arches along the curvaturæ minor et major, from which the smaller branches to the organ are derived. That

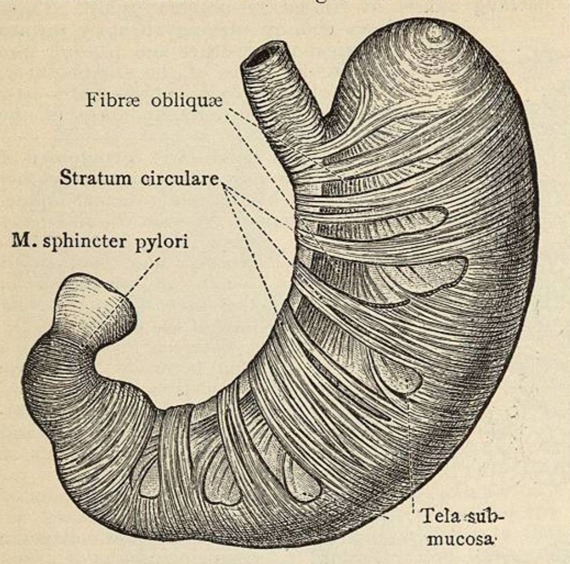


FIG. 4512.—The Middle and Internal Layers of the Tunica Muscularis of the Stomach. Stratum circulare and fibræ obliquæ. The stratum circulare has been removed in places. (After C. Toldt, "Anatomischer Atlas," Zweite Auflage.)

along the lesser curvature is formed by the union of the right gastric branch (arteria gastrica dextra) of the arteria hepatica with the left gastric artery (arteria gastrica sinistra); that of the greater curvature, by the union of the right and left gastro-epiploic arteries (arteriæ gastro-epiploicæ dextra et sinistra) derived from the hepatic and splenic arteries. In addition, the fundus ventriculi receives a number of short branches (arteriæ gastricæ breves) from the arteria lienalis. The large vessels formed by these anastomoses may be compared, according to Mall, to the vascular arches of the mesenteric arteries.

From the arches thus formed branches come off which penetrate the tunica muscularis at the curvatures, and are distributed in the tela submucosa of both surfaces of the organ. These branches in the submucosa are, in the dog, according to Mall, of various sizes, being smallest and most numerous in the pyloric region and fundus, largest in the middle zone. They pass in a circular direction around the stomach, branching and anastomosing freely to form a fine plexus of vessels, located at about the middle of the tela submucosa. From this plexus vertical branches arise which pass through the lamina muscularis mucosæ at very regular intervals and supply the mucous membrane. As soon as the bases of the glands are reached, each of these vessels breaks up into radiating branches (the stellate arteries), which in some animals form a second plexus within the deepest portion of the mucous membrane.

From these stellate arteries arise numerous capillaries which form a dense network with elongated meshes, surrounding the gastric glands from the bases to their necks. As the capillaries approach the openings of the glands, they begin to collect into larger vessels, which in turn communicate with a plexus of veins located under the epithelium. Thus the deeper layer of the mucous membrane receives the blood in a more arterial condition than do the superficial layers.

The subepithelial venous plexus is composed of small vessels which form a network of meshes surrounding the foveolæ near the openings. From this plexus larger veins pass vertically to join the subglandular plexus at the outer edge of the mucous membrane just internal to the lamina muscularis mucosæ. From this second venous plexus branches pass to the tela submucosa, which join one another and communicate finally with the submucous plexus of large veins. The veins which form the submucous plexus correspond in their distribution very closely to the vessels of the arterial plexus. Each large artery has, as a rule, two accompanying veins, the smaller arteries one. The arteries are, as a rule, more superficial than the veins and smaller in size.

The tunica muscularis is supplied, to a limited extent, along the greater and lesser curvatures by branches which come from the arteries as they pass through to the submucosa. The great bulk of the muscular coat, however, is supplied with blood by means of recurrent branches from the plexus of vessels in the submucosa. These branches pass directly outward from the submucous plexus through the stratum circulare, to the intermuscular layer, where they form a plexus the meshes of which are for the most part elongated in the direction of the fibres of the stratum longitudinale. From this plexus and from the recurrent arteries which form it are given off branches which break up into capillaries in the muscular layers. The circular coat receives, in addition, numerous branches directly from a plexus lying between the tela submucosa and the tunica muscularis.

All the veins leave the stomach in company with the arteries.

The lymphatics of the stomach begin as comparatively

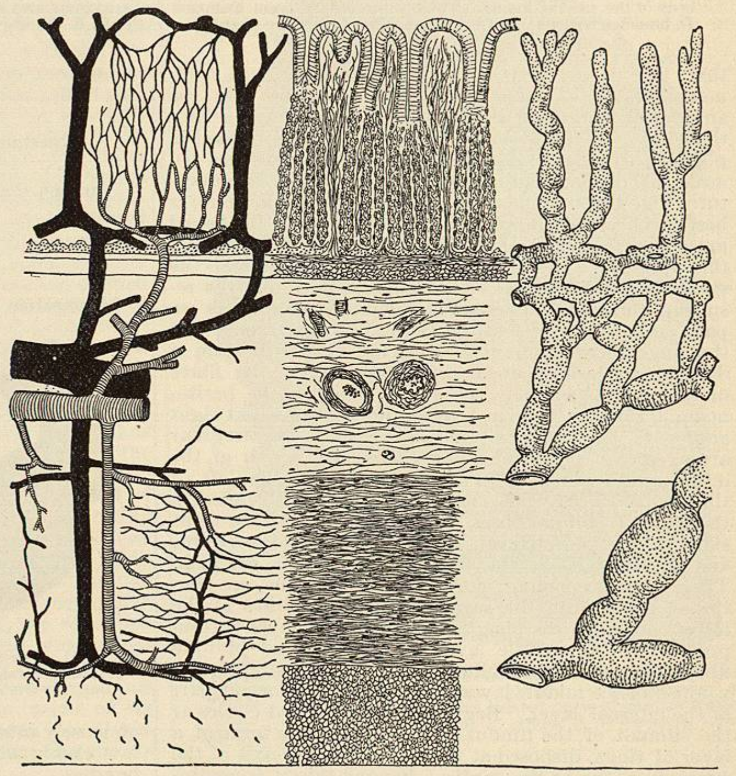


FIG. 4513.—Three Sections of the Stomach Wall of the Dog, Placed Side by Side to show the Situation of the Blood and Lymph Vessels in the Different Tunics. × 70. Veins black; arteries striated; lymphatics dotted. (From A. Oppel, '96, after F. P. Mall.)

wide, blind, capillary tubes beneath the epithelium of the stomach. These pass somewhat irregularly outward and join to form larger trunks, which communicate with a fine network of lymphatic vessels located in the mucous membrane between the lamina muscularis mucosæ and the bases of the glands. This plexus (plexus mucosus) in turn communicates by means of vessels which pass at right angles through the lamina muscularis mucosæ with a second plexus located in the inner part of the tela submucosa. This plexus is composed of large vessels with many valves. From it arise many irregular branches which anastomose and pass through the substance of the submucosa to join the large collecting branches. The latter, in turn, communicate by large branches which pass through the circular muscle with the intermuscular plexus, the large vessels of which run toward the lesser curvature. For further detials as to the arrangement of the large lymphatic vessels of the stomach, see the article on the *Lymphatic System*.

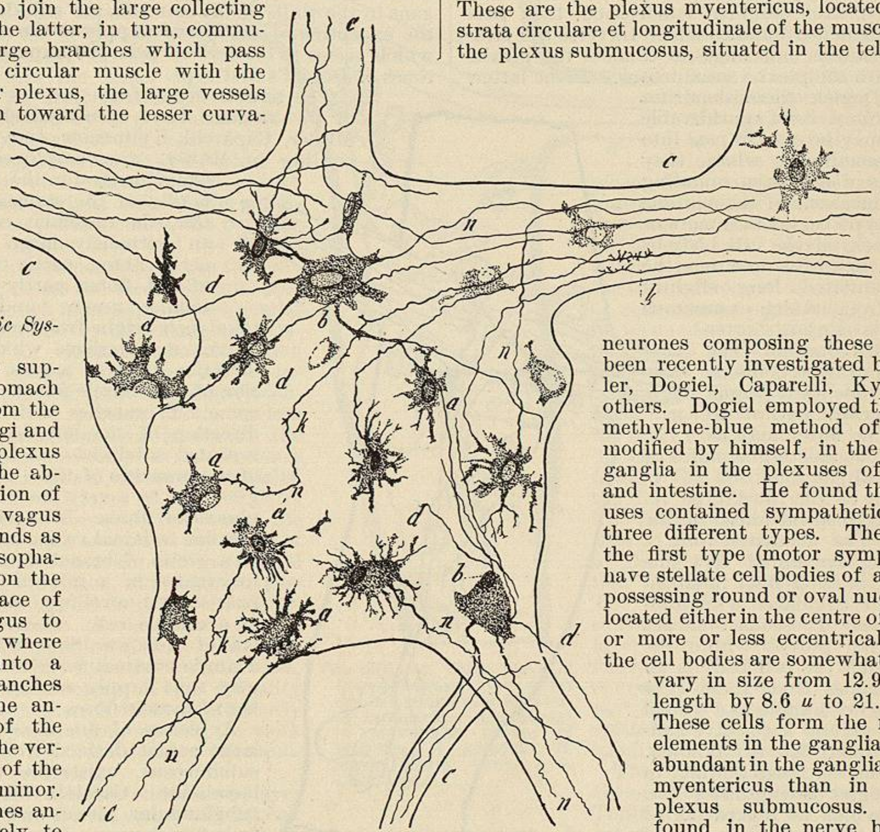


FIG. 4514.—Ganglion from the Plexus Myentericus of the Small Intestine of Man. *a*, Cell bodies of neurones of the first type (sympathetic motor neurones); *b*, neurones of the second type; *c*, nerve bundle. (After A. S. Dogiel, '99.)

The nerve supply of the stomach is derived from the two nervi vagi and from the plexus cœliacus. The abdominal portion of the nervus vagus sinister descends as the chorda œsophagea anterior on the anterior surface of the œsophagus to the stomach, where it divides into a group of branches located on the anterior face of the viscus, near the vertical portion of the curvatura minor. These branches anastomose freely to form the plexus gastricus anterior. From this plexus come off branches which radiate over the anterior face of the stomach. These branches run in the tunica serosa for a longer or shorter distance, but finally penetrate the muscular coats to terminate in the intrinsic plexuses of the organ. The right vagus goes in large part to the ganglion semilunare dextrum, but contributes some branches to the plexus gastricus posterior, distributed on the posterior face of the organ.

The sympathetic nerve supply is derived from the plexus cœliacus by means of fibres which accompany the several branches of the arteria cœliaca. The plexus gastricus superior accompanies the arteria gastrica sinistra, but also receives communicating branches from the right vagus, and from the plexus hepaticus, which reach the stomach in company with the arteria gastrica dextra. Some of the branches of the anterior gastricæ plexus accompany the rami œsophagei of the left gastric artery to the cardia; others descend upon the anterior and posterior surfaces of the stomach beneath the peritoneum, anastomosing on the left with the branches of the plexus lienalis which accompany the arteriæ gastricæ breves to the fundus, on the right with the branches of the plexus hepaticus which accompany the arteria gastrica dextra. Additional fibres from the hepatic and splenic plexuses accompany the arteriæ gastroepiploicæ dextra et sinistra respectively and are distributed to the greater curvature. The nerve fibres from all these sources, after a longer or shorter course in the tunica serosa, penetrate the muscular coats and join the intrinsic nerve plexuses of the organ.

The stomach, like the intestine, contains two characteristic nervous plexuses formed of branching and anastomosing bundles of non-medullated nerve fibres, forming a fine network with ganglia at the nodal points. These are the plexus myentericus, located between the strata circulare et longitudinale of the muscular coat, and the plexus submucosus, situated in the tela submucosa. The former plexus furnishes the motor supply to the tunica muscularis, the latter supplies the lamina muscularis mucosæ.

The structure of the neurones composing these plexuses has been recently investigated by Cajal, Müller, Dogiel, Caparelli, Kytmanow, and others. Dogiel employed the *intra-vitam* methylene-blue method of Ehrlich, as modified by himself, in the study of the ganglia in the plexuses of the stomach and intestine. He found that these plexuses contained sympathetic neurones of three different types. The neurones of the first type (motor sympathetic cells) have stellate cell bodies of angular shape, possessing round or oval nuclei, which are located either in the centre of the cell body or more or less eccentrically. Many of the cell bodies are somewhat flattened and vary in size from 12.9μ to 34.4μ, in length by $8.6\ \mu$ to $21.5\ \mu$ in width. These cells form the most frequent elements in the ganglia, and are more abundant in the ganglia of the plexus myentericus than in those of the plexus submucosus. A few are found in the nerve bundles which connect the ganglia with one another. From each pole of the cell body come off four to six or ten to twenty short, wide, somewhat flattened dendrites which a short distance from the cell subdivide into several more or less flattened short branches, which in turn divide and subdivide in a similar manner. According to Dogiel the terminal branches of these dendrites anastomose directly with similar dendrites belonging to other neurones of the same character. This direct continuity is, however, denied by La Villa and von Kölliker, who maintain that the apparent anastomoses seen by Dogiel are superposed but independent dendrites. Each of these neurones possesses, according to Dogiel, a single axone, which arises commonly from the cell body itself, but sometimes from a dendrite, by means of a thick cone of origin. This axone is a thin, smooth, or slightly varicose filament which traverses a greater or less extent of the ganglion and enters one of the connecting nerve bundles through which it courses to a second or third ganglion, in some cases even returning to the ganglion in which it took its origin. From this axone come off numerous extremely fine collaterals which leave the plexus in the groups of fibres distributed to the muscle coat. Finally, these axones break up into several fine varicose fibres which also terminate in the muscular layers, of which they appear to form the motor supply.

The neurones of the second type have somewhat larger cell bodies than the foregoing, and occur in much smaller numbers. Each cell body contains a moderately large, round, or oval nucleus with one or two nucleoli. From the poles of the cell body come off from three or four to as high as six or ten dendrites, which have the appearance of moderately thick fibres, and which presently divide into several thin branches. The latter do not terminate within the ganglion as do the dendrites and neurones of the first type, but enter the connecting nerve bundles, whence, after frequent subdivision, they pass into those small nerve bundles which traverse the stratum circulare tunicæ muscularis to connect the plexus myentericus with the plexus submucosus. In the latter, according to Dogiel, these dendrites may be often followed for considerable distances, and may be seen to pass into the mucous membrane, where they form the plexus of nerves surrounding the glands. The axone of the neurone of the second type begins in a more or less thick hillock on the cell body or on one of the dendrites and has the form of a nodulated, long, slightly wavy fibre, from which numerous collaterals similar to but shorter than the dendrites come off. The mode of ending of these collaterals and of the axone itself Dogiel does not describe, except to point out that the latter may be traced into the connecting bundles of fibres to a second ganglion.

The neurones of the third type resemble in many respects those of the second type. The dendrites form a richly branching system of very fine threads, which, in their finer ramifications, may be distinguished with difficulty from axones. These fine branches form a very rich plexus within the ganglion in which the cell body is located. The axones from these cells pass out by a nerve bundle to a second ganglion or to several successive ganglia. Their ultimate fate is unknown.

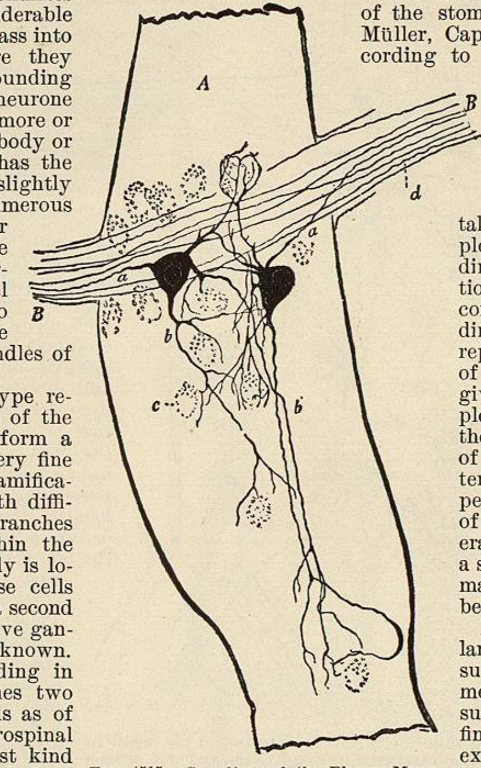


FIG. 4515.—Ganglion of the Plexus Myentericus of the Guinea-pig, showing the Cell Bodies of Neurones of Dogiel's Third Type. *a*, Axone; *b*, dendrites, some of which form a plexus around other cell bodies. (After A. S. Dogiel, '95.)

Among the nerve fibres ending in the ganglia, Dogiel distinguishes two kinds, one of which he regards as of sympathetic, the other of cerebrospinal origin. The fibres of the first kind are extremely thin, smooth, or slightly varicose threads, which do not differ in any respect from the axones of the neurones of the ganglia of the plexus. These fibres enter a ganglion by a nerve bundle, describe a more or less tortuous course among the nerve cells of the ganglion, and break up on their way into much thinner varicose fibrils, which in turn subdivide into a number of extremely fine end fibrils, which are beset with numerous round and oval varicosities. These end fibrils form an extremely close, intercellular plexus within the ganglia, without coming into direct contact with the cell bodies, from which they are always separated by the capsular cells. The second kind of fibres is distinctly coarser than the preceding and exhibits large, round, and spindle-shaped varicosities. In some cases Dogiel was able to trace these fibres through the longitudinal muscle coat and to demonstrate their continuity with medullated fibres. These fibres enter a ganglion from one of the connecting nerve bundles and may, in favorable preparations, be traced a considerable distance through the ganglion. In its course through the ganglion it gives off two to six or more varicose collateral branches, and ultimately breaks up into several similar fibrils. Both the collateral and the terminal branches go to the cell bodies of the ganglia, penetrate the capsules, and terminate in a number of fine varicose fibrils around the cells.

The stellate cells described by Cajal, Müller, and others, on the walls of the small blood-vessels and on the membrana propria of the glands, are regarded by Dogiel as connective-tissue cells.

As the foregoing description indicates, the exact relations of the nerve fibres which enter the stomach wall and of the axones and dendrites of the sympathetic neurones of the two principal plexuses, to the terminal organs in the walls of the stomach, are still doubtful, with the exception of the nerve supply to the muscle coats, which seems to be derived from the axones of the neurones of Dogiel's first type.

The terminations of the nerves in the walls of the stomach have been studied by Berkley, Müller, Caparelli, Kytmanow, and others. According to Müller, who employed the rapid Golgi method in the study of the nerves of the stomach and intestine, the muscular coats contain an extremely large number of nerve fibres, partly in the form of end fibres, partly as larger or smaller nerve bundles. These take their origin from branches of the plexus myentericus, which run in a direction at right angles to the direction of the muscle fibres. From these come off branches which follow the direction of the muscle fibres. The repeated subdivision and intercrossing of the branches of these nerve bundles give rise to a very fine intramuscular plexus of fibres. The termination of the fine terminal twigs takes the form of a group of branches, each of which terminates in a minute spherical or pear-shaped swelling on the surface of a muscle cell. There may be several of these swellings in the course of a single terminal nerve filament, which may thus supply successively a number of muscle fibres.

A plexus of fine nerve fibres, to a large extent derived from the plexus submucosus, exists in the mucous membrane. Cacciola distinguishes a subglandular plexus and a plexus of finer fibres surrounding the glands and extending as far as the free surface of the mucous membrane.

According to Müller the nerves terminate by free, often swollen extremities, under the cylindrical epithelium, or between the pointed proximal ends of the cells. Kytmanow, using the methylene-blue method, was able to trace the nerve terminations through the basement membrane into the glands, where they terminate by each dividing into a group of coarsely varicose filaments, which penetrate between the cells of the glands and lie in close contact with both the surfaces of the parietal and chief cells.

The stomach is developed as a spindle-shaped dilatation of the primary endodermal canal, which may be recognized in very early embryos. The stomach is at this early stage vertical and median in position. In embryos of 5 mm. length there is already an indication of the greater and lesser curvatures, and in the 12.5 mm. embryo these are well formed, the greater curvature being directed backward and slightly toward the left; the lesser curvature forward. Owing to the increase in length of the œsophagus and stomach, the latter has descended from its primary position above the septum transversum into the abdominal cavity. The stomach at this stage is

connected with the abdominal walls both dorsally and ventrally by a double layer of mesoderm, forming the mesogastrium anterius and the mesogastrium posterius. The former extends from the septum transversum to the umbilicus and contains between its two layers the developing liver, of which it subsequently forms the tunica serosa. The portion of the mesogastrium anterius between the liver and the anterior abdominal walls forms the falciform ligament (ligamentum falciforme hepatis); that between the liver and the lesser curvature of the stomach becomes the lesser omentum. The final position of the stomach is reached by a gradual shifting of the upper end of the organ from its median position toward the left side, and a rotation of its axis in such a way that the primary right side of the stomach becomes the posterior face, the primary left side the anterior face; and the fundus of the stomach becomes directed to the left. During this process the mesogastrium posterius undergoes a more rapid development than is necessitated by the changing position, forming an elongated pouch, which hangs down ventral to the rest of the intestine, and forms the great omentum (omentum majus). The portion of the cœlom enclosed between the two layers of the elongated mesogastrium posterius becomes the lesser peritoneal sac, or bursa omentalis.

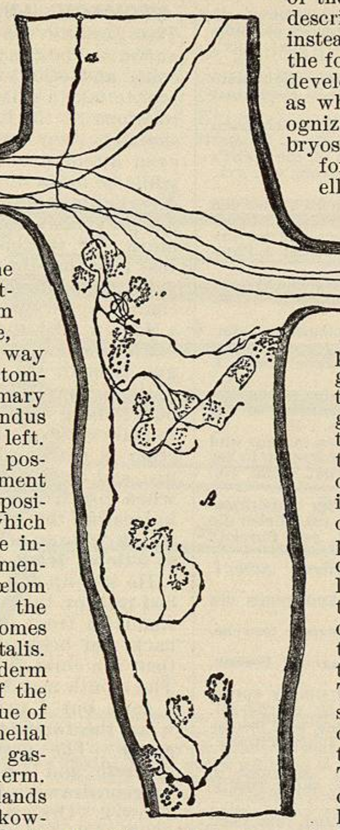
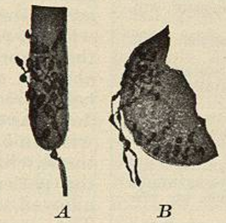


FIG. 4516.—*a*, Nerve fibres of Dogiel's second type which end in a ganglion of the plexus myentericus (guinea-pig) in pericellular groups of branches; *A*, ganglion; *B*, nerve bundle. (After A. S. Dogiel, '95.)

From the visceral layer of the mesoderm are developed the three outer layers of the wall of the stomach as well as the tissue of the lamina propria mucosæ. The epithelial elements of the stomach, including the gastric glands, are derived from the endoderm.

The development of the gastric glands has been investigated by Kölliker, Laskowsky, Brand, Toldt, Sewall, Salvioli, Ross, and others. On account of the difficulty of obtaining human material in a sufficiently good state of preparation, most of the work along this line has been done on the stomachs of lower mammals.

According to Toldt, the endodermal layer of the stomach in the cat embryo of 2.5 cm. body length is still composed of a single layer of small pyramidal or conical cells, the nuclei of which are placed at different levels. Of these he recognized two kinds: one of these has its broader end directed toward the inner surface of the stomach and contains a large oval nucleus near the free border; the other kind of cell has the broader base directed toward the attached side of the epithelium. Both of these cells extend through the whole thickness of the epithelium, which is thus unstratified, though he points out that in poorly preserved material the impression of stratification might easily be obtained. In somewhat older cat embryos, up to 5 cm., the condition is much the same, except for the greater number of cells of the second type mentioned above in the epithelium. In cat embryos from 5 cm. body length upward, the structure of the epithelium is modified by the appearance in it of the rudiment of the gastric glands. Concerning the formation of the latter two views exist. According to one group of observers, including Kölliker, Brand, and Sewall, the determining factor in the formation of the gastric glands is the irregular growth of the mesodermal stratum. This, according to Brand, is accomplished by the growth of villus-like processes covered with epithelium. By the coalescence of the bases of these villi shallow pits are formed which are the rudiments of the glands. A similar description of the origin of the glands is given by Sewall, except that he describes the gland processes as short ridges instead of villi. According to Toldt and Ross, the formation of villi has nothing to do with the development of the glands, which they regard as wholly intra-epithelial in origin. Toldt recognized the rudiments of the glands in cat embryos of from 5.3 to 6.8 cm. body length in the form of single scattered cells of spherical or ellipsoidal shape located between the bases of the cylindrical cells, which at this stage make up the gastric epithelium. In addition to their characteristic location, these cells are distinguished from the other cells by their coarsely granulated protoplasm and greater opacity. In places several such cells could be seen so grouped together as to leave little doubt that they had arisen by division of the single isolated cell. Such groups often contained a minute circular vacuole-like space, the future lumen of the gland. This group of cells assumes gradually, by increase of its elements, an elongated shape, and an opening to the surface is obtained by displacement of the overlapping cylindrical cells. The displacement of the bases of the latter by the growing gland rudiment causes the inner ends of the epithelial cells immediately surrounding the gland to converge toward the opening, forming in this way the first indication of the gastric foveola. The further development of the glands consists in the increase in length and number of the gland tubules and the differentiation of their specific glandular elements. The increase in length of the glands soon causes them to project beyond the epithelial layer into the subjacent mesoderm. The increase in number of the glands in the course of development is accomplished in part by the formation of new glands in the epithelium, in part by the branching and subdivision of those already existing.



A B

FIG. 4517.—*A*, An isolated chief cell of the fundus gland of the cat showing the termination of a nerve fibre in a group of branches around the cell; *B*, a parietal cell of the same animal; vital methylene-blue staining. (After K. A. Kytmanow, '96.)

The differentiation of the specific cellular elements of the glands occurs, according to Toldt, at a somewhat late stage of development. In cat embryos of 13–14 cm. body length—that is, shortly before birth—he found the majority of cells forming the glands still undifferentiated. In the deeper part of the glands, however, a few larger richly granular parietal cells could be seen.

The recent account of the development of the gastric glands, given by Ross, practically confirms Toldt's observations in all essential details. These two observers are agreed as to the non-participation of the villus-like ridges of the developing stomach in the formation of the glands.

R. R. Bensley.

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STOMACH AND ŒSOPHAGUS. (SURGICAL.)—I. THE SURGERY OF THE ŒSOPHAGUS.—*Methods of Examination.*—The *x*-rays are very useful in locating bone; also coins and other metallic foreign bodies. It is usually best to take a skiagraph, in order to determine the exact relations of the foreign body. The fluoroscope is occasionally very useful, and the surgeon may sometimes even attempt to extract the foreign body with forceps while he looks through the fluoroscope. An œsophageal diverticulum may be shown by the *x*-rays, if the patient has previously swallowed capsules of subnitrate of bismuth. If the bismuth enters the diverticulum, it will coat it so that the pouch will cast a shadow in the *x*-rays. A bougie containing a piece of metal on a small metallic chain may, in some cases, enter the diverticulum and cast a shadow with the *x*-rays.

The most common method of examining the œsophagus is with the exploratory sound. A flexible bougie with an ivory tip will locate an obstruction, whether it be a foreign body or a stricture. In an adult, it is best to make an examination of this kind without ether. If ether is not employed, we can keep the patient sitting up; and he can help us by swallowing the instrument when directed to do so, and can also aid us somewhat in locating the obstruction. In a child, it may be necessary to give an anæsthetic. The bougie should be passed as follows, when the patient is not anæsthetized:

He sits up and rests his head against a chair-back, a bed-rest, or the chest of another person. The surgeon stands in front of him. The patient's head is thrown back and held securely by an assistant. When the patient is a child, it will be necessary to hold the arms also. The mouth may be gagged open with a bit of wood or a cork, but I usually dispense with a gag and simply wrap the forefinger which is to be inserted with some gauze. The instrument is warmed and smeared with glycerin, and is passed into the rear of the pharynx, the surgeon drawing the tongue forward and holding it with a towel. Drawing the tongue forward draws the larynx a little forward also, and enables the instrument to pass more readily over the glottis. In some cases it is necessary to guide it over with the index finger of the left hand.

As soon as the instrument strikes the back of the pharynx, the patient will attempt to vomit; but the slight respiratory obstruction met with here should not deter one, although, of course, if there is violent respiratory difficulty the instrument must be at once withdrawn, because of the fear that it may have entered into the larynx. After it strikes the back of the pharynx it should be pushed on steadily but lightly, and the patient should be directed to swallow. The passage of the instrument will thus be greatly aided. When the instrument is blocked by an obstruction, one must not attempt to force it, but should hold it gently in contact with the obstruction. If this is only spasmodic, the spasm may relax and let the instrument pass. If the obstruction is organic, it will not relax. We should always remember, however, that an organic stricture may be associated with a spasm above it, and therefore that we may be blocked by spasm before reaching the true seat of disease. If we are in doubt as to whether we are dealing with a pure spasm or with an organic stricture, the administration of an anæsthetic will solve the doubt; for a pure spasm relaxes when the patient is anæsthetized, so that the instrument is allowed to pass, but an organic stricture does not relax. The average distance from the incisor teeth to the cardiac opening of the stomach in the adult is, according to Maylard, from fourteen to sixteen inches.

The *œsophagoscope* (Fig. 4518) has been used for many years by Mikulicz, but it is only of late that its real value has become recognized by the profession at large. In fact, in this country the appreciation of this seems to date from the visit of Gottstein, Mikulicz's assistant, about a

year ago. The œsophagoscope is undoubtedly a useful instrument. With its aid one may see a tumor, an ulcer, a foreign body, varicose veins, or a strictured area; and may remove in some cases a foreign body and in others a tumor for examination. Of course, in order to use the instrument well a man must be specially trained, and good results can be obtained only by an expert; but the same assertion is true of the use of the ophthalmoscope, the laryngoscope, and the cystoscope. Any one can learn to use the œsophagoscope, but only an expert will use it really well. One great lesson in its use is to be very gentle and never to force it, and, if it is obstructed by spasm, to wait for the spasm to subside before urging it onward.

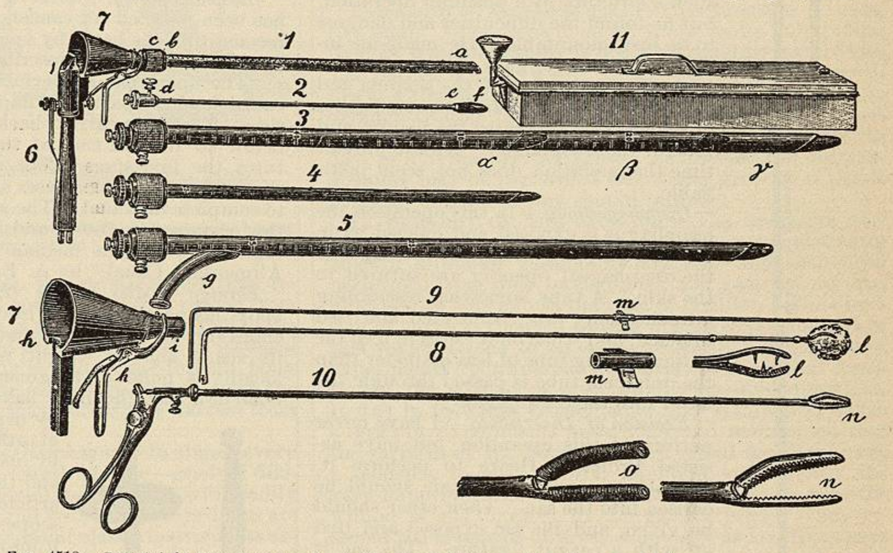

FIG. 4518.—Gottstein's Œsophagoscope. *1*, Œsophageal tube with oblique end (*a*), with hard-rubber ring (*b*), with bayonet catch (*c*); *2*, mandrel for the tube with screw at the upper end (*d*), fitting into the bayonet catch, and a hard-rubber olive point at the lower end (*e*), bevelled on the side (*f*); *3*, œsophageal tubes of different lengths (26, 36, and 46 cm.) and 14 mm. in diameter; *4*, children's size of tubes, 10 mm. in diameter; *5*, tubes with outflow tube (*g*) at the upper end; *6*, Casper's panelectroscope; *7*, the intermediate piece between the tube and the panelectroscope—external end (*h*), internal end (*i*), handle for detaching it from the tube (*k*); *8*, sponge-bearer with double teeth (*l*); *9*, sound with a rider (*m*); *10*, forceps with rough jaws (*n*), or covered with rubber (*o*); *11*, hot-water pan.

When one has decided to use this instrument, he should first employ a sound to locate the situation of the obstruction. The pharynx, the larynx, and the upper part of the œsophagus are then cocainized with a ten-per-cent. solution of cocaine. The patient lies upon the table, on his right side, the clothing about his neck and his chest being loosened. His head rests upon a pillow, being bent back so far that a straight line through the mouth would enter into the œsophagus. He is told to raise his left hand if he feels pain and wishes the instrument withdrawn, and he is ordered to breathe quietly and regularly. Then the tongue is drawn forward and the tube is introduced into one side of the mouth and carried into the pharynx. As the patient swallows, the instrument passes down to the desired point. Then the plunger is withdrawn and the panelectroscope is inserted, throwing light to the bottom of the tube. Any mucus present is swabbed away with pieces of gauze caught in forceps; the region of disease is carefully studied, and, if thought desirable, a piece of tumor is removed. A note on the use of this instrument may be found in *American Medicine*, October 25th, 1902, in the editorial comment on general surgery; and the instrument is fully described by Gottstein in his "Technik u. Klinik der Oesophagoscopie."

OPERATIONS ON THE ŒSOPHAGUS.

Internal Œsophagotomy.—By this operation one divides a fibrous stricture. The method of performing it is to pass an instrument known as an œsophagotome. In order that this may be passed, the channel of the stricture must be large enough to admit the instrument. After the latter has passed through the stricture, the blade is protruded and the instrument is withdrawn. From forty-eight to seventy-two hours after the operation, the surgeon begins to effect distention by means of bougies. Gussenbauer performs internal œsophagotomy by making an opening in the œsophagus above the stricture, and then, through this opening, cutting the stricture by means of a tenotome. Internal œsophagotomy may be productive of dangerously severe hemorrhage and is occasionally followed by infective processes—for instance, by empyema. It should never be attempted for malignant obstruction.

Electrolysis.—Electrolysis has been much improved by Fort and others. It should not be used for malignant obstruction, but may be of great benefit in cicatricial stricture. It will fail, however, if the stricture is very hard. It is probable that several applications will be necessary in most cases, after which bougies should be used for a considerable length of time.

External Œsophagotomy.—External œsophagotomy may be performed through the neck by what is known as cervical external œsophagotomy; or it may be performed through the mediastinum—the intramediastinal method. External œsophagotomy may be done for the purpose of treating a cicatricial stricture of the œsophagus, either directly—as in Gussenbauer's method—or indirectly—as in Abbe's string-saw method. It may also itself directly divide a stricture. The chief use of the operation, however, is to remove foreign bodies, when these are lodged above the lower third of the œsophagus. If the foreign body has been in the œsophagus over twelve hours and has sharp edges, attempts to extract it through the mouth should not be made, but external œsophagotomy should be performed at once.

The incision is usually made on the left side, the cut being at the anterior edge of the sterno-cleido-mastoid muscle, and running from half an inch above the sterno-clavicular joint to the level of the superior border of the thyroid cartilage. The muscles are retracted, in some cases the omohyoid is divided, the trachea is drawn forward, great care is taken to avoid the recurrent laryngeal nerve, and the gullet is exposed. If a foreign body is palpable, the incision is made upon it; otherwise a bougie is introduced, and the gullet is opened upon that.

After the foreign body has been removed, there is a question as to how the wound should be managed. It seems certain that it should not be closed without any drainage. In fact, some surgeons do not close it at all, but simply pack it with gauze. It is wiser to suture the mucous membrane with stitches of silk or chromicized catgut, to run a piece of gauze down to the suture line for drainage, and then to suture the muscles and the skin, the gauze drain being removed within two or three days.

For the first twenty-four hours after the operation the patient is given no food by the mouth, but is fed by the rectum; and rectal feeding is continued as a supplement to mouth feeding until sufficient food can be taken by