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STUDIES OF THE INTESTINE AND PERITONEUM IN THE HUMAN FŒTUS. PART IV.

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THE SEPTUM BURSARUM OMENTALIUM AND THE AREAS OF GASTRIC ADHESION.

The Septum Bursarum Omentalium in relation to the Subdivisions of the Lesser Sac of Peritoneum.

IF the line of the coronary artery be taken as marking off the walls of the *superior* from those of the *inferior omental recess*, we cannot, in many cases, take the free edge of the fold of peritoneum which contains this vessel (*i.e.* the free edge of part of the septum bursarum omentalium of Huschke) as forming the boundary line between these two parts of the lesser sac of peritoneum. For in several cases the free margin of the ascending or parietal part of this fold lies altogether away from the line of the arterial circle in relation to the lesser curvature of the stomach. Indeed, this fold may project markedly on to the posterior wall of the inferior omental recess. But in all cases the free border of this part of the septum may bound, when present, a small aperture which, since it lies at the upper limit of the adhesions which form what I have figured and named in Part II. of my "Studies," "the inferior area of gastric adhesion," may be termed *the supra-adhesion foramen* (see figs. 4, 5, 6, 1).

In most fœtuses, however, the free margins of the two parts, hepatic and coronary (see fig. 2), of the septum bursarum omentalium converge towards one another (see fig. 2) and the cœliac artery, and the boundary line, may be given as follows:—

(1) The free edge, at which the hepatic artery always lies, of the hepatic part of the septum up to the point of origin of the pyloric artery (arteria gastrica dextra, see fig. 2).

(2) The line of the pyloric artery.

(3) The free margin, at which the coronary artery (arteria gastrica sinistra) and "posterior" (Jonnésco) coronary artery (see fig. 3) *may lie* throughout its whole extent, of the coronary part ("deep ligament of the stomach") of the septum bursarum omentalium.

The hepatic artery is thus a boundary of the foramen omenti majoris of Huschke, and not a boundary of the foramen of Winslow (foramen omenti minoris of Huschke), since it lies distinctly to the left —more so than the common bile-duct—of the free margin of the small omentum.

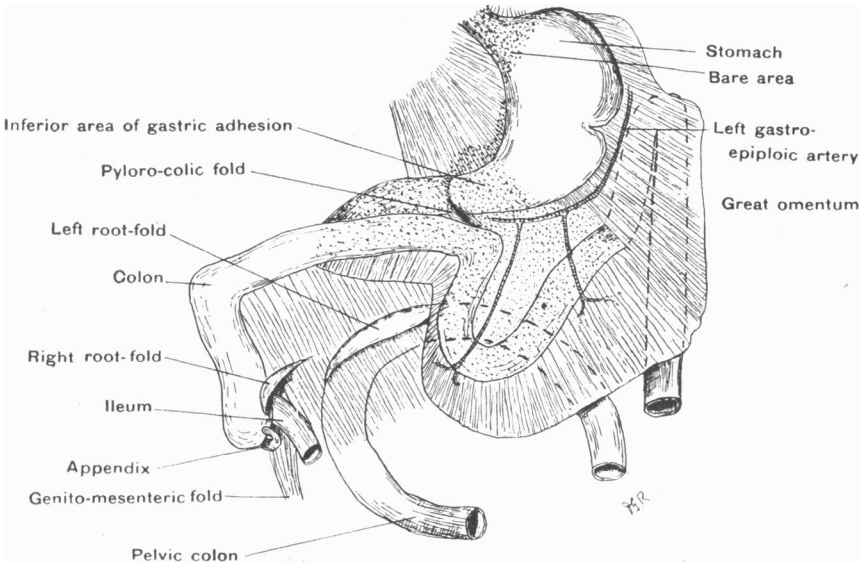

FIG. 1 (reproduced from Part II. of my "Studies," *Journal of Anatomy and Physiology*, vol. xlv., 1911).—The stippling indicates areas of adhesion. In this and all the other fœtuses the meso-duodenum to the right of the pylorus is completely covered by the transverse colon and the mesentery of the intestinal loop. This is discussed in another paper. The figures and descriptions given in the books dealing with the development of the peritoneum are inaccurate in this respect.

Therefore a part of the lesser sac of peritoneum must be recognised lying to the right of the free border of the hepatic part of the septum bursarum omentalium, and below the caudate lobe of the liver. To this part the name of *vestibule* has been given.

"A l'hiatus de Winslow fait suit un couloir ou vestibule (vestibulum bursæ omentalis, *B. N. A.*) allant jusqu'à l'arc de l'hépatique" (Fredet in Poirier's *Anatomy*).

I. *The Part of the Septum Bursarum Omentalium in relation to the Coronary (Gastric) Artery (Deep Ligament of the Stomach of Jonnesco).*

(*a*) *Relations of the Spigelian Lobe of the Liver* (see fig. 4 (indicated by +) and fig. 6).—In order to expose the deep ligament of the stomach fully, it is necessary, in most cases, to remove part of the Spigelian lobe (tuberculum papillare part). This often projects downwards so as to cover the whole breadth of the pancreas and come into contact with the trans-

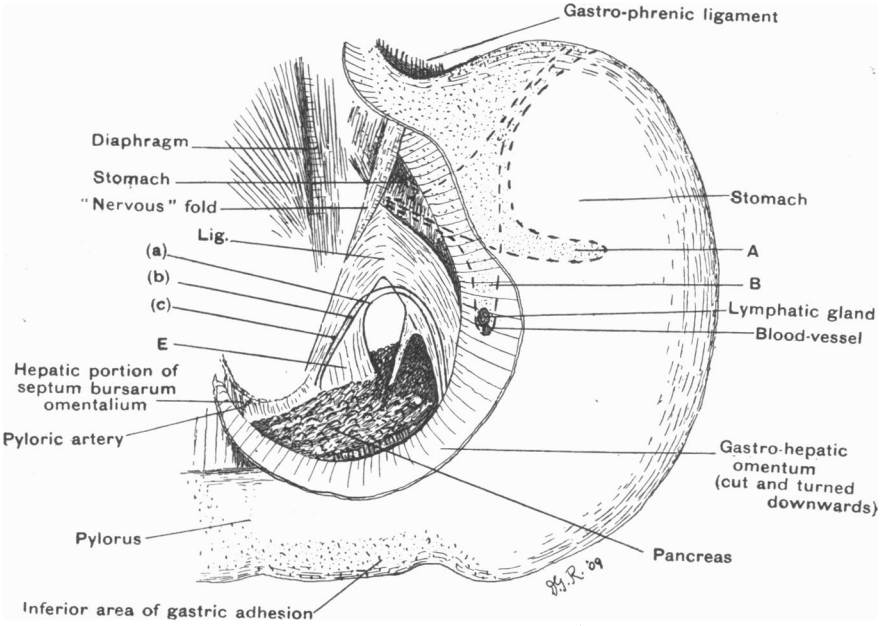

FIG. 2.—The liver has been removed. The anterior surface of the stomach really looks distinctly upwards as well as forwards. The angular shape of the free border of the deep gastric ligament in fœtuses Nos. VII., XVI., and XVIII. is indicated by the line (b). The shape of this border in fœtus No. V. is indicated by the line (c); and its shape in fœtus No. XX. is indicated by the line (a). The interrupted lines indicate three chief variations in outline of the "bare area" (superior area of gastric adhesion). The "bare area" is sometimes continuous with the inferior area of gastric adhesion; and the opening into the part of the lesser sac which lies behind and below the stomach is thus obliterated.

verse mesocolon to which the posterior (direct) lamina of the great omentum is fused. In seven cases, however, out of twenty-three, including the three smallest (12 to 14 cm. long) and the largest (22·9 cm. long), this was unnecessary, for in them, as also in another fœtus 6·7 cm. long, the Spigelian lobe scarcely descended below the level of the parietal portion of the septum bursarum omentalium (upper border of the pancreas). Thus in

a 12 cm. fœtus a well-developed pancreatic omental tuberosity pushed forwards the small omentum, and in the 6·7 cm. fœtus the Spigelian lobe only just reached the upper border of the pancreas.

But in most cases the pancreas (posterior wall of the inferior omental recess) was not directly related to the lesser omentum on account of an intervening Spigelian lobe. In the adult the Spigelian lobe generally fails to reach the upper border of the pancreas by a short distance—the breadth of the hepatic artery.

The Spigelian lobe usually covered the left surface of the hepatic part

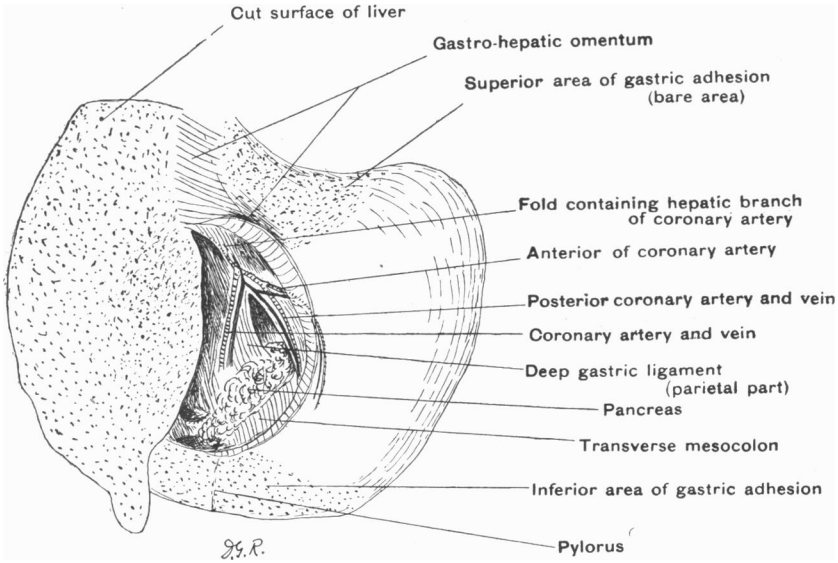

FIG. 3.—The disposition of the blood-vessels in the deep gastric ligament is shown.

of the septum and the anterior or antero-superior surface (see fig. 4) of the deep gastric ligament.

In two cases the inferior gastric adhesions, involving the whole breadth of the pyloric canal and adjacent part of the stomach, extend upwards along the lesser curvature of this viscus to become continuous with the superior gastric adhesions (" bare area " of the stomach).

Thus the Spigelian lobe was shut off into a separate compartment of the lesser sac closed except at the vestibule. In three other cases the inferior area of gastric adhesion has the extent indicated in figs. 1 and 4, so that a compartment is formed for the Spigelian lobe opening on the left into the major part of the lesser sac of peritoneum through the very small

supra-adhesion foramen (see figs. 4, 6). The Spigelian lobe sent towards the left a hook-like process (see fig. 6, B) which, insinuating itself below a falciform fold of peritoneum formed by the coronary artery and its hepatic branch (see fig. 6), abutted against the supra-adhesion foramen.

(*b*) *Form and Relations of the Deep Gastric Ligament.*—In many fœtuses the deep ligament of the stomach is a small fold whose free margin

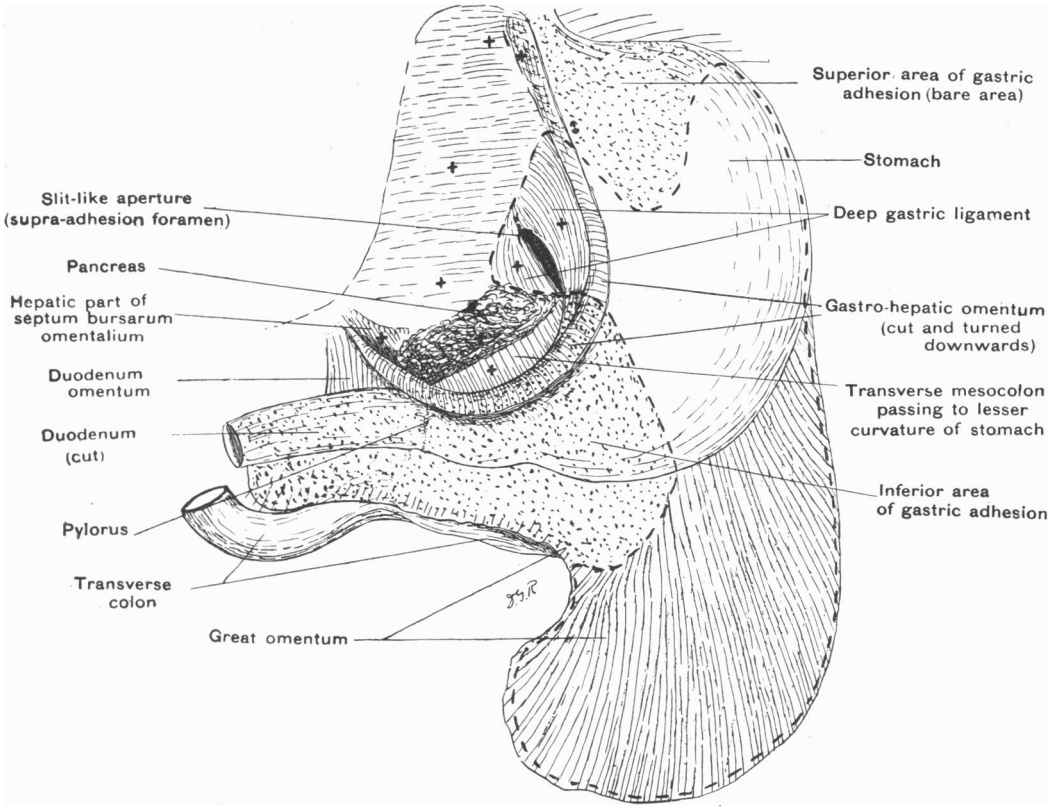

FIG. 4.—Drawing from a fœtus 19 cm. long. The interrupted line represents the outline of the part of the recessus inferior omentalis which communicates with the rest of the lesser sac simply through a minute slit-like aperture (supra-adhesion foramen) seen just to the right of the descending part of the lesser curvature of the stomach and above the adhesions which form the inferior area of gastric adhesion. + indicates the parts with which the Spigelian lobe comes into contact. (The free borders of the two parts (parietal and gastric) of the deep gastric ligament decussate slightly in this specimen.)

is rounded over the coronary artery. In other cases the coronary artery lies in a broad, thin, flat fold of peritoneum, falciform or angular in form. The variations in shape of this fold are shown in figs. 2, 3, and 4.

The gastric border of the deep ligament generally is situated below the gastric border of the lesser omentum (see fig. 2), but may be attached to the lesser curvature of the stomach in common with the small omentum (see fig. 4), so that the superior omental recess surfaces of the two structures are directly continuous, and the hepatic branch of the coronary artery (fig. 3), which generally has to cross from one fold to the other over a portion of the stomach, passes directly into the lesser omentum.

The parietal border, attached over the vertebral portion of the diaphragm (see figs. 2, 3), has coursing in immediate relation to it a bundle

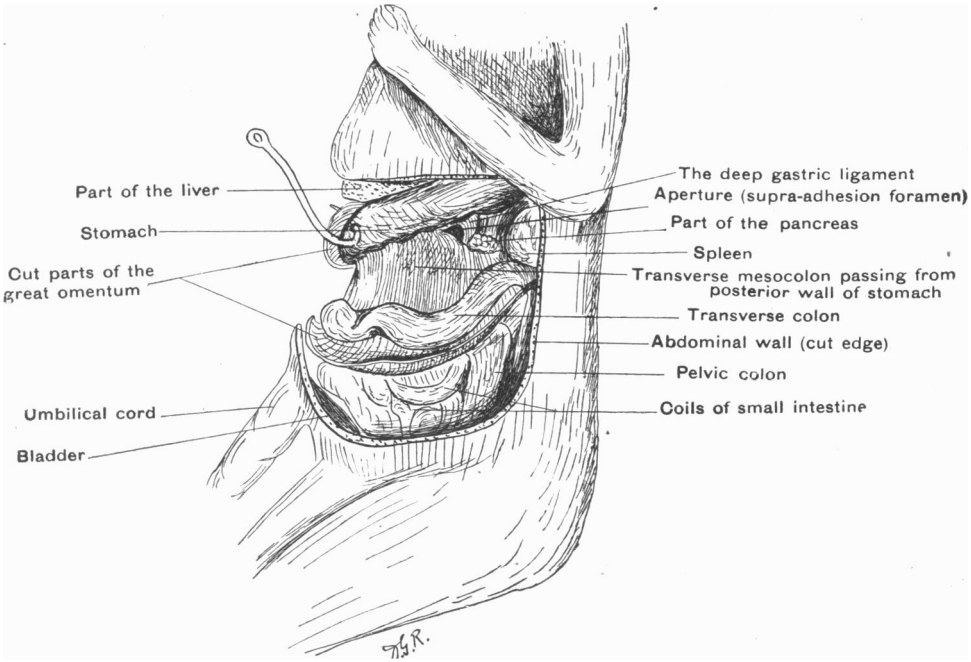

FIG. 5.—Drawing from the same fœtus as shown in fig. 4. The left wall of the abdomen has been removed in great part, and the specimen is viewed from the left. A large part of the liver has been removed. The greater curvature of the stomach has been pulled upwards, forwards, and to the right. The great omentum has been cut through so as to expose the posterior wall of the lesser sac. Parts of it are left attached to the stomach and transverse colon. The aperture mentioned under fig. 4 is seen in front of the parietal part of the deep gastric ligament.

of fibres of the right vagus (see fig. 6), taking a course towards the right splanchnic element of the solar ganglion (ganglia cœliaca).

It extends slightly on to the body of the pancreas in several specimens. But the ligament has a marked attachment to the pancreas in four cases. Thus in one fœtus (see fig. 2, E) the parietal border is directed horizontally towards the left, upon the upper part of the anterior surface of the body of

the pancreas, for quite 3 mm.; in another for 4 mm. (fig. 3); and in another it extends outwards for 5 mm., and quite crosses the pancreas to end at the root of the transverse mesocolon (fig. 4).

In these fœtuses, therefore, this part of the fold projects markedly on to the wall of the inferior omental recess. Moreover, it tends to lie in a distinctly frontal plane, being moulded, as it were, upon the back of the Spigelian lobe; and its free edge, directed towards the left, does not bound the foramen of Huschke, but happens to bound, in two cases, a very small definite supra-adhesion foramen (see figs. 4, 6). Behind this portion of the deep ligament which is placed in the frontal plane lies a deep recess (see fig. 4), bounded behind by the parietal peritoneum of the posterior abdominal wall, and closed below at the line of attachment of the ligament to the peritoneum covering the pancreas.

The third border of the ligament takes a curved or angular direction (see figs. 2, 3, 4). It is generally free. But in one fœtus a cord of peritoneum (see fig. 2) passes from the gastric portion of the free border of the ligament to the anterior surface of the body of the pancreas, about midway between its superior and anterior borders. It is placed in the same plane as the ligament. I have noted a similar cord in another fœtus.

The superior omental recess surface of the ligament is always free.

The inferior omental recess surface of its gastric part may, however, become fused down to the transverse mesocolon (to the extent indicated in fig. 4 by the stippling). In these cases the adhesions which form the inferior area of gastric adhesion extend from the greater to the lesser curvature of the stomach (see fig. 4), which, along with the gastric part of the deep ligament, and the lesser omentum, at its attachment to the lesser curvature of the stomach, is bound down by them to the transverse mesocolon.

Thus in the case represented in fig. 4 the transverse mesocolon with its coat of great omentum gains an attachment to the lesser curvature of the stomach, to which four sheets of peritoneum, all connected together, thus came to be attached (see fig. 4):—

(1) The small omentum.
(2) The deep gastric ligament.
(3) The transverse mesocolon.
(4) The posterior (direct) lamina of the great omentum blended with (3).

Thus the two parts of the deep ligament, whose edges almost meet upon the transverse mesocolon (see fig. 4), close to the anterior border of the body of the pancreas, almost completely surrounded a small slit-like supra-adhesion foramen, closed below by the transverse mesocolon.

The hepatic branch of the coronary artery as it courses towards the

liver may lie in a distinct fold upon the posterior (superior omental recess) surface of the gastro-hepatic omentum (see figs. 3, 6). This, together with a ridge containing the coronary artery as it lies in the deep gastric ligament, may form a falciform projection of the peritoneum (see fig. 6). This sometimes produces a well-marked groove (see fig. 6, B) upon the Spigelian lobe,

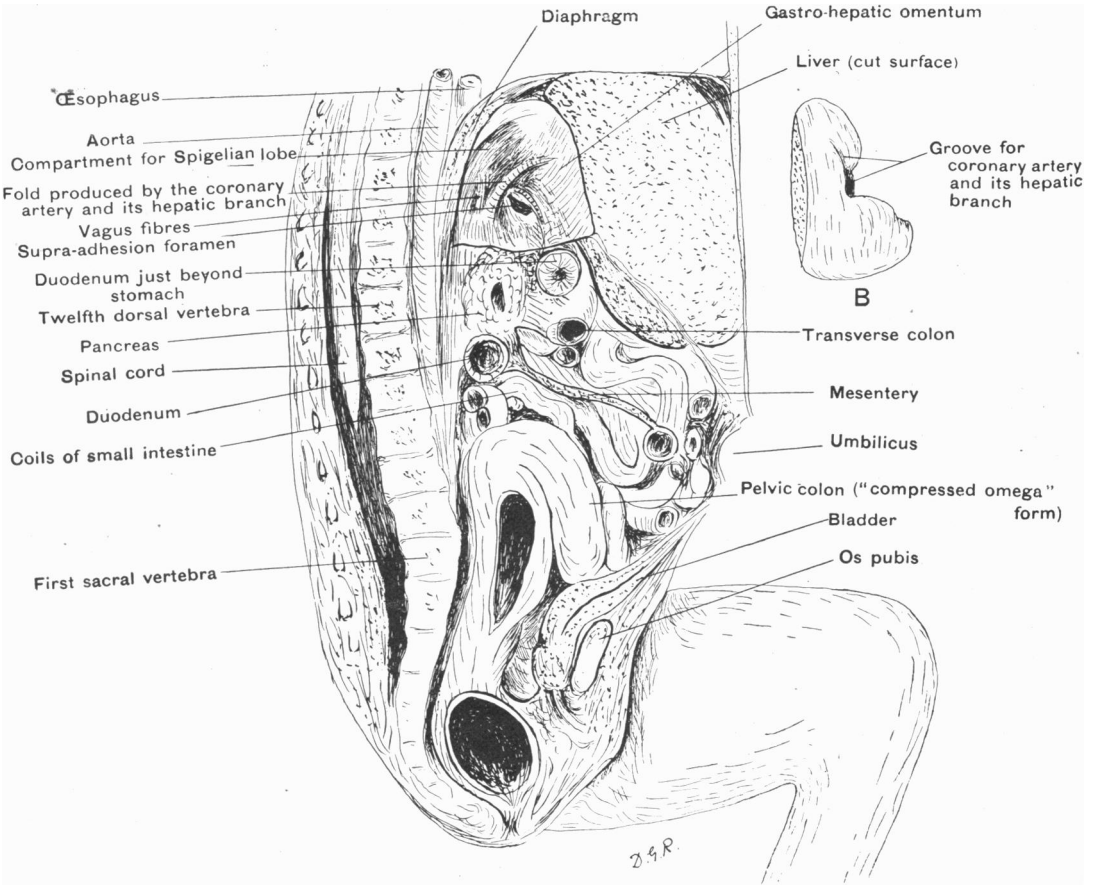

FIG. 6.—Longitudinal section of male fœtus 20 cm. long. B is a figure of the part of the Spigelian lobe which has been removed from a definite compartment of the lesser sac of peritoneum. It is viewed from the front, and shows the hook-like process, which abutted against the supra-adhesion foramen, and the groove for the coronary artery and its hepatic branch.

which in some specimens presents the hook-like process already described. Fig. 7 shows the relation of the ligament to the left suprarenal body.

In one fœtus there is a very thin fold (see fig. 2) 1 mm. high, attached

along the line of the upper portion of the parietal border of the deep gastric ligament, and above this to the stomach (for a distance of 5 mm.) between the deep ligament and the lesser omentum. Beyond the lesser curvature it extends upwards, for 2 mm., upon the gastro-hepatic omentum towards the fissure for the ductus venosus. Its surface is in apposition with the stomach and the upper part of the septum bursarum omentalium. It lies along a line which corresponds to that along which the hepatic branch of the coronary artery usually courses. But this artery is absent, and the fold contains nerve filaments derived from the right and to a certain extent from the left vagi.

This is thus a "simple nervous" fold (see classification, this Journal, vol. xlvi. p. 240).

(*c*) *Contents of the Deep Gastric Ligament.*—". . . la coronaire stomachique parvenue sur la petite courbure se divise en deux branches qui cheminent parallèlement vers le pylore. . . . Il y a donc une double arcade artérielle sur la petite courbure fait qui n'est pas mentionné par les auteurs. . . ."

I dissected the contents of the deep gastric ligament in a number of fœtuses in which it formed a relatively large and thin sheet of peritoneum. The general disposition of the vessels it contains is shown in fig. 3.

The coronary artery gives off in many cases a hepatic, or hepato-œsophageal, branch and divides into posterior and anterior branches (the "posterior" and "anterior" coronary arteries of Jonnesco). The posterior branch courses in the gastric portion of the deep ligament. The anterior leaves the ligament to course in front of, and roughly parallel to, the posterior branch (see figure). The coronary vein, and generally the posterior coronary vein, lie nearer to the free margin of the ligament than do the corresponding arteries (see figure).

In a 21 cm. fœtus the coronary artery and the posterior coronary artery lie in the deep gastric ligament following, and in close relation to, its attached border. The coronary vein and the posterior coronary vein lie more definitely within the ligament, for both are nearer its free margin.

But between the coronary veins and the free edge of the ligament is a distinct interval. Within this portion of the ligament (septum) are placed several tributaries of the coronary veins, a lymphatic node, and filaments of the right vagus, one of which lies close along the free margin of the ligament. These filaments are connected by cross branches to form a kind of plexus; they extend into the parietal portion of the ligament.

In a fœtus 20·4 cm. long the coronary vessels are placed more definitely within the septum, with the veins, as before, nearer the free border; but still closer to this margin are nerve filaments.

In fœtuses 20·3 and 19·3 cm. long the vessels are placed also quite away from the free margin of the ligament.

In a fœtus 17·5 cm. long, with a large, deep gastric ligament, the coronary vein courses side by side with the artery close to the free margin of the ligament (the posterior coronary artery also, in this specimen, lying nearer the free margin than its companion vein). In this and three other specimens the coronary vessels form an angle the vertex of which is situated at the point where the hepatic vein joins the coronary vein (see fig. 3), or at the point of junction of the posterior coronary and coronary veins.

In the 17·5 cm. long fœtus the vertex of this angle lies at the apex of the angular-shaped free border of the ligament. In the others it lies exactly opposite, but at a distance from it. The form of the free edge of the ligament varies, therefore, with the disposition of the vessels within the fold; and the frontal prolongation of the ligament upon the pancreas is, in some cases, associated with the termination of the coronary vein in the splenic vein. Thus in a full-time fœtus the coronary vein, as it lies in the deep gastric ligament, diverges from the coronary artery, and, passing along the free margin of a well-developed frontal prolongation of the ligament (such as is figured in fig. 4), pierces the pancreas and terminates in the splenic vein, ·5 cm. from the place of origin of the portal vein.

The ligament is naturally enough larger and of different shape (with frontal prolongation) than in the specimens in which the vein, although lying along the free border throughout, terminates in the portal vein.

In a fœtus 14·6 cm. long the coronary vessels, forming a curve, lie immediately along the free border of a large, deep gastric ligament.

II. *The Hepatic Portion of the Septum Bursarum Omentalium.*

The hepatic part of the septum always had the hepatic artery lying at its free border. The left surface of this part of the septum was usually completely covered by the Spigelian lobe (see fig. 4, +).

The Superior Area of Gastric Adhesion ("Bare Area" of the Stomach), and its relation to the Deep Gastric Ligament.

There was usually a large bare area. It generally tapers below into the apex formed by the meeting of the lines of attachment of the parietal and gastric borders of the deep gastric ligament. It may descend, however, beyond this point (see fig. 2). Folds may be present prolonging the bare area downwards or outwards. Some of these contain blood-vessels, and lymphatic nodes are present in one (see fig. 2). It may be continuous with the inferior area of gastric adhesion. The greater

curvature of the stomach, in many cases, adhered directly to the diaphragm in place of a gastro-phrenic ligament with a distinct free edge. Can one draw any inferences from the arrangements which I have enumerated?

The supra-adhesion foramen appears (like the "bare area" itself) to be purely secondary in development. Different stages in the formation of the "bare area" are figured in Poirier's *Anatomy* (1905), vol. iv. p. 956; and I have failed to find evidences of an inferior area of gastric adhesion in fœtuses measuring 25 and 37 mm. in length. It was also absent in the two smallest (12 cm. fœtuses) of the larger specimens examined, and also in

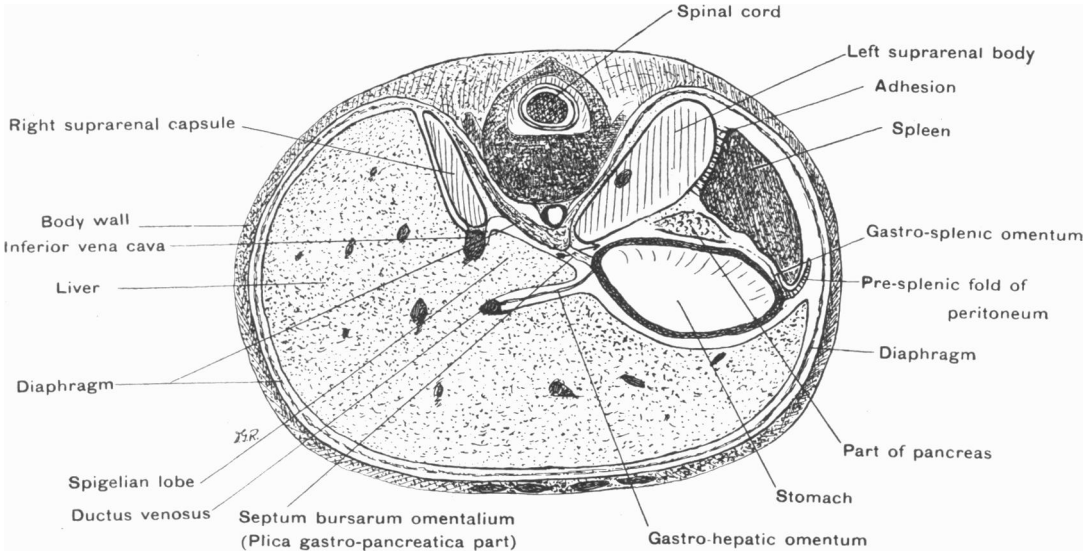

FIG. 7.—Transverse section of a fœtus 15·5 cm. long (vertex-coccygeal measurement). One and a half times the actual size. The arrow indicates the position of the foramen (of Huschke) below the free edge of the plica gastro-pancreatica (part of the septum bursarum omentalium of Huschke). The spleen, of course, does not normally adhere to the suprarenal capsule. It is interesting to compare this section with those (especially fig. 4) of Swaen (*Bibliographie anatomique*, tome vii.), of embryos showing the development of the lesser sac of peritoneum.

a 6·7 cm. fœtus. Its development therefore appears to depend simply on the occurrence of a secondary adhesion between the stomach and the transverse mesocolon, the lesser omentum and the deep gastric ligament being also, in some cases, involved in this adhesion.

The significance of the cords of peritoneum is problematical. They may represent, like the septum bursarum omentalium, a portion of the mesogastrium which has survived and been isolated by the penetration of the frontal diverticulum from the superior omental recess (the first part

of the lesser sac to develop) into the left lamina of the dorso-hepatic partition to form the upper part of the inferior omental recess, which is later extended by growth of the great omentum (see fig. 7).[1]

They may be taken as evidence for the occurrence of such a diverticulum. The "nervous" fold which is attached to the stomach has doubtless been isolated in the same way. In these fœtuses in which the coronary falx is large, the coronary vein, in the two youngest specimens, is placed close to the free edge of the deep gastric ligament. In the older fœtuses this vein lies further away from the free margin. The vessels appear to have receded from the free border, the nerves ("the most conservative of all the structures which go to build up the body")—filaments of the right vagus—being left stranded; and in this manner the ligament may become chiefly "nervous." But even in a full-time fœtus the vein may be placed close along the free edge of a large flattened falx. Here, however, the prolongation of the fold along the pancreas appears to be associated with the place of termination of the vein. But the vein may not be parallel to the free margin of such a prolongation of the ligament along the pancreas. The presence of tributaries of the vein, and of nerve filaments, in this portion of the ligament is, however, to be kept in mind.

The vessels of the "coronary circle" appear thus to form relatively rigid bars about which the peritoneum is excavated and moulded to give rise to the septum bursarum omentalium and a part of the lesser sac of peritoneum.

The posterior coronary artery of Jonnesco, and its significant association with the right vagus, appear well worthy of notice.

An Inferior Area of Gastric Adhesion.

I have already figured and named this area in previous papers (see fig. 1).

An adhesion of the posterior surface of the stomach, from the pylorus (usually) outwards towards the left for a variable distance, to the transverse mesocolon (coated by the posterior (direct) lamina of the great omentum, which in every case was soldered to the antero-superior surface of the transverse mesocolon) is normal. But it is absent in the three smallest (6–12 cm.) of the larger fœtuses examined, as well as in 25 and 37 mm. fœtuses. It appears, therefore, to be secondary in development. It may be termed *the inferior area of gastric adhesion*, and is present in full-time fœtuses as well as in adults.

In the Cambridge dissecting-room I have frequently found very extensive adhesions binding the stomach to the transverse mesocolon, and

[1] A good synopsis of the views (especially of Brachet and Swaen) on the development of the lesser sac is given in Poirier's *Anatomy* (1905), vol. iv. p. 942.

producing, with the fold containing the coronary vessels ("deep ligament of the stomach"), small supra-adhesion foramina.

Although the inferior area of gastric adhesion does not usually extend from the greater to the lesser curvature, it in some cases does so (see figs. 1, 3, 4). In one fœtus (see fig. 1) it extends from the stomach above the lesser curvature, for the adhesions bind down the gastro-hepatic omentum to the transverse mesocolon and also to the anterior surface of the pancreas which was not covered in front by the Spigelian lobe.

The deep gastric ligament may be bound down to the transverse mesocolon (fig. 4). When extensive, and ascending to the lesser curvature, small supra-adhesion foramina are produced (figs. 4, 5, 6). The adhesion may involve the whole of the posterior surface of the long pyloric canal of the stomach, but is not confined to this, extending, in most cases, to the left beyond it. In one case it did not involve the pyloric canal at all, but the stomach just to the left of this. I have frequently noted a type similar to this in adults.

In two fœtuses it is even connected along the lesser curvature of the stomach and across the front of the pancreas with the "bare area," so that there is one large area of gastric adhesions extending from the cardia to the pylorus. The Spigelian lobe thus lies in a compartment of the lesser sac closed except at the vestibule. In other fœtuses, however, it is confined to the part of the stomach in the immediate neighbourhood of the greater curvature; but in these cases it may extend outwards from the pylorus for 15 mm. (in 12 to 22 cm. fœtuses). Along with this area of inferior gastric adhesion the whole of the posterior surface of the duodenum is "bare" in ten out of twenty-three specimens. In others there is a small, sometimes extremely small, part of the first portion of the duodenum free (indicated in fig. 2).

I have already drawn attention to the remarkable adhesions which the great omentum may present (see fig. 1). These are continuous above with the inferior gastric adhesions (see figs. 1, 4). Thus the lesser sac of peritoneum may be constricted to a remarkable extent (see figs. 1, 4); and should the surgeon desire to open into that portion of the lesser sac that lies behind the stomach, his incision should be made in the neighbourhood of the spleen even in a young child.

The firm resistance of the large liver must be remembered in accounting for gastric adhesions; and it is noteworthy that in the fœtus the Spigelian lobe rests on the deep ligament of the stomach (see fig. 4), so that its gastric part is compressed between the liver and the small intestine which lies below the transverse mesocolon, and may secondarily adhere to the mesocolon as a result of this pressure against a relatively unyielding surface.