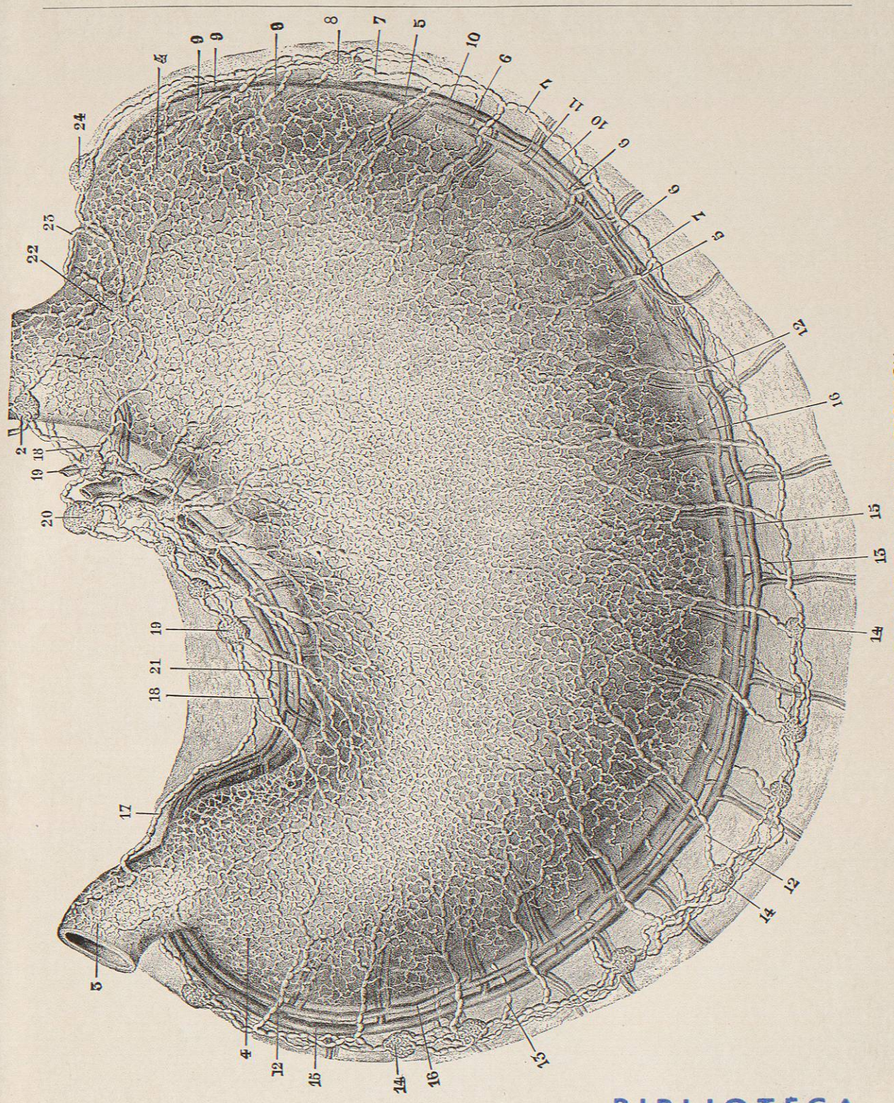
EXPLANATION OF PLATE XLIII.

Which Represents the Lymphatics of the Human Stomach. (Sappey, Atlas.)

1, Gastric end of the œsophagus; 2, lymphatic gland receiving part of the œsophageal lymphatics; its efferent vessels extend to the glands around the coronary blood-vessels and there join those from the stomach; 4, 4, fine network of vessels in the muscularis of the stomach; 3, the beginning of the duodenum; 4, 4, fine network of lymphatic vessels in the muscularis; from this fine network arise all the collecting trunks of the muscular coat; 5, 5, 5, lymphatic trunks on the left part of the great curvature; 5, 5, 6, 6, lymphatic vessels from the dorsal and ventral surfaces of the left third of the great curvature; 7, 7, 7, the principal trunk encircling the left half of the great curvature of the stomach; it receives the branches from the stomach and extends toward the left to enter a large gland (8) situated near the tail of the pancreas and the hilus of the spleen; 8, gland at the left of the stomach near the hilus of the spleen; it receives trunks from both directions, also some from the spleen; 9, trunks from the extreme left of the stomach to the gland marked 8; 10, vena gastro-epiploica sinistra; 11, arteria gastro-epiploica sinistra; 12 and 13, trunks from the dorsal and ventral aspect of the pyloric region; 14, 14, 14, the chain of glands on the right along the great curvature; through these pass all the lymphatics from the half next the greater curvature. The efferent trunks from these glands finally extend to the glands at the head of the pancreas; all the glands in the chain around the great curvature are sometimes designated as the *glandulæ lymphaticæ gastro-epiploicæ inferiores*. They lie in the great omentum, and form part of the cœliac lymphatic plexus; 15, 16, vasa gastro-epiploica dextra; 17, trunk from the duodenum and the pylorus to the glands along the lesser curvature; 18, 18, trunks extending to the lesser curvature; 19, 19, the lymphatic glands along the gastric coronary vessels in the lesser curvature (*glandulæ lymphaticæ gastro-epiploicæ superiores*); they receive all the so-called ascending trunks from the stomach and some of the trunks from the œsophagus; they form part of the cœliac lymphatic plexus; 20, the large cœliac gland to which the efferent vessels from 19 extend; 21, vasa coronaria gastrica; 22, gland, often double, on the ventral aspect of the cardia; 23, large trunk winding round the cardia and joining the trunk to 22 and 24; 24, gland, sometimes double, at the extreme left of the great curvature.



LYMPHATICS OF THE HUMAN STOMACH
(SAPPEY, ATLAS)

follow the blood-vessels, and finally terminate in the lumbar glands near the end of the spermatic vein.

The lymphatics of the testis of a mature animal are exceedingly easy to inject by the puncture method, and the collecting trunks accompanying the spermatic vein are so prominent, straight, and well supplied with valves that they are among the most striking of the lymphatic trunks in the body.

The lymphatics of the spermiduct are abundant at the ends, but very few along the middle part. Those from the testicular half follow the lymphatics of the testis, while those from the other half join the lymphatics of the vesiculæ seminales. The lymphatics of vesiculæ seminales form a close network, which was first described by Hewson; they unite into two principal trunks. Those next the spermiduct join the lymphatics of the latter, and together they enter one of the iliac glands. The other trunk passes between the prostate and vesiculæ seminales, so as to join an iliac gland. The lymphatics of the prostate were discovered and described by Sappey in 1854, who found them abundant, and with two collecting trunks on each side. One of the trunks passes quite directly to one of the hypogastric glands, while the other extends upon the walls of the urocyst, or urinary bladder, and then curves to the side to enter a hypogastric gland. The trunks extending upon the urocyst were mistaken by Mascagni and Cruikshank for the lymphatics from the bladder itself.

Internal Female Genitalia—Vagina, Uterus, Fallopian Tubes, and Ovaries.—As described above, the external or inferior fourth of the vagina sends its lymphatics to the ectal inguinal glands; from the remaining three-fourths the collecting trunks extend toward the uterus, penetrate the walls of the vagina, and traverse the utero-vaginal lymphatic gland on the way to the hypogastric glands. Up to the present, no lymphatics have been demonstrated in the muscular wall of the vagina in the human being, but their presence has been shown in that of the large domestic animals.

The uterine lymphatics are naturally divided into those of the mucosa and those of the muscularis. Those of the mucosa are difficult or impossible to demonstrate in a gravid uterus, and often so in a non-gravid adult uterus, and Sappey states that he never succeeded in demonstrating them in the uterine mucosa of any of the lower animals. It is only in girls before puberty that these lymphatics are demonstrable by the ordinary methods. No doubt they exist in the adult woman, and also in the uterine mucosa of the lower animals, but they have not been satisfactorily demonstrated. When demonstrated in a child they showed a delicate network whose collecting trunks traverse the walls of the neck of the uterus and enter the utero-vaginal lymphatic glands (15 and 16, of Fig. 3271). At the os uteri they are continuous with those on the vaginal part of the uterus and the vaginal mucosa.

The lymphatics of the uterine walls are numerous and easily demonstrated in most animals. The collecting trunks extend laterally in the broad ligament on each side to three different groups of glands; those from the summit follow the Fallopian tubes out to the ovary, where they join the ovarian network, and accompany the collecting trunks of the ovary to the lumbar glands around the termination of the ovarian veins (Fig. 3271). Those from the body of the organ extend across the broad ligament, curve round the Fallopian tubes, and enter the iliac glands; while those from the cervical region extend with those from the utero-vaginal glands to the hypogastric plexus.

Lymphatics have been demonstrated only on the uterine and ovarian ends of the Fallopian tubes. But it is probable that they are present throughout the whole extent. The collecting trunks accompany the ovarian lymphatics.

The lymphatics of the ovary, like those of the testis, are in prodigious numbers, and are very easily injected. The collecting trunks are very long and straight and accompany the ovarian vein, and consequently those on the left are opposite the hilus of the kidney (Fig. 3271).

In the lower animals, so far as has been investigated, the lymphatics of the internal genitalia agree in all essential particulars with those of the human being. In the dog, cat, and rabbit, while the ovarian and testicular lymphatics follow the same general course, they almost always enter the lumbar glands, and therefore do not follow the spermatic or ovarian veins to their termination (Fig. 3281, 21, 22).

Urinary Organs and Adrenal.—Up to the present time all efforts to demonstrate lymphatics in the mucosa of the urocyst or urinary bladder have failed both with men and with animals, but the muscular coat has been shown to be plentifully supplied. The vessels form a wide-meshed network at the summit and on the body. This network unites into one or more trunks on each side, and the trunks extend nearly or quite to the neck when they turn aside and enter the hypogastric lymphatic glands. The trunks described by Cruikshank and Mascagni as urocystic lymphatics were really from the prostate. Sappey succeeded only once in injecting them in man, but almost constantly in the dog and rabbit.

The muscularis of the ureters has been shown to possess lymphatics in the horse, but all attempts to demonstrate them in the mucosa have failed. Although not demonstrated in man they are presumably present.

The lymphatics of the kidney form an ectal network over the surface and an ental network in the substance of the organ. The trunks were first seen in 1532 by Massa, but first described carefully by Nuck in 1590. Those of the surface form a wide-meshed network, the collecting trunks of which extend in part directly toward the hilus of the kidney and join the ental lymphatics and part extend toward the convex border and then wind round the ends to the hilus. Next the adrenal the lymphatics of the two organs are closely connected. The ental lymphatics follow the blood-vessels and terminate in a group of the lumbar glands situated on the renal vessels.

Although the blood-vessels of the adrenal have been long known, the lymphatics were not so early discovered. It is now known that the lymphatics are as abundant as the blood-vessels, extending throughout the substance as well as upon the surface. The collecting trunks, many of them join those of the kidney, and all extend to a gland near the junction of the adrenal and kidney (5, 6, of Fig. 3271).

Lymphatics of the Intestine and Stomach.—Throughout the entire alimentary canal, it has been shown that where a distinct muscular coat exists the lymphatics form two layers or sets, one in the mucosa, including the submucosa, and one in the muscularis. In those parts supported by duplicatures of serosa (mesenteries) the finer network of the mucosa proper extends to a coarse and characteristic network in the submucosa (Fig. 3298), and finally the collecting trunks penetrate the wall at the attached edge and join the lymphatics of the muscularis. The lymphatics of the muscularis are throughout its entire thickness, but soon become subserous and wind round to the attached edge, and with those from the mucosa extend between the layers of the supporting membrane mostly in company with blood-vessels to lymphatic glands, which are also situated between the serosal walls (Fig. 3272, 2, 3, 4; Plate XLIV.).

The intestinal lymphatics at the anus are directly continuous with those of the skin. The trunks from the muscularis and mucosa of the rectum extend between the folds of the mesorectum, often traversing minute glands in their course, and then enter the sacral lymphatic glands and ultimately go to the lumbar glands on their way to the chylocyst. The lymphatics of the main part of the *colon descendens* pass to the lumbar lymphatic plexus. Those of the *cæcum, colon ascendens et transversum*, also part of the *colon descendens* pass through one or more of the numerous mesocolic glands and then enter the mesenteric glands and mingle with the lacteals from

the small intestine, and with these go through the *truncus intestinalis* to the chylocyst.

Lacteals.—The lymphatics of the small intestine are usually called lacteals or chyle vessels, from the fact that during digestion they have a cloudy or milky appearance owing to the contained chyle (Figs. 3292, 3293, 3294, 3300).

As the small intestine has two planes of lymphatics like the rest of the alimentary canal, it is really only those of the mucosa which absorb and convey the chyle, and which, therefore, should properly be denominated lacteals, as those from the muscularis always convey lymph only. A further and finer distinction still has been made by Sappey,[1] who holds that the vessels of the intestinal villi are the only ones which absorb the chyle, and they do nothing else, so that they alone are the true lacteals, and that the other lymph vessels of the mucosa and submucosa, including those from the Peyerian patches and other lymphoid tissue, should be considered simply lymphatics, as they take no part in the absorption of the chyle. The submucosal network simply receives the chyle poured into it by the lacteals of the villi. As stated above, this is not the common view. It is ordinarily believed that the lacteals contain lymph like other lymphatics, except during digestion. It is also common to call all the vessels from the small intestine lacteal vessels, without regard to their origin from the muscularis or the mucosa. Whatever the origin, all the vessels unite at the attached border and extend to the nearest gland, where their contents are mixed, so that usually all the collecting trunks in the mesentery appear milky and are called lacteals or chyle vessels, although some of them might really have come from the large intestine. In man there are usually several tiers of mesenteric glands through which the chyle passes before finally emptying into the large trunk along the superior mesenteric artery. This trunk, which also receives the efferent vessels of the cœliac and mesocolic glands (*truncus lymphaticus intestinalis*), is either single or multiple, and forms one of the most important constituents of the chylocyst (Figs. 3281–3287).

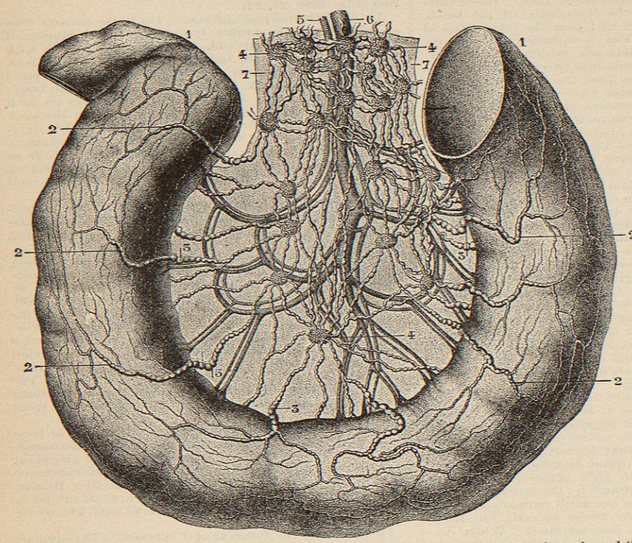


FIG. 3272.—Loop of the Small Intestine of Man, to show the Mesenteric Glands and Blood-vessels, and the Lymphatics from the Muscularis. (Sappey, Atlas.) 1, 1, The ends of the loop of intestine; 2, 2, 2, 2, 2, 2, lymphatic vessels arising in the muscular layer; 3, 3, 3, swellings or enlargements in these vessels near the mesenteric edge of the intestine; 4, 4, 4, mesenteric glands along the course of the lymphatics; 5, branch of the superior mesenteric artery; 6, mesenteric vein; 7, the mesentery.

Stomach.—The lymphatics of the stomach are continuous with those of the œsophagus and duodenum. Those of the muscularis form a most beautiful network throughout the entire thickness of the coat; the collecting trunklets penetrate the tissue and become subserous, and from an intermediate area on both faces extend to the nearest of the chain of lymphatic glands, extending almost around both curvatures; those in the lesser curvature being known as the *glandulæ lymphaticæ gastro-epiploicæ superiores*, and those around the great curvature as the *glandulæ lymphaticæ gastro-epiploicæ inferiores* (Plate XLIII.). The lymphatics of the gastric mucosa form a remarkable network throughout the entire thickness of the coat, being very fine in the mucosa proper and coarser in the submucosa. The collecting vessels penetrate the muscularis along the curvatures, join those of the muscularis, extend to the same glands, and finally to the intestinal lymphatic trunk (Plate XLIV.).

Pancreas.—The lymphatics of this organ are difficult to demonstrate, but when well injected are found to form a fine network around the tubules, and the collecting trunks emerge quite directly to the surface, and form upon the surface a round-meshed, rather coarse network around the lobules. From this network vessels extend in three directions—part of them going to the tail or splenic end of the pancreas to join the glands at the hilus of the spleen, part to the gastric edge of the pancreas to enter some of the numerous glands along the course of the splenic vessels, and still others extend toward the duodenum to enter a large gland which also receives part of the lymphatics of the duodenum. The lymph finally reaches the intestinal trunk after traversing one or more of the cœliac glands. No lymphatics have been demonstrated in the pancreatic ducts.

Spleen.—The lymphatics of the spleen are in enormous numbers. Their origin seems to be from the lymph follicles so abundant throughout the organ. According to Sappey, the usual division of the lymphatics into a superficial and deep set does not hold with man, in whom

EXPLANATION OF
PLATE XLIV.

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 mucosæ; (*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 mucosæ on the other. Between the muscular layers another meshwork of vessels is formed, but after passing through the muscularis mucosæ 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 mucosæ, and from this network twigs pass into the mucosa and break up into capillaries.

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

Another meshwork is formed on the opposite side of the muscularis mucosæ 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 mucosæ. 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 mucosæ, blue-green; submucosa, pink; circular muscular layer, orange; longitudinal muscular layer, yellow; lymphatic vessels, blue. (*Fl*) Lymph follicles in the mucosa (cf. Fig. 3); (*M.L.*) mucosal lymphatic network; (*S.M.L.*) submucosal lymphatic network; (*J–Msl–L*) intermuscular lymphatic network. The efferent lymph vessels from the submucosal and intermuscular networks are shown below at the mesenteric edge of the intestine. From this point they pass to the lymphatic glands (cf. Figs. 3272, 3281–3286).

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 of the intestines the vessels pursue a nearly straight course (cf. Fig. 3). The passage through the muscularis mucosæ 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 mucosæ, 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 retracted by the use of ten-per-cent. nitric acid.

In this figure is well shown the club-shaped central lacteal or lymphatic with a slender, spiral projection extending nearly to the end of the villus (cf. Fig. 3294). 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 mucosæ is not present over the lymph follicles

FIG. 1

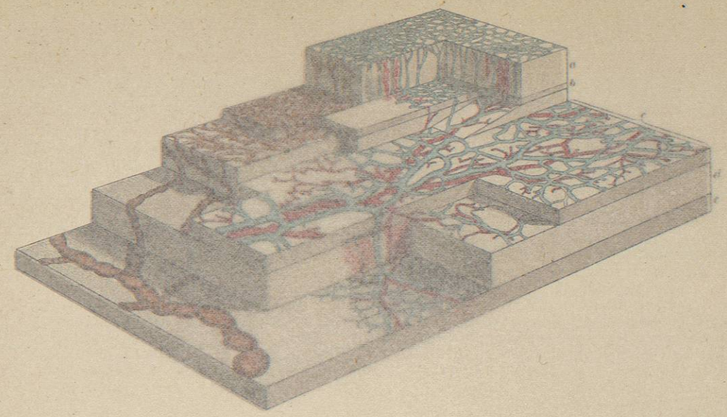


FIG. 2

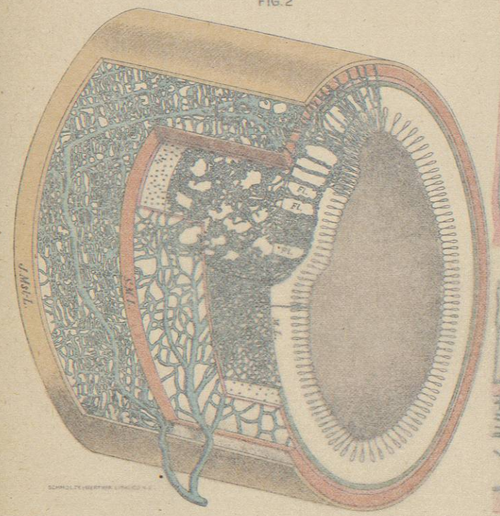
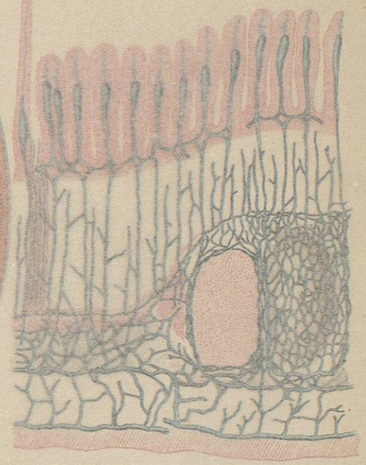


FIG. 3



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