3273). The ental or deep lymphatics, according to Sappey, are divided into two distinct, although anastomosing sets, one set following the portal vessels and bile-ducts, the other the hepatic vessels. Those following the hepatic vessels enter the thorax, traversing some glands on the postcava, and mingling with the ectal lymphatics, follow the pillars of the diaphragm to join the thoracic duct. The lymphat-

ics following the portal veins reach the hilus of the liver, and traverse one or more of the glands there situated (Fig. 3273). From these glands in the hilus, branches extend to the glands in the lesser curvature of

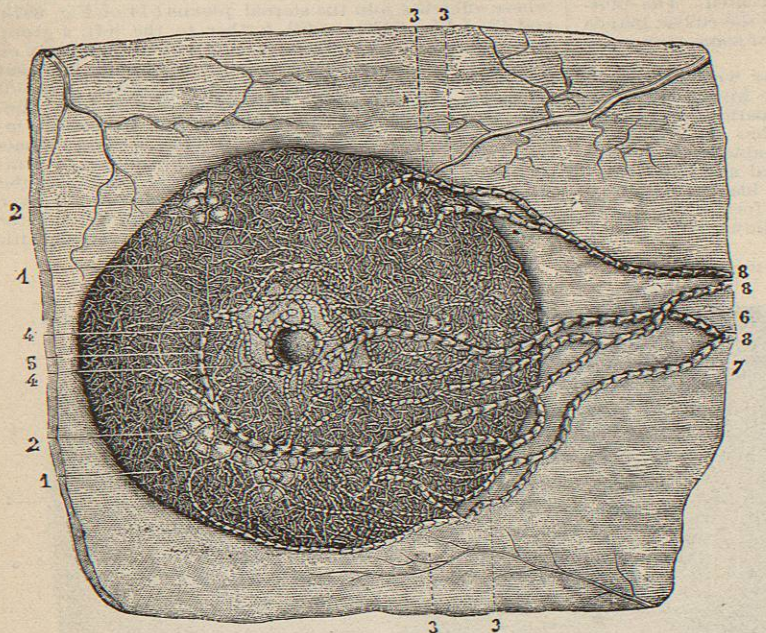


FIG. 3274.—Left Mammary Gland of a Woman during Lactation. The skin and adipose tissue have been removed to bring the lymphatics plainly into view. At three of the corners of the figure blood-vessels are represented. (Sappey, Atlas and Anat.) 1, 1, Network of lymphatics so dense that they make almost a continuous layer. The entire gland is filled throughout in this way; 2, 2, truncules surrounding the lobules, the finer network being omitted; 3, 3, 3, large trunks at the border of the gland; 4, 4, network of large vessels around the nipple; they originate in the depth of the mamma; 5, 5, great trunk arising at the mesal side of the nipple, and extending across the gland and pectoral region to the axillary lymphatic glands; 6, large trunk from the lateral aspect of the nipple extending directly toward the axilla; 7, large trunk from the caudal (inferior) border of the mamma, and uniting with the preceding on its way to the axilla; 8, 8, the two great trunks from the mammary gland going to terminate in the axillary lymphatic glands.

the stomach, and to those on the splenic vessels; but finally all pass to the celiac glands, and then some branches may enter the chylocyst independently, but most of them join the intestinal trunk.

LYMPHATIC GLANDS, PLEXUSES, AND TRUNKS OF THE ABDOMINAL AND PELVIC CAVITIES.—The glands in the abdominal and pelvic cavities form a continuous network from the inguinal glands to those in the oesophageal opening; they also extend out on the great vessels of the viscera. Although there are no sharply defined limits and limited grouping of the two hundred to four hundred glands in this part of the body, groups have been made as in the neck for convenience. Following Krause, the following groups may be recognized, commencing with the iliac region: (1) Iliac; (2) hypogastric; (3) sacral; (4) lumbar; (5) mesenteric, including those of the mesocolon; (6) celiac. Each of these groups of glands with the connecting vessels is also called a plexus. As the efferent vessels of all these groups unite to form the chylocyst and thoracic duct by three main trunks, these also have received names: (1, 2) The two lumbar trunks (a *truncus lymphaticus lumbalis* of each side) from the iliac, hypogastric, sacral, and lumbar plexuses, and (3) a single trunk (*truncus lymphaticus intestinalis*) from the mesenteric and celiac lymphatic plexuses. As was remarked in discussing the cervical glands, different authors may assign a collecting trunk from an organ to different groups of glands, although the same gland is meant. As the di-

vision into groups is artificial, and the glands vary considerably in position and in different individuals, even in number, this confusion is probably inevitable.

The iliac lymphatic glands and plexus (*glandula iliaca, s. iliaca, s. anteriores; plexus lymphaticus iliacus, s. iliacus externus, s. anterior*) form a chain along the external and common iliac blood-vessels. At the crural ring this plexus is continuous with the inguinal plexus. The afferent vessels are from the inguinal plexus, those accompanying the internal epigastric and circumflex iliac blood-vessels, those from the vesiculae seminales and the body of the uterus (those from the last two sources are often said to extend to the hypogastric plexus). This plexus is connected with the hypogastric and sacral by several communicating branches, but the main efferent trunks pass to the lumbar plexus.

Hypogastric Glands and Plexus (*glandula lymphatica hypogastrica, s. iliaca interna, s. pelvina; plexus hypogastricus, s. iliacus internus, s. pelvinus*). These are on the sides of the pelvis, around the hypogastric and internal iliac blood-vessels. The afferent lymphatics are from the gluteal, sciatic, and obturator vessels, part of the spermiduct, the prostate, urocyt, most of the vagina, the uterine mucosa, and neck of the uterus. According to most authors, the ental lymphatics of the external genitalia in both sexes pass to these glands. Sometimes also part of the inguinal efferents pass to this group. This plexus is closely connected with the iliac and sacral, but its principal efferent trunks pass to the lumbar plexus.

Sacral Glands and Plexus (*glandula lymphatica sacralis; plexus lymphaticus sacralis*). This group of glands is between the folds of the mesorectum next the sacrum.

The afferent vessels come from a part of the pelvic wall, and the vertebral canal, and from the rectum. Like the other pelvic plexuses it is connected with all the others, but its efferent trunks pass to the lumbar plexus.

The Lumbar Glands and Plexus (*glandula lymphatica lumbales, s. lumbares; plexus lymphaticus lumbalis*). The lumbar glands form three irregular rows, one mesal and two lateral, extending along the great blood-vessels from the bifurcation of the aorta nearly to the origin of the superior mesenteric artery. Its afferent vessels are the efferent trunks from the iliac, hypogastric, and sacral plexuses, lymphatics accompanying the ilio-lumbar and part of the lumbar blood-vessels, those from the testis, spermiduct in part, ovary, summit of uterus, Fallopian tubes, kidney, adrenal, and most of the colon descendens. It is also connected by a greater or less number of communicating branches with the celiac plexus. Its efferent vessels unite to form two principal trunks, a right and left lumbar lymphatic trunk (*truncus lymphaticus lumbalis*), which with the intestinal trunk form the chylocyst, the enlarged beginning of the thoracic duct.

Celiac Glands and Plexus (*glandula lymphatica celiaca; plexus lymphaticus celiacus*). The celiac plexus is situated along the celiac vessels, the portal vein and the beginning of the superior mesenteric artery on the dorsal side of the pancreas, duodenum, and pylorus. This group was formerly reckoned as part of the lumbar plexus. The efferent lymphatics come from the stomach,

part of the oesophagus and duodenum, part of the liver, the pancreas, and spleen. The efferent vessels join the intestinal trunk, or sometimes one or more branches pass directly to the chylocyst.

Mesenteric Glands and Plexus (*glandula mesenterica, s. mesaraica; plexus lymphaticus mesentericus, s. mesaraicus*). The mesenteric glands and plexus (one hundred to two hundred) lie along the blood-vessels between the folds of the mesentery and the meso-colon. They are usually in three irregular tiers, one tier being near the intestine, one near the middle, and one near the root of the mesentery. The afferent vessels are from the small intestine, except part of the duodenum, and the large intestine to the sigmoid flexure. The efferent vessels receive the efferent trunks from the celiac plexus, and then terminate in the chylocyst as the intestinal trunk (*truncus lymphaticus intestinalis*).

As will be seen by a glance at Figs. 3281-3286, the lymphatics and the glands in the abdominal cavity of the dog, cat, and rabbit are essentially as in man, but there is a great concentration of the glands, so that the groups are well defined. No sacral glands were certainly found in any of them.*

LYMPHATICS OF THE THORAX.—The thoracic lymphatics are divisible into three fairly distinct, although communicating, groups: (1) Those of the skin and other surface structures; (2) the ental lymphatics of the thoracic walls, including the diaphragm; (3) the lymphatics of the thoracic viscera—heart, lungs, trachea, and oesophagus.

*Sappey describes and figures in his Atlas (Plate XLVIII, Fig. 111) the lumbar trunks in the rabbit and the trunks from the ovary entering them without traversing any glands. He says further concerning the lumbar trunks, in describing the figure: "Gros troncs lymphatiques provenant des membres postérieurs et du bassin; ils se rendent directement dans l'origine du canal thoracique sans avoir traversé dans leur trajet aucun ganglion [lymphatique]." Such a condition was never observed by the writer in any of the white rabbits dissected.

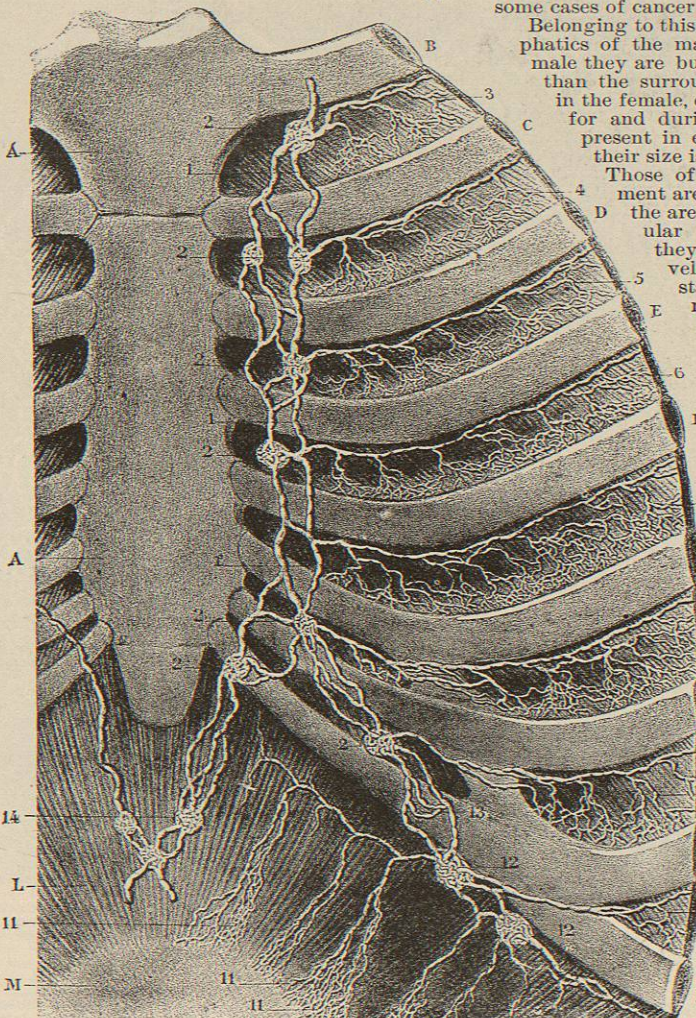


FIG. 3275.—The Ental or Pleural Aspect of the Sternum, Parts of the Ribs and the Diaphragm, to show the Sternal Plexus. (Sappey, Atlas.) A, A, Sternum; B to K, the first nine ribs; L, M, the ventral part of the Diaphragm, part of the central tendon being shown at M; 1, 1, 1, 1, 2, 2, 2, the sternal plexus of lymphatic glands and the connecting vessels; 3 to 10, lymphatic network and trunks in the intercostal spaces. The trunks extend along the caudal margin of the ribs to reach the sternal glands. These trunks are directly continuous dorsad with the intercostal plexus (cf. Fig. 3280); 11, 11, vessels on the pleural surface of the diaphragm, finally extending to the sternal glands; 12, 12, 13, sternal glands opposite the eighth and ninth ribs and their efferent trunks; 14, glands receiving the lymphatics from the suspensory ligament of the liver.

The ectal lymphatics, like those of the abdomen, are quite sharply divided into those of the right and those of the left side, although on both the dorsi- and ventri-meson the vessels interdigitate.

The beginning of many of the subcutaneous trunks of the thorax is likewise from an oblique zone surrounding the body at about the level of the umbilicus (Fig. 3269), and there is a somewhat similar, although less clearly defined, limiting zone between the neck and thorax. The collecting trunks extend in the most direct manner to the axillary lymphatic glands (Fig. 3269). Part of those, however, in the subclavicular and adjoining pectoral regions pass to the supraclavicular glands. This is supposed to explain the involvement of these glands in some cases of cancer of the breast.¹

Belonging to this ectal group are the lymphatics of the mammary gland. In the male they are but little more developed than the surrounding integument; but in the female, especially in preparation for and during lactation, they are present in enormous numbers, and their size is also greatly increased.

Those of the mammary integument are especially numerous in the areola, but it is in the glandular substance itself that they reach their highest development. From the substance of the gland they reach the surface in four places, and extend as four principal trunks toward the axilla, but most often unite to form two large trunks before entering the axillary glands. Most authors assign part of the lymphatics of the breast to the internal mammary or sternal plexus, but Sappey states that the course is as described above.

Besides the lymphatics from the mammary glands, many of those from the ectal muscles pass to the axillary glands. These trunks pass along the great pectoral muscles and the vasa thoracica longa, and usually traverse a few small glands (pectoral glands) in their course.

The lymphatics of the diaphragm were discovered by Rudbeck, and fully described by Nuck. They are among the most easily demonstrated of any in the body, and from the thinness of the diaphragm and the clearness with which the lymphatics may be fol-