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TOPOGRAPHICAL ANATOMY OF THE THORAX IN THE FŒTUS AT TERM AND THE NEW-BORN CHILD

BY

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The following anatomical conditions, aside from those connected with the circulatory apparatus and dependent upon the placental type of respiration, impress their character most strongly on the arrangement of the viscera in the fœtal thorax, when contrasted with the form and contents of the adult chest cavity.

1. Differences in extent and configuration of the lungs before and after pulmonary respiration has been established.

2. Differences in the extent of the pleural sacs and of the complementary pleural spaces, especially the costophrenic sinus.

3. Presence of the thymus gland.

4. Relative large size of the fœtal liver, influencing indirectly the arrangement of the thoracic contents by determining the level of the diaphragm.

The following memoranda have been compiled from the examination of the thorax and its contents in five fœtus at term, four newly-born infants who died within a few hours after birth, and two fœtus of 25 and 31 weeks (estimated) respectively.

The material has in all cases been prepared by the preliminary injection through the umbilical vein of a ten per cent. formaline solution, at a hydrostatic pressure varying from one to three feet. This hardening fluid possesses peculiar value for the determination of the topographical relations of the body cavities and viscera. In the strength above indicated the œdematous swelling at times observed with the use of weaker solutions is entirely confined to the subcutaneous connective tissues. The deeper parts, especially the viscera, are hardened *in situ* in such a manner as to preserve, even when removed from the body, their correct form, and to indicate most accurately by the surface markings their natural relationship to surrounding structures. The solution is eminently well adapted to the complete hardening and preservation of the lung. The viscus appears of almost rubber-like consistency, and admits freely of manipulation, without the least impairment of the normal shape, and without disturbing the relations

to surrounding structures. The preparations which can be obtained by this method are of the greatest value in determining the topography of the thoracic cavity. More especially is it possible by their aid to deal with the mutual relations of the lungs and mediastinal contents from an entirely novel point of view. The hardened lung reflects accurately its relation to the thoracic parietes and to the structures contained in the mediastinum.

It is especially desirable to formulate a precise description of the thoracic organs in the fœtus for comparison with the same structures in the adult.* In the following communication this attempt has been made, and although the material is not large, yet the uniform disposition of the more important structures in all the preparations examined affords good ground for regarding the conditions described as conforming to the normal type.

The lungs of the fœtus and new-born infant are free from the disturbing influences which in later life pulmonary disease so frequently exerts on the disposition of the thoracic organs. For this reason the study of fœtal material possesses a special value in the regions in question.

The subject matter of these observations may be arranged under the following headings:

I. Form and External Characters of the Lungs.

A. *Surfaces of the Lungs.*

Each lung presents four surfaces—the viscus having the form of a truncated pyramid, with three unequally developed lateral surfaces converging to a blunt apex, the fourth surface forming the broad base by means of which the organ rests on the convex upper surface of the diaphragm.

The general disposition of the side and basal surfaces is best obtained by examining the hardened lungs of a fœtus in the later months.

Figs. I to IV present the medial and lateral aspects of the right and left lungs of a fœtus estimated to be in the twenty-fifth week, and Figs. V and VI give outline representations of the basal or phrenic surfaces of the same lungs.

The sharp anterior margin (Figs. V and VI, 2) admits readily of the usual division into a lateral or sternocostal convex, and a medial or mediastinal concave surface.

While this sharp differentiation exists along the entire well-defined anterior margin of the lung, the arrangement of the posterior thick portion presents, in the organ detached and removed from the body, greater difficulties. The correct appreciation of this portion of the lung depends upon exact reference to the mediastinal structures and to the part of the thoracic wall with which the same comes into contact.

The examination of the basal outlines of these fœtal lungs shows that

* While this paper was in press, Dr. J. A. Blake, of Columbia University, presented the results of similar investigations of the adult thorax to the Association of American Anatomists at Washington in May of this year. His paper will be published in the Proceedings of the Ninth Annual Meeting of the Association, and will form a very valuable sequel to the present communication.

each presents a cast of its side of the thoracic cavity. The following surfaces can be distinguished:

1. *Sternocostal surface* (Figs. V and VI, 1) extends transversely between the sharp anterior margin (2) and the blunt posterior margin (6), fitted against the concavity of the parietal pleura lining the internal surface of the thoracic wall from the posterior surface of sternum and costal cartilages in front to the line marked superficially by the costal angles behind.

2. *Mediastinal surface* (Figs. V and VI, 3) is included between the anterior (2) and internal margin (4), concave in main, directed inward and somewhat forward in the posterior part, modelled upon the contents of the anterior portion of the mediastinum, especially upon portions of the pericardium, thymus gland, and large vessels covered by the mediastinal pleura.

3. *Costovertebral surface* (Figs. V and VI, 5) directed backwards and inwards, included between the internal (4) and posterior borders (6). This surface is applied to that portion of the parietal pleura which covers the sides of the vertebral bodies and intervertebral disks, the heads of the ribs and sympathetic nerve strand, and the anterior surface of the necks and bodies of the ribs as far out as the point where the latter change their original outward and backward direction to curve forward in the lateral thoracic wall.

The principle adopted in the above definition of the lung surfaces is afforded by the direction of the surfaces, the presence of distinct margins, and the relations to thoracic contents and walls. The mediastinal surface is taken to include all that portion of the medial aspect of each lung which comes indirectly, by means of the interposed mediastinal layer of the parietal pleura, into contact and relation with the visceral, vascular, and nervous structures contained in the mediastinal space. This is quite readily apparent in the anterior parts of this surface, where large impressions exist for adaptation to the bulky thymus gland and pericardium. In the posterior portion of this area the relation to structures entering and leaving the lung at the hilus is well defined, from the intimate connection of these parts with the pulmonary substance. But above, below, and behind the hilus the mediastinal surface of the lung comes into contact with the pleura covering vascular and visceral structures which pursue in main a vertical course in the posterior mediastinum.

The published descriptions of the anatomy of the lung separate a sternocostal and mediastinal surface by the sharp anterior margin, and state in general that posteriorly these pass into each other by means of a thick, rounded posterior border. Even to take the posterior margin of the aortic groove as separating the mediastinal from the parietal surface of the left lung, and the posterior margin of the azygos furrow as separating the corresponding portions of the right lung, is not correct. In the detailed consideration of the relations of the mediastinal pulmonary surfaces, given below, it will be seen that the character of this area is complex, coming into relation with successive structures as they approach or recede from the posterior part of the mediastinal pleural leaf.

It seems, therefore, more in accordance with the actual conditions to define the mediastinal surface as including that portion of the lung which is in relation with the mediastinal pleural reflection covering the vascular, glandular, visceral, and nervous structures of the mediastinal space.

This area is separated by what we have termed the "*internal*" margin from the surface in contact with the parietal pleura investing the walls of the thoracic cavity. This internal margin, varying in distinctness in different parts of its extent, is, therefore, the composite of the successive posterior borders of a series of impressions which result from the relation of this portion of the lung to the pleura investing the longitudinal vascular and visceral contents of the posterior part of the mediastinal space. The details of this margin will be subsequently considered.

The surface of the lung in contact with the pleura covering the thoracic parietes is generally convex, and in the fœtal lung is quite evidently divided into a *lateral* or *sternocostal*, and *posteromedial* or *costovertebral surface*.

The *sternocostal surface* is limited anteriorly by the sharp anterior margin, in which it meets the mediastinal surface. The posterior limit is afforded by a rounded but distinct border (Figs. V and VI, 6), which fits into the vertical groove formed by the succession of ribs and intercostal spaces at the point where the former change their original outward and backward direction to turn forward in conformity with the lateral curve of the thoracic wall.

The *costovertebral surface* extends between this posterior border and the internal margin, as above defined. As the name proposed indicates, this surface comes into relation with the parietal pleura covering the lateral aspects of the vertebral centres and disks and the portions of the ribs and intercostal spaces which extend between the costovertebral line of articulation and the line indicated superficially by the succession of the costal angles.

B. *Changes in External Form During the Later Developmental Stages of the Lungs.*

In the earlier stages of development the posterior border is sharper, and the costovertebral surface is directed obliquely backward and inward (Figs. V and VI). As the lung develops, the increase in size affects primarily the posterior portions.

Figs. VII to XII present the lateral and medial aspects and the outlines of the basal surfaces of the right and left lungs of a fœtus of thirty-one weeks (estimated).

It will be noted (Figs. XI and XII, 6) that the posterior margin is more rounded, and that the costovertebral surface looks almost directly inwards (Figs. XI and XII, 5). This change in direction produces a diminution in the distinctness of the internal margin (Figs. XI and XII, 4) as seen from the basal surface, since the costovertebral surface forms a more direct continuation backwards of that part of the mediastinal surface which is in relation with the vertical structures occupying the posterior mediastinal space. At the same time it will be presently seen that the differentiation of the two surfaces, as indicated by the impressions produced, becomes more marked with the full development of the lung.

Fig. XIII represents the basal aspect of the lungs of a fœtus at term, together with the inferior surface of the pericardium and attached portion of the diaphragm. The same relative changes are to be noted here.

The *phrenic* or *basal surface* of both lungs is uniformly concave, moulded over the convexity of the diaphragmatic cupolæ. The varying proportions in which the different lobes contribute to the formation of this surface will be considered in speaking of the course of the main interlobar incisures.

C. *External Form, Fissures, Incisures, and Lobes.*

The comparison of the fœtal lung in the earlier stages with the fully developed organ at term shows some characteristic changes in form.

1. *Left Lung.*

The lung represented in Figs. III and IV (25 weeks, estimated) gives the following picture:

Elongated, cone-shaped, the sternocostal, costovertebral and mediastinal surfaces narrowing uniformly and gradually to the apex, which presents a smooth, rounded lateral and slightly concave medial surface.

A slight depression (Figs. III and IV, 2), differentiating the apex proper from the posterior border, is produced by the proximal portion of the anterior margin of the first rib. The anterior margin shows a similar though slighter costal impression (Figs. III and IV, 3), separating it from the apex.

The anterior margin appears crenated by a number of short incisures. One of these, *the anterior marginal incisure** (Figs. III and IV, 4), extends somewhat more deeply upward and backward on the medial surface. A second more deeply marked incisure (Figs. III and IV, 5) appears to foreshadow the development of the typical cardiac curve. These secondary fissures represent rudiments of the occasional additional fissure which in the adult at times extends backward from the deepest portion of the cardiac incisure to meet, in extreme cases, the main interlobar incisure, and thus repeat the intermediate fissure of the right lung.

The lung shown in Figs. IX and X (31 weeks, estimated) exhibits, when contrasted with the preceding, the typical changes occurring in the further development of the organ. The most notable difference exists in the upper and apical portions of the lung. The site of the original rounded blunt apex of the cone is still discernible, both the posterior and anterior margins exhibiting the first costal impression (Figs. IX and X, 2, 3).

The anterior marginal fissure (Figs. IX and X, 4) is well marked on both the lateral and medial surfaces. The extent of the upper lobe, measured along the anterior margin between 3 and 4, and along the posterior border between 2 and the intersection of the main interlobar incisure, indicates a very marked antero-posterior expansion of this portion of the lung.

* It has been considered advisable to designate this fissure of the left lung by a special term, on account of its constant occurrence in the earlier stages and the part it plays in the production of the more important fissural variations of the left lung in the later stages.

In the earlier stages (Figs. III and IV) the anterior margin slopes uniformly and gradually downward and forward from the apex to the anterior marginal fissure (4), at an angle of about 45 degrees with the vertical long axis of the posterior border. In Figs. IX and X the same portion of the anterior margin in the older lungs is seen to pass at first forward from the apex, nearly at right angles with the line of the posterior border. It then abruptly turns downward, and recedes somewhat to the beginning of the anterior marginal fissure (4), developing a blunt, nearly quadrangular superior marginal process, which overhangs the cardiac incisure from above.

Below, the lingula is also produced forward and inward, resulting in the hook-like inferior limit of the cardiac incisure. The formation of the wide cardiac incisure is chiefly to be credited to the forward expansion of the anterior portion of the upper lobe, between the apex and the anterior marginal fissure. The anterior margin of the lung in the region of the cardiac incisure presents the same crenated appearance, although the fissures and indentations are relatively smaller and of less depth than in the first lung.

The changes affecting the lower lobe are best appreciated by considering the course of the main interlobar incisure, the extent of the medial surface of the inferior lobe, and the position of the hilus.

In the first lung (Fig. IV) the main interlobar incisure runs a much more vertical course on the sternocostal surface. Fig. IX indicates by the more oblique course of this fissure that in the later stages the growth has involved more especially the anterior and lateral portions of the inferior lobe, resulting in a sagittal increase of the lower portion of the sternocostal surface. Coincident with this, the relative extent of the inferior lobe on the mediastinal surface is less. In the earlier lung (Fig. III) the mediastinal surface of the lower lobe presents a broad triangular area, forming approximately one-third of the entire mediastinal surface, between the main interlobar incisure, the line of attachment of the ligamentum latum, and the medial margin of the phrenic surface. In the later stage this area is reduced in extent, but much more prominent, forming (Fig. X) a sharp triangular process (pericardio-œsophageal tuberosity), to be subsequently considered in detail with the topographical relations of this surface. It is, however, to be remembered that individual variations in the arrangement of the main fissures and incisures are not infrequent. (See below.) As already stated, reference to the outline tracing of the phrenic surface (Figs. VI and XII) shows an expansion and rounding of the posterior margin and a more sagittal direction of the costovertebral surface.

The uncinate character of the lingular process, curving forward and inward, is also to be noted in comparing the basal surface of the second with that of the earlier lung.

The aortic groove becomes much more distinct in the later stage, and in the view of the medial aspect (Fig. X) the beginning of the costovertebral surface dorsal to the groove is to be observed.

The hilus of the more advanced lung occupies a relatively greater area on the mediastinal surface. This is more especially marked in the inferior portion, resulting in a shortening of the ligamentum latum.

In the further development of the external form of the left lung the changes indicated above lead to the establishment of two quite distinct types.

Instances of these are given in Figs. XIV to XVII, representing the sternocostal and mediastinal surfaces of two left lungs at term.

Type 1. *Lung with well-developed cardiac incisure* (Figs. XIV, XV, and XVIII).

The quadrangular form, noted as appearing in IX and X, is here still further developed, due to the great antero-posterior extent of the superior lobe and marked development of the anterior portion of the same above the cardiac incisure. The quadrangular marginal process forming the upper limit of the latter is especially prominent.

The anterior marginal fissure is present and distinct, appearing both on the sternocostal and mediastinal surfaces.

The cardiac incisure is deep, forming three sides of a rectangle, bounded below by the prominent incurve of the hook-like lingula.

The main interlobar incisure on the sternocostal surface meets the inferior margin at a point which would correspond to the vertical prolongation downward, across the root of the lingula, of the bottom of the cardiac incisure.

On the mediastinal surface the inferior lobe presents an extensive area. The course of the main interlobar incisure, in returning to the anterior margin of the hilus, on the mediastinal surface, follows the type indicated in the earlier stages in Fig. III. The incisure meets the anterior border of the hilus nearly at the middle, and a large triangular area, belonging to the mediastinal aspect of the inferior lobe, presents in its anterior and larger part a concavity for adaptation to the left surface of the pericardium, its smaller posterior and inferior segment forming the prominent triangular œsophageal surface.

Type 2. *Absence of cardiac incisure. Assimilation of external form to that of right lung.*

In strong contradistinction to the preceding form is the superficial configuration of the lung shown in Figs. XVI and XVII.

The entire appearance of the lung suggests the structure usually encountered on the right side. The anterior margin is nearly vertical. There is no cardiac incisure. The anterior marginal fissure is well developed and crosses the sternocostal surface so as to nearly intersect the main interlobar incisure. The anterior margin turns with an obtuse angle into the superior division, sloping slightly upward and backward to the apex.

The upper lobe, compared with the first type, is slightly less quadrangular. Possibly the absence of the cardiac incisure, and the consequent increase in lung substance along the anterior and inferior marginal portions of the lung, accounts for the somewhat smaller sagittal extent of the upper part of the superior lobe.

The middle lobe, which is thus marked out on the sternocostal surface, evidently corresponds to a very highly developed lingula.

On the mediastinal surface the main interlobar incisure follows the course indicated previously in Fig. X. It does not quite reach the inferior part of the anterior hilus margin. The mediastinal surface of the inferior lobe is confined to the strongly developed triangular pericardio-œsophageal tuberosity.

The anterior marginal fissure penetrates on the mediastinal surface backward and upward, covering two-thirds of the distance between the anterior lung margin and the anterior border of the hilus.

The difference in the conformation of the left lung and of the cardiac incisure exhibited by the above types appears to be independent of the development of the thymus gland. In both cases a well-developed typical thymus was present. The large size and pronounced character of the cardiac incisure in the first form (Figs. XIV and XV) would appear to negative the view expressed by some authors,* according to which the cardiac incisure does not make its appearance until involution of the thymus permits of greater expansion of the upper portion of the left lung.

2. *Right Lung* (Figs. I, II, V, VII, VIII, XI).

The right lungs of the two younger fœtus of 25 and 31 weeks are represented in medial and lateral views and in projection outline of the basal surface in the above figures.

The differences in the external form of the right lung in the earlier and later stage are of the same character as on the left side, but less pronounced. The right lung of the earlier fœtus is less elongated than the left lung of the same preparation, the greatest sagittal and vertical diameters being more nearly equal.

The pointed apical portion of the earlier stages (Figs. I and II) is, however, again replaced by the more quadrangular form in the older lung (Figs. VII and VIII), due to the sagittal expansion of the upper lobe. The first part of the posterior margin, which inclines obliquely backward and downward in the younger specimen, is directed almost horizontally in the older lung, bringing the apex more into direct continuation with the anterior margin. Later, at term, the expansion of the upper and anterior segment of the superior lobe restores the apex to its position as the upper rounded termination of the posterior margin (Figs. XIX, XX, XXI, XXII). Between the apex proper and the beginning of the vertical portion of the anterior margin, a superior marginal portion passes forward with but a very slight downward inclination (Figs. XIX to XXII). At times, apparently after pulmonary respiration has been inaugurated, the beginning of the vertical portion of the anterior margin is marked on the mesal aspect by a prominent rounded tubercle, which imparts to the superior segment of the marginal portion, between it and the apex, a slight concavity upwards (Fig. XXIII, above 3).

A number of variations are presented in the arrangement of the interlobar fissures of the right lung.

* C. Gegenbauer, Lehrb. d. Anat. d. Menschen, 1890, Bd. ii., p. 104.

a. Sternocostal surface.

(1) The typical form, which corresponds to the usual adult condition, is represented on the sternocostal surface by Fig. VII. The intermediate fissure leaves the main interlobar incisure at an acute angle and passes forward over the sternocostal surface to the anterior margin, its direction being nearly parallel to the course of the anterior part of the inferior margin. The outline of the sternocostal surface of the middle lobe is nearly that of a parallelogram.

(2) In a second form, the middle portion of the intermediate fissure is obliterated, partially or completely (Figs. XVIII and XIX), the fissure developing only at its point of departure from the main interlobar incisure, and again a short distance from the anterior margin.

(3) A third type is presented by the extension of the intermediate fissure dorsad of the main incisure (Fig. XXI). At times this is combined with island formation at the anterior extremity (Fig. II).

b. Mediastinal surface.

The return of the main interlobar incisure of the right lung across the lower portion of the mediastinal surface again presents variations which are similar to those encountered on the left side.

The usual arrangement is indicated in Figs. VIII, XX, XXII, and XXIII. The termination of the fissure meets, or nearly meets, the anterior inferior margin of the hilus, defining the anterior border of an irregularly quadrangular field for apposition to the inferior vena cava (XX, XXII, XXIII, 1). More exceptionally (Fig. I) the fissure returns on the mediastinal surface to the inferior angle of the hilus, nearly excluding the inferior lobe from participation in the composition of the mediastinal surface.

The intermediate fissure usually appears reduced on the mediastinal surface, rarely reaching as far as the anterior border of the hilus.

Figs. I, XX, and XXIII exhibit instances of this limitation of the mediastinal portion of the intermediate fissure. Figs. VIII and XXII afford examples of the more extensive development of this fissure on the mediastinal surface. The beginning of the main interlobar incisure at times traverses the azygos groove (Figs. I and XX), beginning at the upper posterior border of the hilus. The entire posterior segment of the fissure is complete, travelling backward over the costovertebral surface. In other instances the incisure, beginning at the same point, is obliterated in the segment crossing the costovertebral surface (Figs. VIII, XXIII). In other cases the region of the azygos groove is not fissured, the incisure first appearing on the costovertebral surface (Fig. XXII).

c. Phrenic or basal surface.

The greater area, compared with the left side, which the phrenic surface of the right lung presents, is seen, by reference to Figs. V, XI, and XIII, to be mainly due to the greater basal surface of the right middle, as compared with the upper left lobe.

In the earlier stages (V and VI) the basal interlobar incisure passes on both sides obliquely backward and inward toward the medial margin of

the phrenic surface. In the older lungs (XI, XII, and XIII) the direction of the incisure both in right and left lung is more nearly transverse.

On the right side the incisure meets the mediastinal border of the phrenic surface a short distance behind the centre. This change in direction is evidently due to the greater area of contact in the later stages between the postero-internal portion of the right lung and the intrathoracic segment of the inferior vena cava.

Azygos lobe and fissure.

At times the median and posterior portion of the phrenic surface is more or less completely separated from the rest of the inferior lobe by a fissure or set of fissures defining a portion of the lung which corresponds in position and relation to the inferior cava to the infracardiac or azygos lobe of lower mammalia.

Fig. XXV, 1, presents a simple form of this fissure and rudimentary lobe.

In the lung represented in Fig. XXIV a more complex arrangement of this structure exists.

The posterior segment of the fissure—beyond 2—is incomplete, although it can be traced backwards and inwards beneath the investing visceral pleura.

In all cases the anterior portion of the azygos lobe passes forward, forming a blunt, tongue-shaped marginal process (Fig. XXIV, 1) which at times projects some distance beyond the internal portion of the main interlobar incisure, resting in contact with the basal surface of the middle lobe.

(The fœtus *D* and *G*, from which Figs. XXIV and XXV are taken, were twins, both female.)

D. *Attachment of Broad Pulmonary Ligament.*

1. *Right Lung* (Figs. I, VIII, XX, XXII, XXIII, 8).

The pleural fold is attached to the "lower œsophageal area" (*vide infra*) of the mediastinal surface, crossing the same usually somewhat obliquely from the lower angle of the hilus downward and backward.

The sharp, somewhat projecting ridge just anterior to the pulmonary attachment of the fold fits into the angular recess between œsophagus and vena cava.

2. *Left Lung* (Figs. III, X, XV, XVII, 1).

The pulmonary attachment of the fold descends from the lower angle of the hilus, usually just posterior to the œsophageal surface of the œsophageal tuberosity.

The broad pulmonary ligament is formed by a right and left pleural fold, passing between the posterior inferior portion of the mediastinal lung surface, below the hilus and the adjacent surface of the œsophagus. The arrangement of the folds is schematically indicated in Fig. XXXIV, representing a thoracic transection below the region of the hilus.

E. *Arrangement of Main Structures at Hilus.*

1. *Left Lung.*

The typical condition is seen in Fig. XXVII, 12–15.

The section of the structures has been made just before they enter the lung.

The left pulmonary artery (12) occupies the highest position. The section has passed through the vessel at the point where the apical branches for the supply of the superior portion of the upper lobe are given off, the two superior extensions of the lumen seen in the cross cut indicating these vessels. The superior left pulmonary vein (13) lies in front. Immediately behind this vessel, and below the pulmonary artery, the left bronchus appears in section immediately beyond the primary division.

The left inferior pulmonary vein (15) occupies the lowest and most posterior position.

Fig. XXVI shows the same structures divided a little nearer to the lung.

The main pulmonary artery (11) appears above and behind, the superior pulmonary vein (10) above and in front, already divided into two main branches.

Between 10 and 11, and crossed by the forking of the former line, are seen the openings of the two apical branches of the pulmonary artery supplying the upper lobe.

12 and 13 are the two primary bronchial trunks, and the inferior branch of the left pulmonary vein again occupies the inferior posterior angle of the hilus.

2. *Right Lung.*

In Fig. XXX the right bronchus is cut after the division into the eparterial (17) and hyparterial trunks (20).

The apical branches of the right pulmonary artery, supplying the upper lobe (18, 19), appear in front and below the eparterial bronchus. Above the latter, between it and the azygos, appears the apical pulmonary vein (not numbered in the figure).

The main trunk of the pulmonary artery (22) is in this section still quite in front of the hyparterial bronchus.

On the same level, constituting the most anterior structure, appears the section of the upper right pulmonary vein (21), while the inferior pulmonary vein (23) is seen below and behind the hyparterial bronchus.

In Fig. XXVIII the same arrangement of the structures is found, the main pulmonary artery occupying the position between the hyparterial bronchus and right superior pulmonary vein.

In Fig. XXIX the bronchus is cut just at the point of division into eparterial and hyparterial trunks (11). The main pulmonary artery lies in front, applied to the anterior and inferior border of the bronchial cross cut. The apical pulmonary arteries (9, 10) are already given off, and lie in front of the upper (eparterial) portion of the bronchial section.

The upper and lower pulmonary veins occupy the usual position at the anterior and inferior portion of the hilus region.

The sections demonstrate well the early derivation and separate anterior course of the apical pulmonary arterial branches and the position of the main arterial trunk prior to the intersection with the bronchial fork.

II. Topography of Mediastinum and Mediastinal Surface of Lung.

As previously stated, the formaline-hardened lung admits of removal from the thorax without impairing the natural form of the organ. The mediastinal surface of the lung carries with it impressions which correspond to the relations with the mediastinal contents, and which afford a means of determining accurately the extent of such relations. In the following, certain portions of the mediastinal lung surface will be described as being "in contact" with certain structures contained in the mediastinal space. It will, of course, be understood that the mediastinal parietal pleura intervenes. In the same way, to avoid circumlocution, such terms as "œsophageal" or "tracheal" "surface" or "area" will be employed, in describing certain regions of the mediastinal lung surface. Here, again, the interposition of the parietal pleura is assumed without further specification.

1. *Topography of Mediastinal Contents. Right Side.*

In Fig. XXVIII (fœtus at term, *E*) the right lateral view of the mediastinal contents is given, after removal of the lung by division of the structures entering and leaving the viscus at the hilus, the parietal pleura remaining in place. In Fig. XXIX (fœtus at term, *D*) the same structures are shown, with the upper portion of the mediastinal pleura reflected. In Fig. XXX (infant, immediately after birth, *F*) the mediastinal contents, hardened *in situ*, are removed from the thorax and viewed from the right side and behind.

These structures, thus built together and invested by the mediastinal pleura, form the bed upon which the mediastinal surface of the right lung rests. The elevations and depressions of this portion of the parietal pleura, caused by the more marked projection of certain of these structures into the right pleural sac, produce a corresponding modelling of the internal surface of the lung. We will see that the plastic lung substance adapts itself to the opposed mediastinal pleural surface, and takes, so to speak, a negative cast of the inequalities of this surface. The appearance, therefore, of the mediastinal surface of the lung will best be appreciated by first considering the arrangement of the mediastinal contents which produce this appearance.

In Fig. XXVIII the anterior portion of the right sternocostal pleura is seen to be reflected to form the mediastinal leaf, along a curved line, convex forward, which descends from behind the right sternoclavicular articulation, over the anterior surface of the thymus gland and the pericardium. These two structures form together the contents of the anterior and larger division of the mediastinal space.

The lateral surface of the thymus (Fig. XXVIII, 9, Fig. XXIX, 8) constitutes approximately the upper third, the pericardium the lower two-thirds of the area in vertical measurement. In the sagittal direction the area increases steadily from the sharp point with which the lateral surface of the thymus begins to appear in the right mediastinal wall above, to

the broad antero-posterior extent of the right margin of the pericardium at its attachment to the diaphragm below. The lateral surface of the thymus, invested thus by the anterior and upper part of the mediastinal pleura, is plane, or even slightly concave. Between it and the prominent right lateral surface of the pericardium a furrow running obliquely downward and forward receives the ridge which, on the mediastinal surface of the right lung, separates the thymic from the concave pericardial area (Fig. XXX, between 2 and 3).

Behind the thymic area the prominent lateral surface of the right innominate vein and superior vena cava is seen (Figs. XXVIII, 10, XXIX, continuation downwards of 3, XXX, 15). In the fœtus the portion of the right innominate vein in contact with the mediastinal pleura is comparatively short, inclined obliquely across the upper apical portion, whereas the superior cava appears relatively long, directed more vertically downwards, dorsal to the thymus and upper right portion of the pericardium.

The right phrenic nerve descends between the superior cava and the thymus, and lower down crosses the pericardium in front of the structures connected with the pulmonary hilus, to continue along the anterior and lateral circumference of the inferior vena cava to the diaphragm (Figs. XXVIII, 8, XXX, 16).

The posterior portion of the mediastinal space is occupied in its middle third by the structures connected with the lung at the hilus, and already considered in detail in reference to their mutual relations.

Immediately above the upper margin of the hilus region the azygos vein arches from behind forward to join the superior cava (Figs. XXVIII, 2, XXIX, 1, XXX, 4).

Between the innominate and superior caval veins in front, the vertebral column behind, the apex of the pleural sac above, and the azygos arch below, the right mediastinal pleura covers a field (Fig. XXVIII, 1) which, after reflection of the membrane (Figs. XXIX and XXX), is seen to contain the following structures: The right lateral wall of the trachea occupies the central portion of this area (Figs. XXIX, 6, XXX, continuation of 3). The tube is separated from the large venous trunks in front by a quantity of fatty connective tissue and small lymphatic glands (Figs. XXIX, 7, XXX, 13), and is crossed obliquely in the direction from above and in front downward and backward by the right vagus (Figs. XXIX, 5, XXX, 4).

Behind the trachea, between it and the vertebral column, the right lateral portion of the œsophagus appears (Figs. XXIX, 4, XXX, continuation of 1).

At the level of the upper border of the hilus the œsophagus encounters the arch of the azygos vein. The vein is rendered very prominent at this point by the underlying œsophagus, and projects strongly into the right pleural sac. Dorsal to the region of the hilus the vein gradually becomes less prominent, and recedes toward the median line. The right lateral surface of the œsophagus again appears below the arch, between the vertical azygos vein behind and the pericardium and structures at the hilus in front.

The œsophageal surface in contact with the right mediastinal pleura gradually increases as the vein recedes. At the beginning of the lower third of the space the œsophagus has entirely replaced the vein in relation to the pleural leaf. In this situation the inferior œsophageal branches of the vagus are seen shining through the investing pleura (Fig. XXVIII, 4).

Below the hilus and in front of the œsophagus is the prominent posterior and lateral wall of the intrathoracic segment of the inferior cava (Figs. XXVIII, 19, XXX, 24).

Behind the œsophagus and azygos, covered by the costovertebral pleura, are seen the intercostal vessels, and more laterally the longitudinal strand of the sympathetic nerve.

2. *Mediastinal Surface of Right Lung* (Figs. XX, XXII, XXIIa, XXIII).

Boundaries:

In front: anterior sharp margin.

Below: mediastino-phrenic margin.

Behind: internal margin.

This surface of the lung is modelled on the mediastinal pleura covering the contents of the space, as above detailed, and accordingly presents a natural division into three fields of unequal extent and conformation.

(1) *Region in Front of Hilus.*

a. Thymic area.—The upper third is formed by a smooth, slightly convex surface in apposition with the parietal pleura covering the lateral surface of the thymus gland (*thymic area*) (Figs. XX, XXII, XXIII, 3), and moulded over the form of this organ. The thymic area occupies the upper half of the medial surface of the upper lobe.

b. Pericardial area.—The lower two-thirds of the anterior region include nearly equal portions of the upper and middle lobes, forming a concave surface (*pericardial area*) moulded over the prominence of the pericardium (Figs. XX, XXII, XXIII, 2). This area extends backward to the anterior margin of the hilus, and presents immediately in front of the latter a narrow, linear, nearly vertical furrow, resulting from its relation to the right phrenic nerve.

The pericardial area is separated from the thymic surface by a moderately prominent blunt ridge, which corresponds to the furrow between the lateral surface of the thymus and the pericardium.

(2) *Region of Hilus.*

a. Hilus.—Irregularly oval, with longest diameter in the long axis of the lung. The posterior border is nearly vertical; the anterior, convex. The upper extremity is blunt, quadrangular; the lower extremity pointed.

The arrangement of the chief structures entering and leaving the lung at the hilus has been described above in detail.

b. Surface above hilus presents in front a sharply defined vertical groove for the reception of the lateral surface of the right innominate and superior caval veins. (Figs. XX, XXII, XXIII, 4). The posterior border of this groove, immediately above the hilus, is interrupted by the junction of the caval depression with the deep groove lodging the terminal

part of the azygos vein (Figs. XX, XXII, XXIII, 6). The latter curves from behind forward, following closely the superior margin of the hilus.

Anteriorly the caval impression is prolonged down to nearly the middle of the anterior margin of the hilus, forming by its anterior margin the posterior boundary of the thymic area.

Behind the caval impression is a smooth quadrangular field (Figs. XX, XXII, XXIII, 5) in contact with the parietal pleura, which here covers smoothly the right lateral surface of the trachea, the peritracheal lymphatic and fatty connective tissue, and the right vagus, which crosses this segment of the trachea obliquely from above and in front downwards and backwards.

c. Surface below hilus.—A rectangular portion of the inferior lobe, deeply concave, surrounds the lateral aspect of the inferior cava (Figs. XX, XXII, XXIII, 1).

This caval surface is bounded above by the inferior margin of the hilus, in front by the prolongation of the main interlobar incisure from the phrenic surface upward and backward upon the mediastinal surface to the lower part of the anterior border of the hilus. Behind, the caval area is limited by a prominent vertical ridge of lung tissue, which fits into the deep angular interval between the œsophagus and the vena cava, and which carries along its dorsal margin the attachment of the broad pulmonary ligament.

(3) *Region behind Hilus.*

This region is occupied by a narrow, vertical field, enlarging somewhat below, which separates the mediastinal from the costovertebral surface, and which is in relation with the œsophagus and the proximal portion of the azygos vein, both structures which produce more or less well marked grooves on this portion of the lung surface.

Above the level of the upper border of the hilus, from the region of the apex down, a narrow, vertical area, situated dorsal to the smooth tracheal surface, is in contact with the mediastinal pleura covering the upper thoracic portion of the œsophagus. This area is separated from the costovertebral surface by a prominent, well-defined, sharp margin, passing into the apical region above, and continuous below with the posterior border of the azygos groove. This margin (Figs. XX, XXII, and XXIII, behind 5) fits into the angle between the upper portion of the œsophagus and the vertebral column.

At the level of the upper border of the hilus the sharply defined curved groove caused by the arch of the azygos vein turns downward, dorsal to the hilus (Figs. XX, XXII, XXIII, 6). In the beginning of its vertical course the groove is well marked. In some lungs a faint impression crosses the upper part of the costovertebral surface obliquely, to join the azygos groove. This second impression is caused by the superior intercostal vein.

Below, the azygos groove gradually becomes less distinct, and merges into a somewhat broader surface, which lies between the posterior margin of the hilus and the costovertebral surface. Reference to the structures

left *in situ* in the posterior part of the mediastinum after removal of the right lung explains this appearance (Figs. XXVIII, XXX). The azygos vein, ascending in the mediastinum, occupies in main a nearly medial position, only beginning to deviate markedly to the right on reaching the level of the sixth thoracic vertebra. Above this point the vein comes into close contact with the right mediastinal pleura and impresses the mediastinal surface of the lung behind the hilus, as indicated. Below this point the vein gradually recedes from the mediastinal pleura, and, on reflecting the membrane, the right lateral margin of the œsophagus begins to appear between the posterior margin of the hilus and vein. This œsophageal area begins above as a narrow pointed surface which expands in descending, until in its lower portion it equals the inferior vena cava in sagittal measure. With the parts undisturbed and in their natural condition, the gradual recession of the azygos vein from contact with the right mediastinal pleura, and its replacement in relation to the membrane by the right border of the œsophagus, is affected without producing any abrupt line of demarcation. Consequently, in the hardened lung removed from the thorax, the azygos groove, sharp and well defined above, gradually fades out below the middle of the hilus, and is replaced by the broader, smooth surface in contact with the mediastinal pleura investing the œsophagus (Figs. XX, XXII, XXIII, 7).

The entire region of the mediastinal lung surface dorsal to the hilus is, therefore, composed of an upper narrower and lower wider œsophageal area, separated from each other by the surface in contact with the azygos vein. The latter structure is rendered prominent in the upper mediastinal region by its course upward, forward, and to the right, and by the underlying œsophagus. Below the middle of the hilus, on the other hand, the vein gradually recedes from the mediastinal pleura and lies nearer the median line, being enabled to assume this position by passing behind the œsophagus, the latter tube gradually inclining forward, and ceasing its close apposition to the anterior surface of the vertebral column.

The relative extent of these areas of relation of the mediastinal lung surface with the contents of the mediastinum is shown schematically in Fig. XXIIa.

3. *Topography of Mediastinal Contents. Left Side.*

Fig. XXVI shows the mediastinal contents *in situ* covered by the pleura in a fœtus at term (*D*), and Fig. XXVII shows the same structures removed from the thorax, with the pleura partially reflected, in the infant immediately after birth (*F*).

In front, as on the right side, the lateral surface of the thymus gland (XXVI, 5, XXVII, 4) appears above, the prominent pericardium (XXVI, 7) below, the latter crossed obliquely by the left phrenic nerve (XXVI, 6, XXVII, 5). At the upper and posterior margin of the left pulmonary root, the arch of the aorta produces a marked elevation of the mediastinal pleura, which is continued along the entire posterior border of the mediastinum by the thoracic aorta, the elevation becoming gradually less marked as the vessel approaches the diaphragm (XXVI, 15, XXVII, 16).

Above the level of the upper hilus margin, between the vertebral column behind and the thymus gland in front, the mediastinal pleura covers the following structures:

1. Immediately in front of the vertebral column the left margin of the œsophagus (XXVI, 7).

2. The intrathoracic segment of the left subclavian artery, forming a prominent rounded ridge in the mediastinal wall (XXVI, 8, XXVII, 6).

3. In front of the subclavian elevation the mediastinal pleura covers smoothly a field (presubclavian) (Fig. XXVI, 4) in which are placed the left common carotid artery (XXVII, 8), the left vagus (XXVII, 9), and a quantity of fatty and lymphatic tissue (XXVII, 3) which lies behind the thymus and left innominate vein.

The latter structure appears in the upper and anterior angle of this surface behind the thymus (XXVII, continuation downward of 1), and frequently receives the left superior intercostal vein (Fig. XXVI, 9, XXVII, 11), which passes upward and forward from below and behind, crossing the aortic arch and pneumogastric nerve, the nerve being placed between the arch and the vein.

The internal mammary artery (XXVII, 2) crosses the upper angle of the lateral thymus surface and the innominate vein (XXVII, 2), and the upper part of the intrathoracic segment of the left phrenic nerve descends behind the innominate vein, crossing usually over the point of entrance into the latter of the superior intercostal vein.

Below the hilus the pericardium projects decidedly into the left pleural compartment. This is especially marked along the posterior inferior segment, where the pericardium covers the prominent posterior part of the left thick ventricular margin and the adjoining posterior and inferior part of the left auricle.

Between the elevation of the posterior part of the left mediastinal leaf produced by the thoracic aorta behind (XXI, 15, XXVII, 16), the diaphragm below, the portion of the pericardium referred to in front and above, with the entrance of the left inferior pulmonary vein as its upper limit (XXVII, 15), the left pleural cavity exhibits a deep triangular recess, bounded internally by the pleura covering the left side of the lower thoracic segment of the œsophagus. One-half of the circumference of the œsophagus appears thus in the inner wall of this recess, after the tube has passed the posterior surface of the left auricle, in the interval between aorta behind, pericardium in front, and diaphragm below (XXVI, 16, XXVII, 18).

4. *Mediastinal Surface of Left Lung.*

This surface corresponds to the structures above described, and is modelled accordingly (Figs. XV, XVII, XVIIa). The lower and longer part is occupied by the deep and well-marked impression for the left side of the pericardium (XV, XVII, 7). The greater portion of this pericardial surface is formed by the medial surface of the upper lobe. A portion of the inferior lobe contributes a smaller pericardial surface to be presently considered in detail.

ERRATUM.

Page 340 (of Report), 5th line from top, instead of "(XXVI, 7)" *read* "(XXVI, crossed by line 8; XXVII, 10)."

Immediately above the pericardial area the medial surface of the left lung rests on the mediastinal pleura covering the left lateral surface of the thymus gland. This thymic surface (XV, XVII, 6) in the hardened lung is plane or slightly convex, and is separated from the pericardial depression immediately below by a raised curved margin, with the concavity directed downward and backward, which corresponds to the curved groove separating the thymus *in situ* from the pericardium. In well-hardened lungs a faint linear impression descending obliquely along the posterior margin of the thymic area is due to the left phrenic nerve.

Above the hilus the medial surface of the lung is grooved by the arch of the aorta (XV, XVII, 3). This groove begins as a faint depression which rapidly deepens until it obtains its greatest development just above and behind the superior posterior angle of the hilus. At this point a narrower, deep, nearly vertical groove passes upward to the upper margin of the lung, produced by the intrathoracic segment of the left subclavian artery.

Between the subclavian groove behind, the upper border of the aortic furrow below, the upper lung margin above, and the thymic surface in front, the medial aspect of the left lung presents a smooth, nearly plane field (presubclavian area, XV, XVII, 5), which rests on the mediastinal pleura covering the proximal portion of the left common carotid artery and the left vagus, embedded in a quantity of fatty and granular connective tissue.

If the superior intercostal vein is large, a shallow linear impression may be produced by it, intersecting the aortic groove obliquely.

Behind the hilus the aortic groove continues to be marked, descending nearly vertically. It can be followed to the lower border of the lung, growing gradually somewhat shallower.

Below the hilus, and in front of the lower portion of the aortic groove, the medial lung surface presents a well-marked triangular process, which can be called, with regard to its relations, the pericardio-œsophageal tuberosity. It occupies the triangular mediastinal recess above described, between aorta behind and pericardium in front, and containing at the bottom the left wall of the œsophagus.

The pericardio-œsophageal tuberosity is a product of the medial surface of the inferior lobe. It starts just in front of the lowest point of the hilus in form of a ridge (XV, XVII, 2), which gradually becomes more and more elevated in proceeding downward, forward, and inward. The tuberosity thus produced presents three surfaces, two mediastinal and one phrenic. The phrenic surface constitutes the most anterior and medial portion of the area which the inferior lobe contributes to the formation of the basal surface of the left lung (Fig. XIII, 4).

The mediastinal surfaces are an anterior and a posterior. The anterior surface (XV, XVII, 8) is concave, and contributes to the formation of the pericardiac depression.

In some instances the return of the main interlobar incisure to the anterior and inferior border of the hilus on the medial surface of the lung

limits this pericardial surface of the tuberosity above and in front (Fig. XVII).

In other cases the pericardial surface contributed by the inferior lobe is much larger and exceeds the limits of the tuberosity. The interlobar incisure then passes upward and backward more vertically from the anterior part of the mediastino-phrenic border, and reaches the hilus nearly at the middle of its anterior margin (Fig. XV). In such a case the pericardial surface of the tuberosity is continuous with the general pericardial surface of the inferior lobe, constituting the posterior inferior segment of the same.

The posterior, or œsophageal, surface of the tuberosity (XV, XVII, 9) looks backward and inward, and rests upon the pleura covering the portion of the œsophagus which appears between aorta, pericardium, and diaphragm. The surface is triangular, with a broad posterior vertical base. The lateral borders are formed below by the postero-internal part of the sharp mediastino-phrenic margin of the lung, and above and in front by the ridge above described as proceeding from the lower angle of the hilus. This ridge separates the pericardial from the œsophageal surface, and corresponds to the depression between pericardium and œsophagus.

The pericardio-œsophageal tuberosity of the left lung evidently corresponds to the elevated ridge of lung tissue which, on the right side, fits into the narrow interval between œsophagus behind and the inferior vena cava in front.

The attachment of the broad ligament is dorsal to the œsophageal surface of the tuberosity, the layers descending almost vertically from the lower angle of the hilus. At the attachment of the ligament to the lung, or just anterior to this line, a sharp vertical ridge is frequently observed which fits into the depression between aorta and œsophagus.

In well-hardened lungs a vertical linear impression, descending over the costovertebral surface, indicates the relation to the sympathetic strand and the line of the costal capitula.

The relation of the thoracic duct to the mediastinal pleura has not been determined in the above preparations, as the demonstration of the same would produce too much disturbance in the arrangement of the remaining structures.

With this exception the above account is believed to present the main relations of the lungs and mediastinal contents correctly.

III. Thymus Gland.

(Figs. XVIII, XXIV, XXVI, XXVII, XXVIII, XXXI, XXXII, XXXIII.)

The gland, situated partly within the thorax, partly in the anterior cervical region, is placed in front of the pericardium and the beginning and termination of the large vessels, accurately adapting itself to the structures with which it comes into contact.

The thoracic portion presents in the gland hardened *in situ* five distinct surfaces, as follows:

Anterior, mediastinal.

Two lateral, pleural.

Posterior, vascular.

Inferior, pericardiac.

The arrangement of the surfaces is well seen in the view of the gland *in situ* from the side, as in Fig. XXVIII. The anterior or mediastinal surface is directed upward and forward in the upper, more directly forward in the lower, part. Viewed from in front (Figs. XVIII, 1, XXXI, 10) this surface is seen to be triangular, with the apex directed downward. Above, the base is continuous with the anterior surface of the cervical portion (XVIII, 5, XXXI, 7). The sides are bounded by the sternocostal-mediastinal reflections of the right and left parietal pleura (XXXI, 3, 11), which pass from the sternum directly backward, to invest the lateral surfaces of the gland.

The inferior surface looks backward and downward, and rests on the upper and anterior portion of the pericardium.

The lateral surfaces (XXVII, 4, XXVIII, 9), invested by the anterior portion of the mediastinal pleura, look directly outward, and are in relation with the thymic area on the medial surface of each lung.

The phrenic nerve descends on each side, near the posterior border of the lateral surface (XXVIII, 8, XXVII, 5). On the right side this posterior border rests on the right innominate vein and the superior cava (XXVIII, 10). On the left side the posterior limit of the lateral surface is formed above, for a short distance, by the left innominate vein; below, by some fatty and lymphatic gland tissue lying between the vein, the trachea, and the left common carotid artery (XXVII, 3). The upper angle of this surface is crossed from behind forward by the left internal mammary artery (XXVII, 2).

The greatest interest attaches to the posterior surface and to the relations of the gland to the large venous trunks in the upper and anterior portion of the mediastinum.

In the typical arrangement the left innominate vein is situated entirely behind the gland. Fig. XXXI shows the aberrant course of the vein in front of the gland. This arrangement was first observed by Astley Cooper in 1832.* Wenzel Gruber† in 1876 reported two additional cases. The same author‡ observed seven cases in which the vein passed through the substance of the gland.

The prethymic position of the left innominate vein is, therefore, an extremely exceptional one. In the case observed by us (Fig. XXXI, 9) the vein traversed the upper portion of the mediastinum immediately behind the manubrium, imbedded in a deep groove on the anterior surface of the thymus, separating the cervical (7) from the thoracic portion of the

* The Anatomy of the Thymus Gland. London, 1832.

† Virchow's Archiv, Bd. 66, 1876, p. 462: "Anatomische Notizen, No. lii."

‡ Beobacht. a. d. Menschl. u. Vergl. Anat., I. Heft, p. 41. Berlin, 1879.

gland (10). Fig. XXVII presents the right lateral view of the same fœtus, showing the relation of the vein (7) to the two portions of the gland.

Figs. XVIII, 1, 6, XXVI, 1, 5, XXIX, 8, show the anterior and the left and right lateral views of the thymus in a fœtus at term (*D*), and Fig. XXXII shows the mediastinal contents of the same individual seen from above, with the thymus partly detached and turned downward and forward. The posterior surface of the gland is seen to rest on the pericardium (13) covering the right auricular appendix (14), the ascending aorta (11) and the pulmonary artery (12). On the right side the anterior surface of the superior cava is in contact with the gland.

The upper and anterior portion of the gland is prolonged into the neck in form of an assymmetrical superior cornu (XVIII, 5, XXVI, 1) which lies in front of the left innominate vein (superior prevenous cornu). On turning this portion of the gland downward and forward (XXXII) a second upper process (superior retrovenous cornu, XXXII, 10) is seen to pass up behind the vein, lying between it and the large arteries at the root of the neck. This case, therefore, is an additional instance of partial retrovenous position of the gland.

The earlier stages of development of the thymus show very clearly how this position is acquired. Fig. XXXIII shows the anterior view of the thoracic contents in a fœtus (*H*) of the latter part of the fourth month. The left innominate vein (1) passes in a groove along the upper border of the thymus gland. The cervical portion of the gland has not yet developed, but is indicated by the slightly more prominent anterior margin of the groove containing the vein. By the further growth of this portion of the gland the upper segment of the thymus attains its usual position in front of the vein.

If the posterior border of the groove develops at the same time, the retrovenous process (XXXII, 10) results; and if this border gives rise to the entire upper segment of the gland, the innominate vein will course in front of the same, at the junction of the thoracic and cervical portions.

The cervical portion is very variously modified by the different form and size of the upper processes and cornua, which frequently reach to the lower border of the thyroid gland.

In the usual arrangement, the more flattened cervical portion is separated when hardened *in situ* from the prismatic thoracic portion by a constriction or neck produced on each side by an oblique groove in which the internal mammary vessels are placed (Fig. XXVII, 2).

Explanation of Figures.

(The letters refer to the individuals, indicating the plates taken from the same fœtus.)

Figs. I to IV. Right and left lungs of fœtus of 25 weeks (estimated) (*A*), medial and lateral surfaces.

1. Pulmonary attachment of broad ligament.
2. Posterior apical costal sulcus.
3. Anterior apical costal sulcus.

Figs. I to IV. Right and left lungs of fœtus of 25 weeks (estimated) (*A*), medial and lateral surfaces.

1. Pulmonary attachment of broad ligament.
2. Posterior apical costal sulcus.
3. Anterior apical costal sulcus.
4. Anterior marginal fissure.
5. Secondary fissure of cardiac incisure.

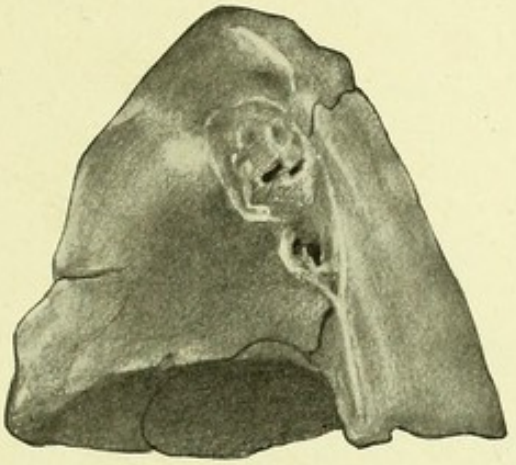

Fig. I.

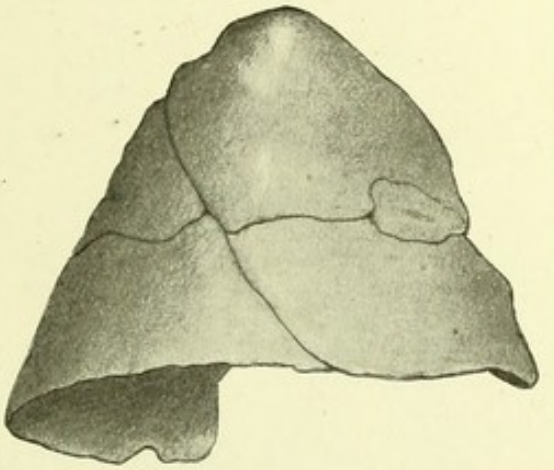

Fig. II.

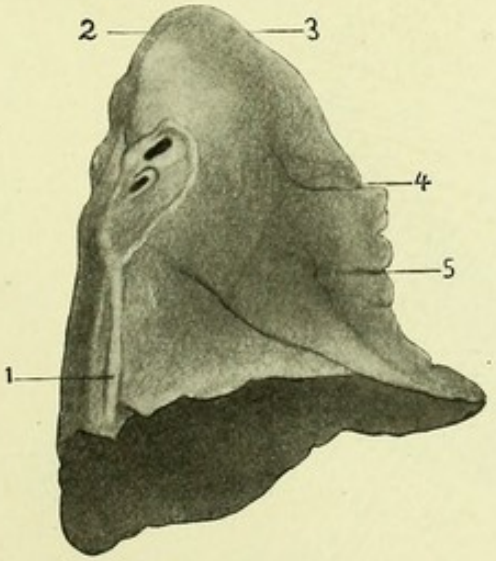

Fig. III.

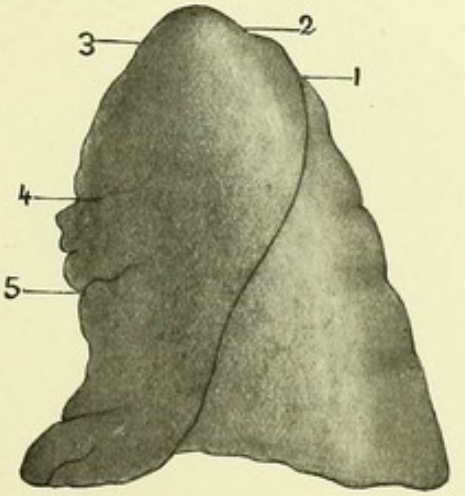

Fig. IV.

Figs. V and VI. Outline representations of the basal surfaces of the same lungs (*A*).

1. Sternocostal surface.
2. Anterior margin.
3. Mediastinal surface.
4. Internal margin.
5. Costovertebral surface.
6. Posterior margin.

Figs. VII to X. Right and left lungs of fœtus of 31 weeks (estimated) (*B*), medial and lateral surfaces.

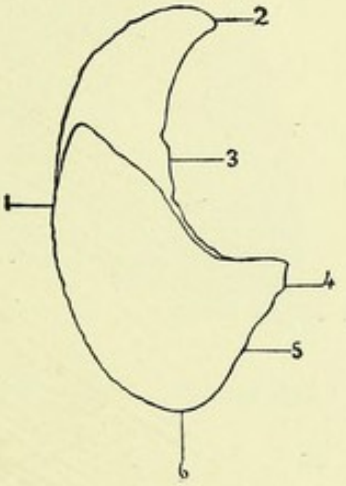

Fig. V.

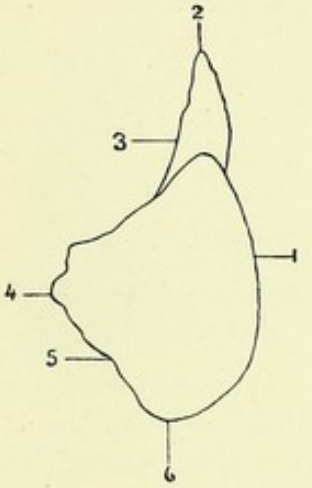

Fig. VI.

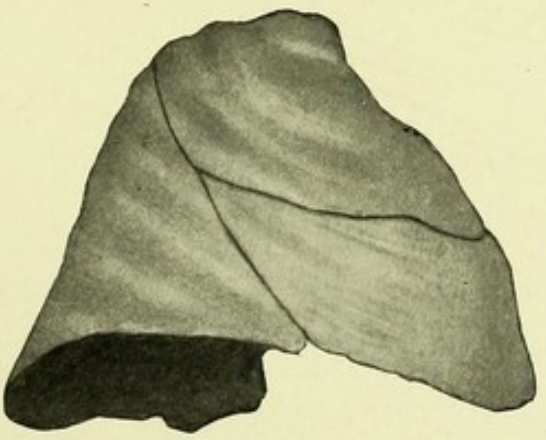

Fig. VII.

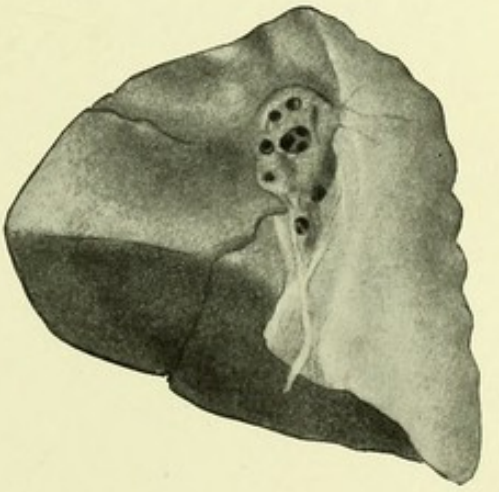

Fig. VIII.

Figs. VII to X. Right and left lungs of fœtus of 31 weeks (estimated) (*B*), medial and lateral surfaces.

1. Pulmonary attachment of broad ligament.
2. Posterior apical costal sulcus.
3. Anterior apical costal sulcus.
4. Anterior marginal fissure.

Figs. XI and XII. Outline representations of the basal surfaces of the same lungs (*B*).

1. Sternocostal surface.
2. Anterior margin.
3. Mediastinal surface.
4. Internal margin.
5. Costovertebral surface.
6. Posterior margin.

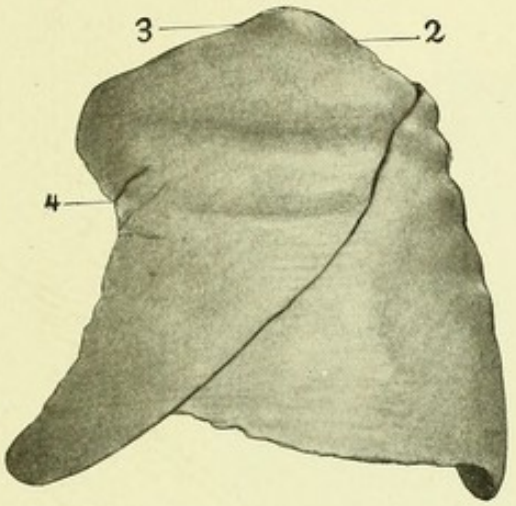

Fig. IX.

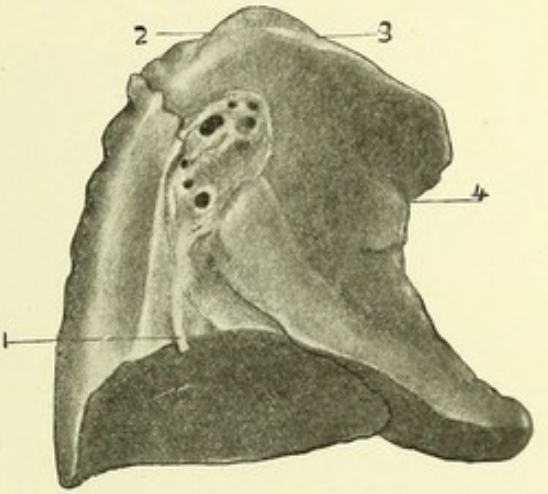

Fig. X.

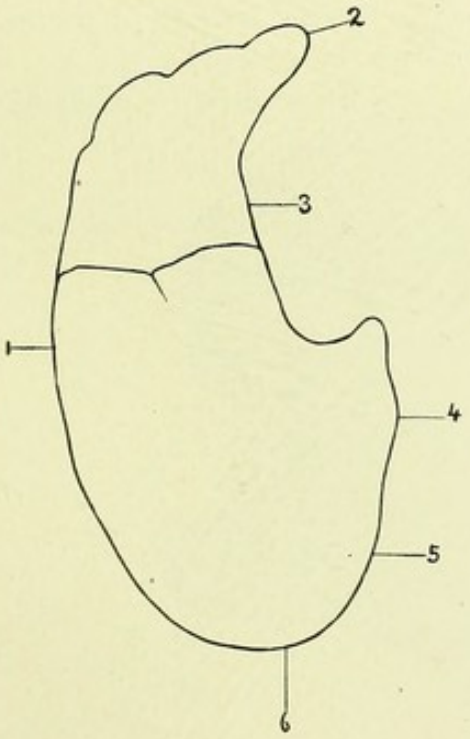

Fig. XI.

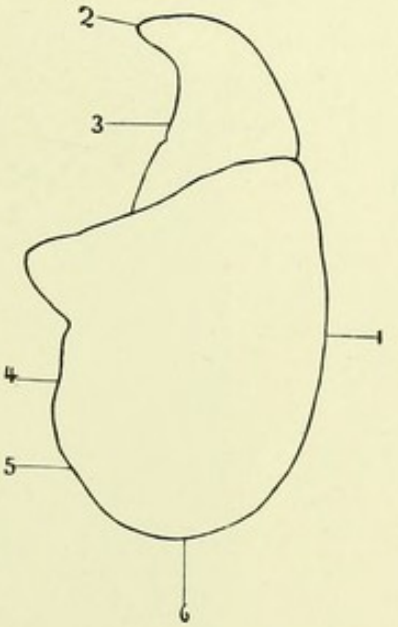

Fig. XII.

Fig. XIII. Fœtus at term (*C*). Basal view of hardened lungs and heart removed together from thorax.

1. Portion of medial margin of phrenic surface in contact with right side of œsophagus.
2. Inferior vena cava.
3. Portion of diaphragm attached to inferior surface of pericardium.
4. Œsophageal tuberosity of left lower lobe, basal surface.
5. Portion of medial margin of phrenic surface in contact with left side of œsophagus.
6. Phrenic margin of aortal surface.

Fig. XIV. Fœtus at term (*D*). Left lung. Sternocostal surface.

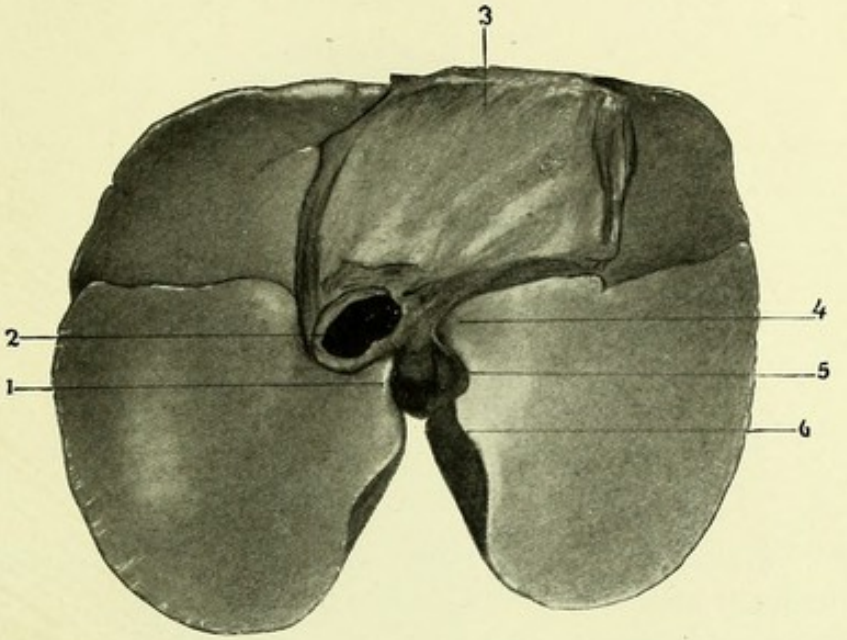

Fig. XIII.

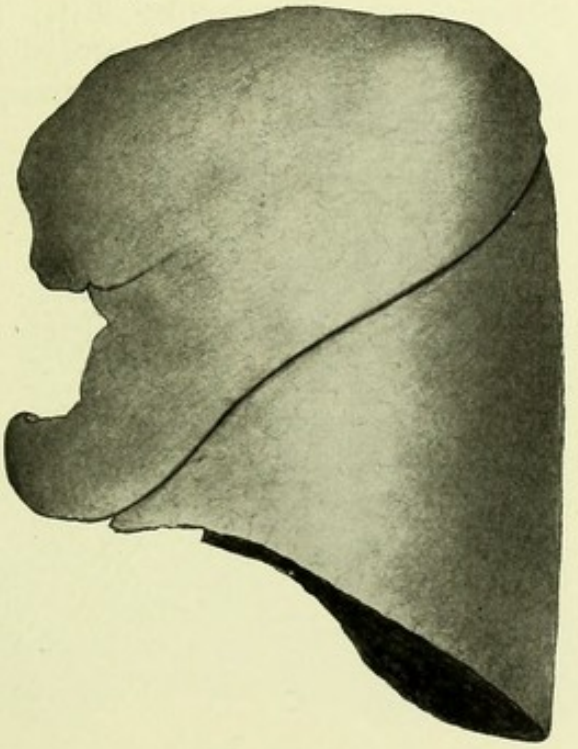

Fig. XIV.

Fig XV. Fœtus at term (*D*). Left lung. Mediastinal surface.
1. Pulmonary attachment of ligamentum latum.
2. Pericardio-œsophageal tuberosity.
3. Aortal groove.
4. Subclavian groove.
5. Presubclavian area.
6. Thymic surface.
7. Pericardial surface.
8. Pericardial surface of pericardio-œsophageal tuberosity.
9. Œsophageal surface of pericardio-œsophageal tuberosity.

Fig. XVI. Fœtus at term (*E*). Left lung. Sternocostal surface.

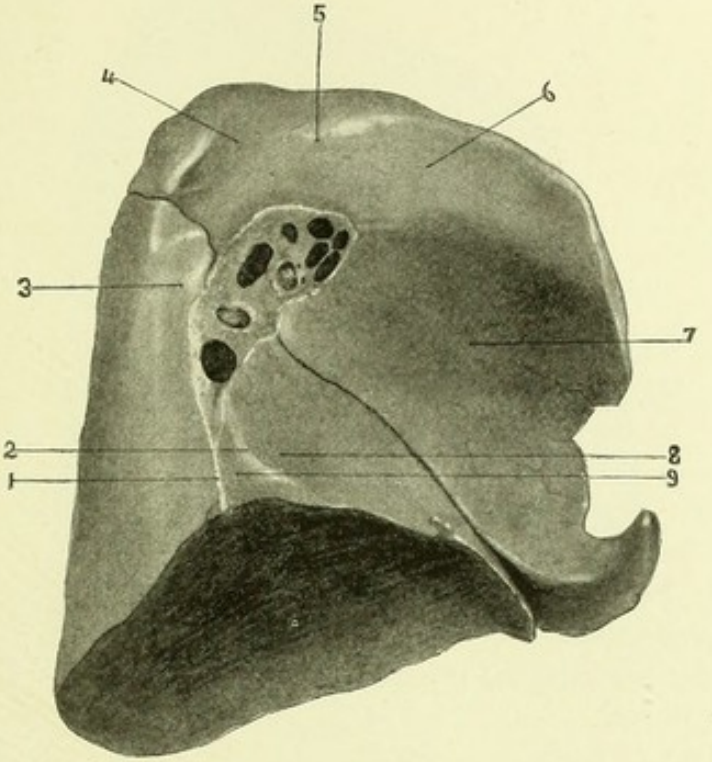

Fig. XV.

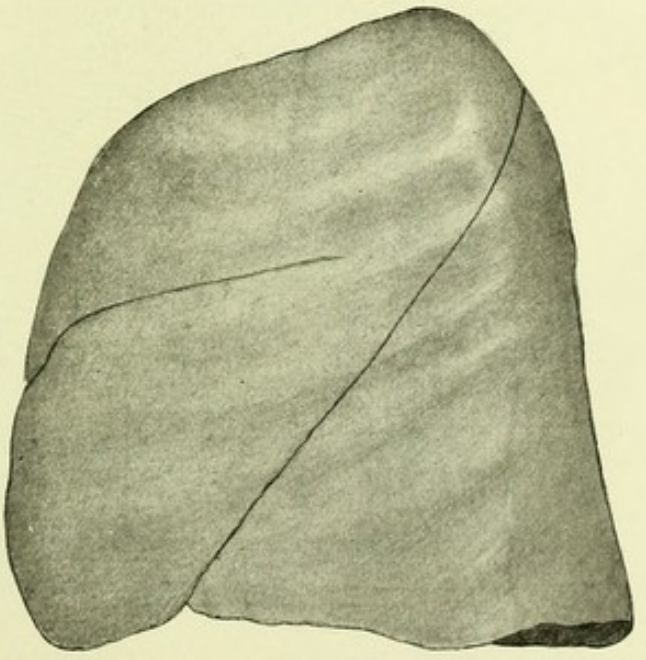

Fig. XVI.

Fig. XVII. Fœtus at term (*E*). Mediastinal surface.

1. Pulmonary attachment of ligamentum latum.
2. Pericardio-œsophageal tuberosity.
3. Aortal groove.
4. Subclavian groove.
5. Presubclavian area.
6. Thymic surface.
7. Pericardial surface.
8. Pericardial surface of pericardio-œsophageal tuberosity.
9. Œsophageal surface of pericardio-œsophageal tuberosity.

Fig. XVIIa. Schematic figure, indicating relations of mediastinal surface of left lung.

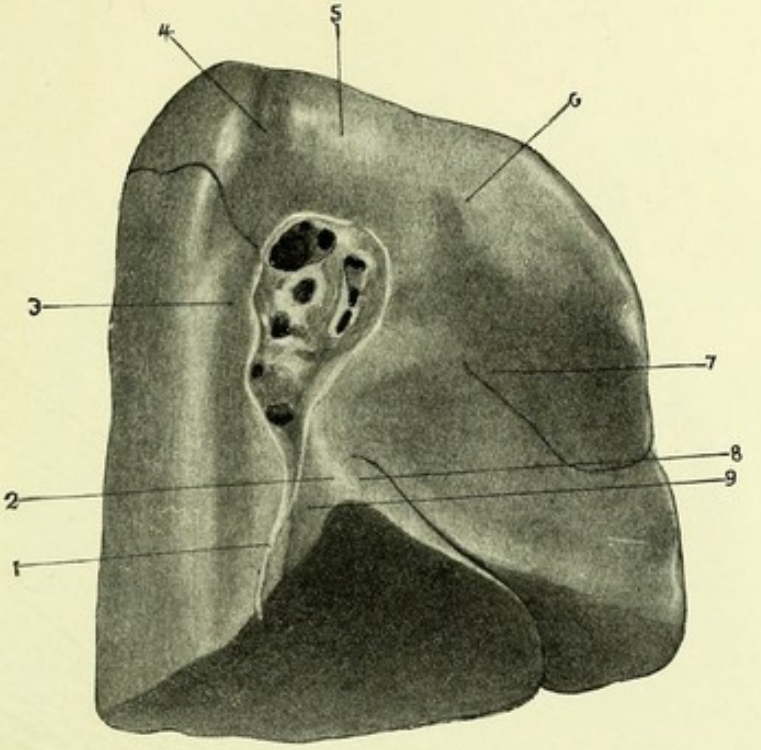

FIG. XVII.

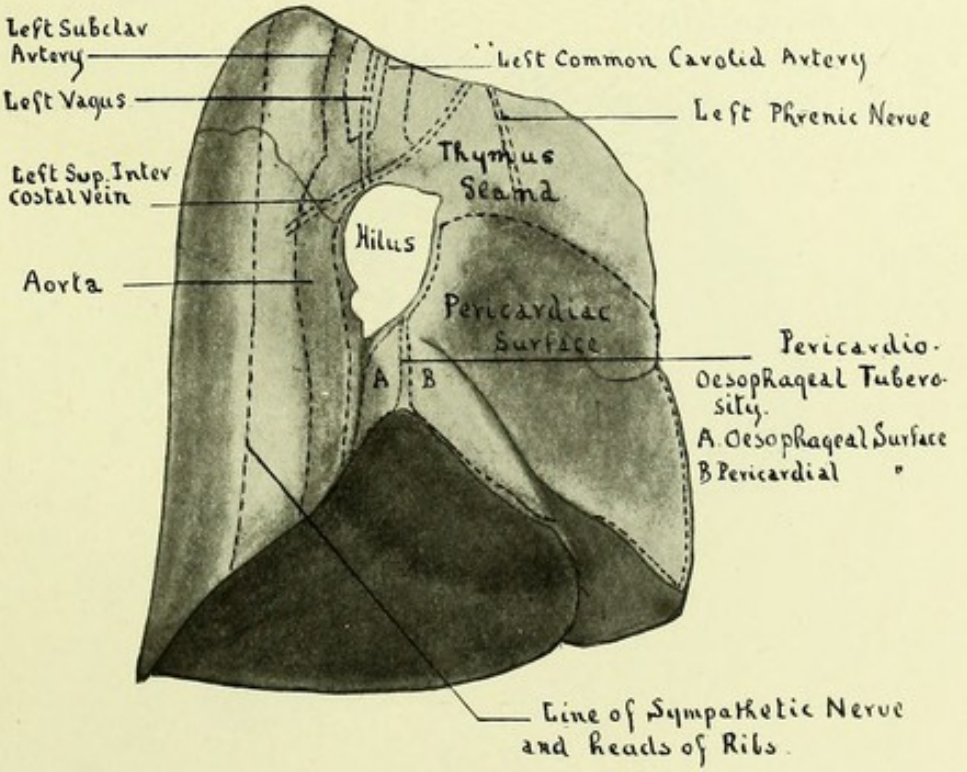

FIG. XVIIa.

Fig. XVIII. Fœtus at term (*D*). Anterior view of lungs and mediastinum *in situ*.

1. Anterior surface of thoracic portion of thymus gland.
2. Junction of right subclavian and internal jugular veins.
3. Right common carotid artery.
4. Inferior thyroid vein.
5. Superior prevenous cornu of thymus gland.
6. Left innominate vein.
7. Left subclavian artery.
8. Parietal pericardium divided by a cruciform incision.

Fig. XIX. Fœtus at term (*D*). Right lung. Sternocostal surface.

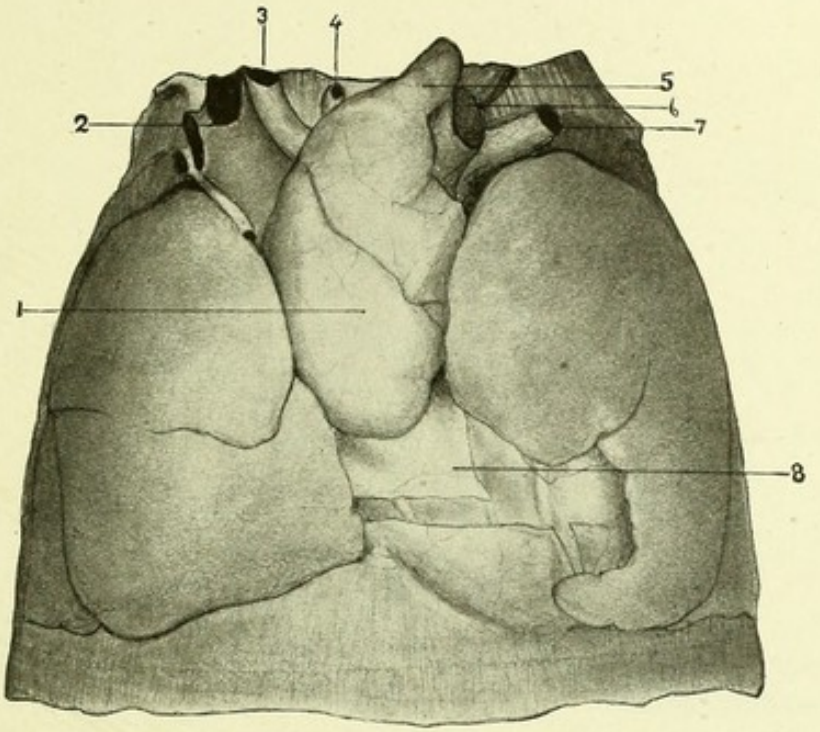

Fig. XVIII.

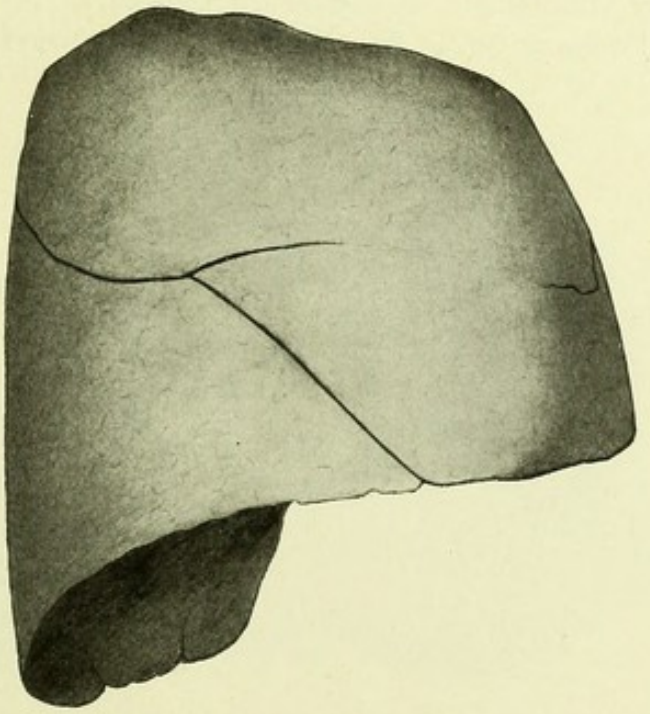

Fig. XIX.

Fig. XX. Fœtus at term (*D*). Right lung. Mediastinal surface.

1. Inferior caval surface.
2. Pericardial surface.
3. Thymic surface.
4. Innominate and superior caval surface.
5. Tracheal and upper œsophageal surface.
6. Azygos groove.
7. Lower œsophageal surface.
8. Pulmonary attachment of ligamentum latum.

Fig. XXI. Fœtus at term (*E*). Right lung. Sternocostal surface.

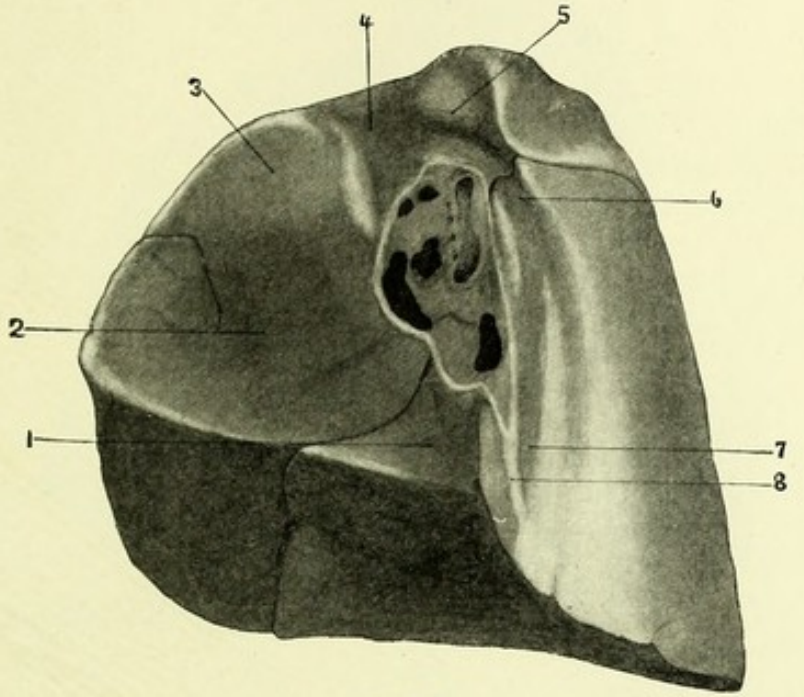

Fig. XX.

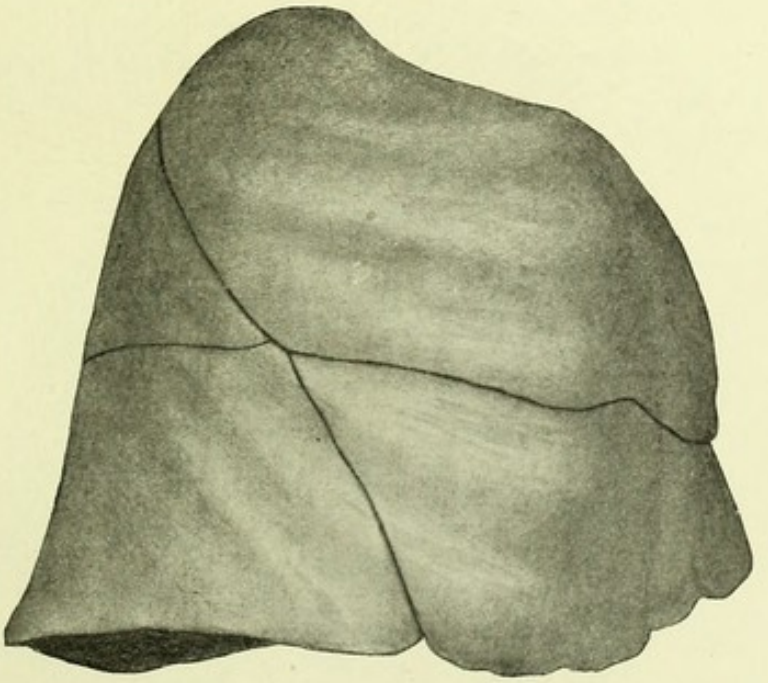

Fig. XXI.

Fig. XXII. Fœtus at term (*E*). Right lung. Mediastinal surface.

1. Inferior caval surface.
2. Pericardial surface.
3. Thymic surface.
4. Innominate and superior caval surface.
5. Tracheal and upper œsophageal surface.
6. Azygos groove.
7. Lower œsophageal surface.
8. Pulmonary attachment of ligamentum latum.

Fig. XXIIa. Schematic figure indicating relations of mediastinal surface of right lung.

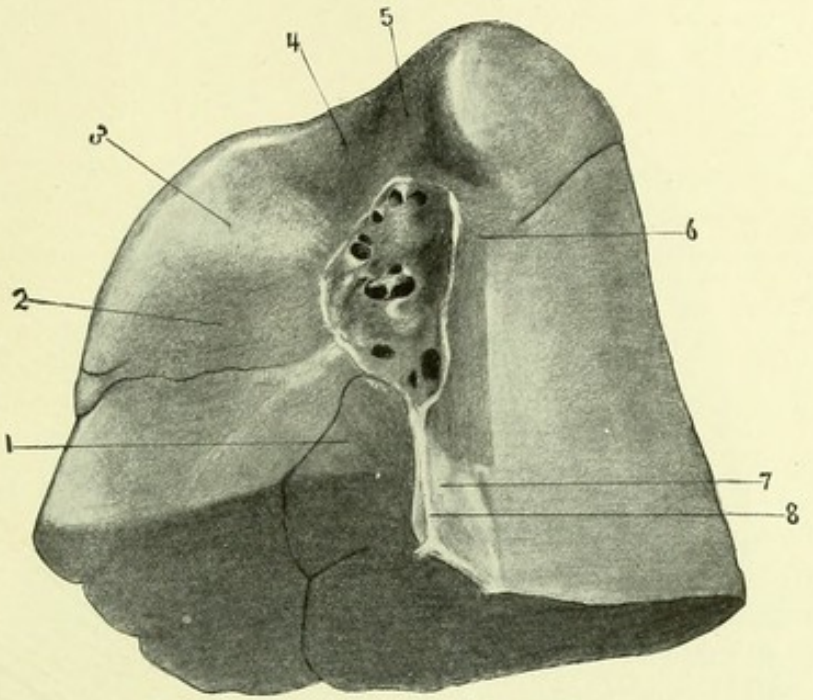

FIG. XXII.

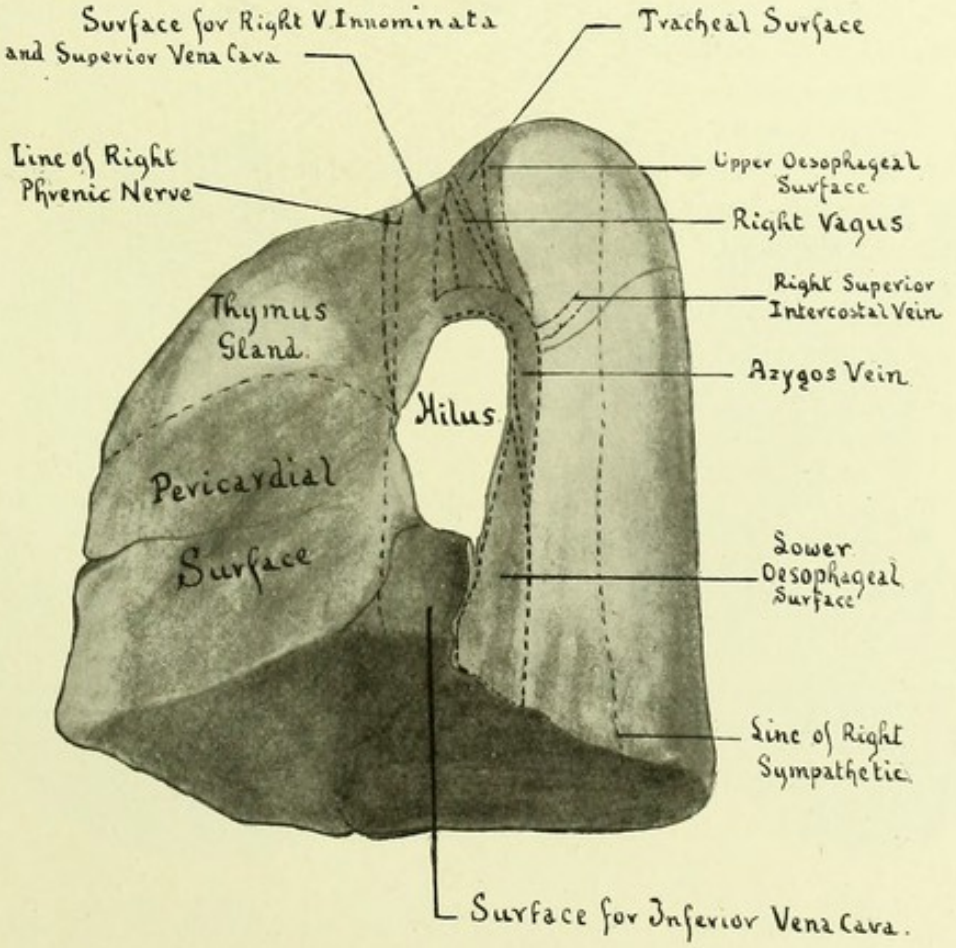

FIG. XXIIa.

Fig. XXIII. Infant, immediately after birth (*F*). Right lung. Mediastinal surface.

1. Inferior caval surface.
2. Pericardial surface.
3. Thymic surface.
4. Innominate and superior caval surface.
5. Tracheal and upper œsophageal surface.
6. Azygos groove.
7. Lower œsophageal surface.
8. Pulmonary attachment of ligamentum latum.

Fig. XXIV. Fœtus at term (*G*). Phrenic surface of right lung, with azygos fissure of lower lobe.

1. Azygos lobule.
2. Azygos fissure.

Fig. XXV. Fœtus at term (*D*). Phrenic surface of right lung, with azygos fissure of lower lobe.

1. Azygos fissure.

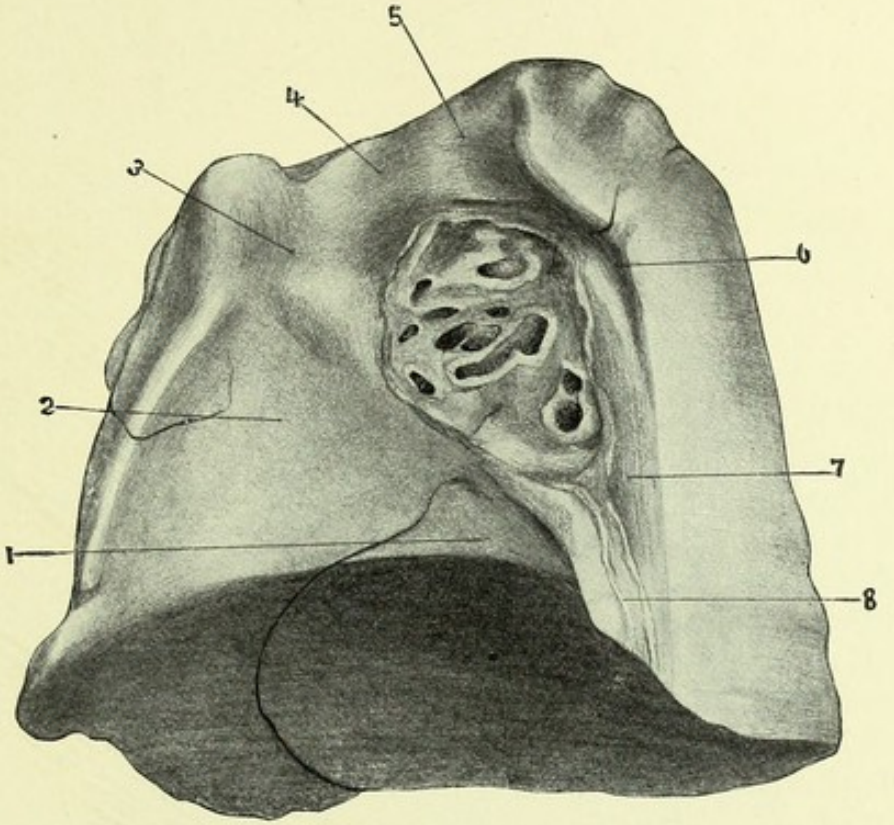

Fig. XXIII.

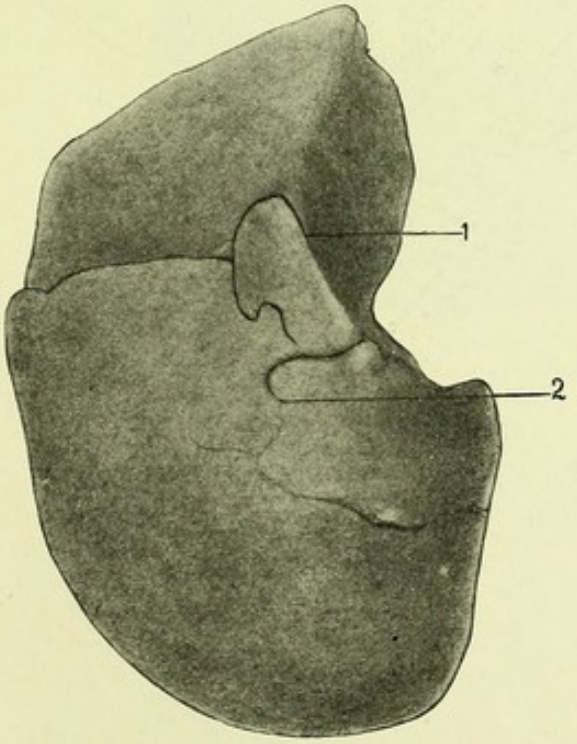

Fig. XXIV.

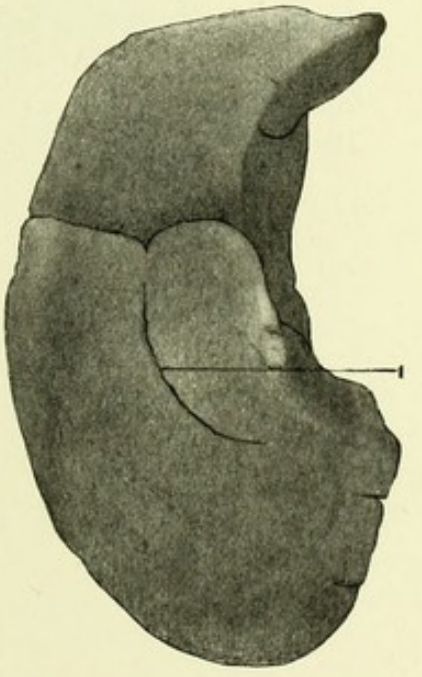

Fig. XXV.

Fig. XXVI. Fœtus at term (*D*). Mediastinal contents, left lateral view, with parietal pleura in place.

1. Superior prevenous cornu of cervical portion of thymus gland.
2. Left subclavian artery, supracostal portion.
3. Left subclavian vein.
4. Parietal mediastinal presubclavian surface, covering fatty connective and lymphatic tissue overlying left common carotid artery, behind thymus and left innominate veins.
5. Left lateral surface of thymus gland, thoracic portion.
6. Left phrenic nerve.
7. Parietal pericardium divided.
8. Left subclavian artery, ascending portion, covered by parietal pleura.
9. Left superior intercostal vein, covered by parietal pleura.
10. Openings at hilus of divided superior left pulmonary veins.

Between 10 and 11, and crossed by the fork at 10, are seen the openings of the divided apical branches of pulmonary artery.

11. Pulmonary artery, divided at hilus.
12, 13. Left bronchus (hyparterial) divided at hilus.
14. Inferior left pulmonary vein, divided at hilus.
15. Thoracic aorta covered by parietal pleura.
16. Left surface of œsophagus covered by parietal pleura.

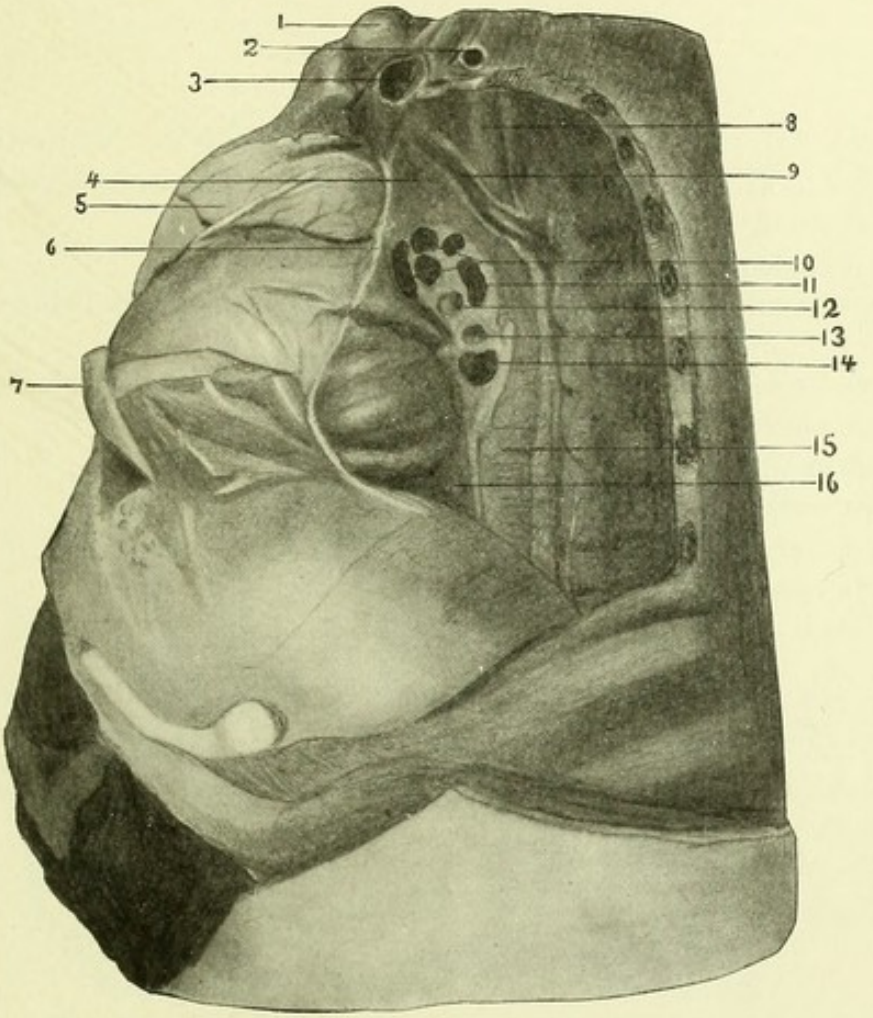

Fig. XXVI.

Fig. XXVII. Infant immediately after birth (*F*). Mediastinal contents, left lateral view; mediastinal parietal pleura partly reflected.

1. Left subclavian vein.
2. Left internal mammary artery.
3. Fatty connective tissue and small lymphatic glands behind left innominate vein and thymus.
4. Left lateral (pleural) surface of thymus gland, thoracic portion.
5. Left phrenic nerve.
6. Left subclavian artery.
7. Left deep cervical vein.
8. Left common carotid artery.
9. Left vagus.
10. Œsophagus.
11. Left superior intercostal vein.
12. Left pulmonary artery.
13. Superior left pulmonary vein.
14. Left bronchus (hyparterial) cut just beyond primary division.
15. Left inferior pulmonary vein.
16. Thoracic aorta, covered by 17, parietal pleura.
18. Œsophagus, covered by 17, parietal pleura.

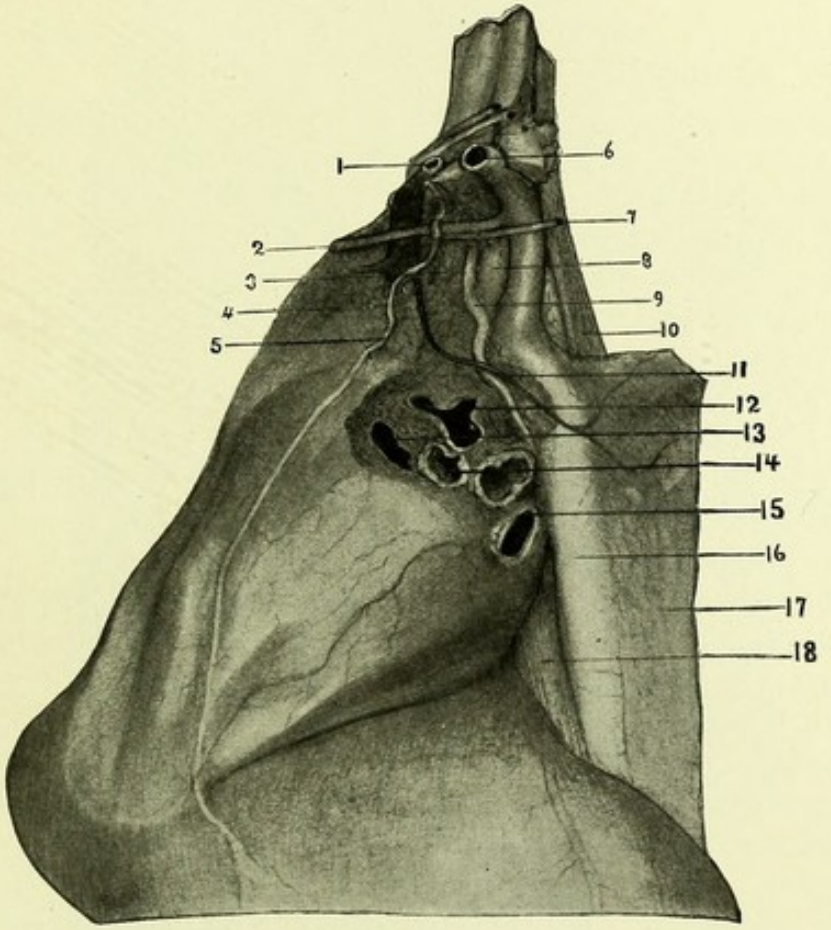

Fig. XXVII.

Fig. XXVIII. Fœtus at term (*E*). Mediastinal contents. Right lateral view. Parietal pleura in place.

1. Parietal pleura covering tracheal and superior œsophageal surfaces and right vagus.
2. Azygos vein at junction with right superior intercostal vein.
3. Right sympathetic nerve.
4. Right vagus, inferior œsophageal branches.
5. Right subclavian artery.
6. Right subclavian vein.
7. Left innominate vein.
8. Right phrenic nerve.
9. Right lateral (pleural) surface of thymus gland, thoracic portion.
10. Superior vena cava.
11. Apical branch, right pulmonary artery.
12. Right eparterial bronchus.
13. Apical branch of right pulmonary artery.
14. Main trunk of right pulmonary artery.
15. Right hyparterial bronchus.
16. Superior right pulmonary vein.
17, 18. Inferior right pulmonary vein.
19. Inferior vena cava, intrathoracic segment.

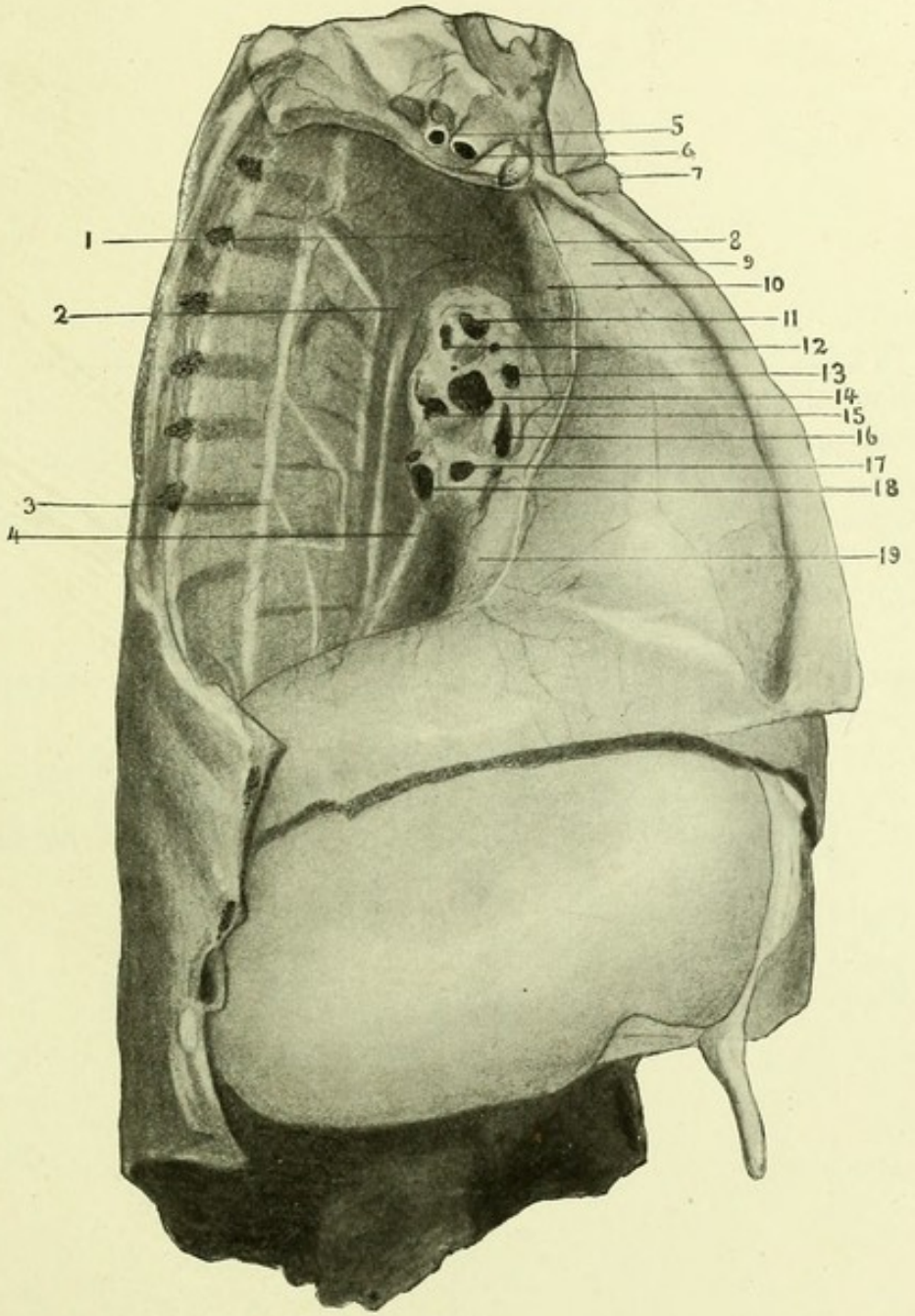

Fig. XXVIII.

Fig. XXIX. Fœtus at term (*D*). Mediastinal contents *in situ*. Right lateral view, upper part of mediastinal pleura reflected.

1. Vena azygos.
2. Right subclavian artery.
3. Right subclavian vein, cut at junction with right internal jugular.
4. Œsophagus.
5. Right vagus.
6. Trachea.
7. Fatty connective and lymphatic gland tissue between trachea and right innominate vein.
8. Right lateral surface of thymus gland, thoracic portion.
9, 10. Apical branches of right pulmonary artery.
11. Right bronchus, cut at division into eparterial and hyparterial trunks.
12. Right pulmonary artery.
13. Right superior pulmonary vein.
14. Right inferior pulmonary vein.

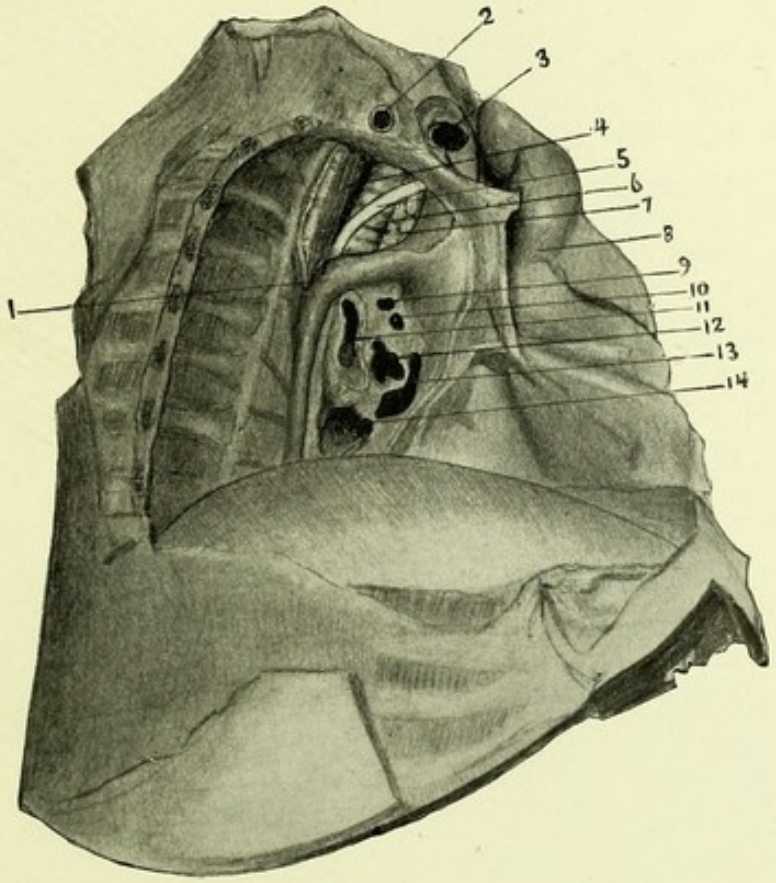

FIG. XXIX.

Fig. XXX. Infant, immediately after birth (*F*). Mediastinal contents, right lateral view, mediastinal parietal pleura reflected.

1. Œsophagus.
2. Right vertebral vein.
3. Trachea.
4. Ayzgos vein.
5. Left parietal pleura, costovertebral division.
6. Thoracic aorta.
7. Hemiazygos vein.
8. Right vertebral artery.
9. Right subclavian artery.
10. Right subclavian vein.
11. Scalenus anticus, cut.
12. Right internal mammary artery.
13. Peritracheal fatty connective and lymphatic tissue.
14. Right vagus.
15. Superior cava.
16. Right phrenic nerve.
17. Right eparterial bronchus.
18, 19. Apical branches right pulmonary artery.
20. Right hyparterial bronchus.
21. Right superior pulmonary vein.
22. Main trunk right pulmonary artery.
23. Right inferior pulmonary vein.
24. Inferior vena cava.

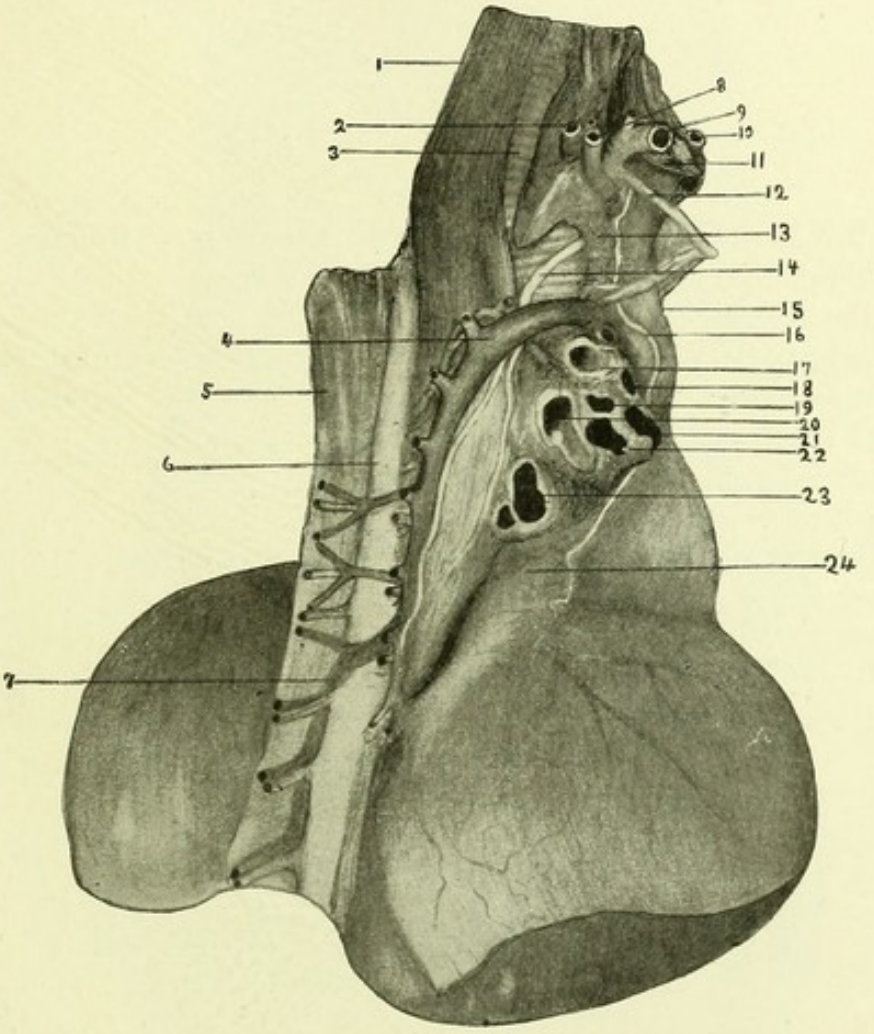

FIG. XXX.

Fig. XXXI. Fœtus at term (*E*). Anterior view of thoracic viscera.

1. Junction of right jugular and subclavian veins.
2. First rib, divided.
3. Right parietal pleura, anterior portion of sternocostal division.
4. Pericardium, portion uncovered by pleura and exposed between right and left mediastinal pleural reflections.
5. Left internal jugular vein.
6. Left external jugular vein.
7. Anterior surface thymus gland, cervical portion.
8. Left subclavian vein.
9. Left innominate vein.
10. Anterior surface thymus gland, thoracic portion.
11. Right mediastinal pleura, passing to lateral surface of thymus gland.

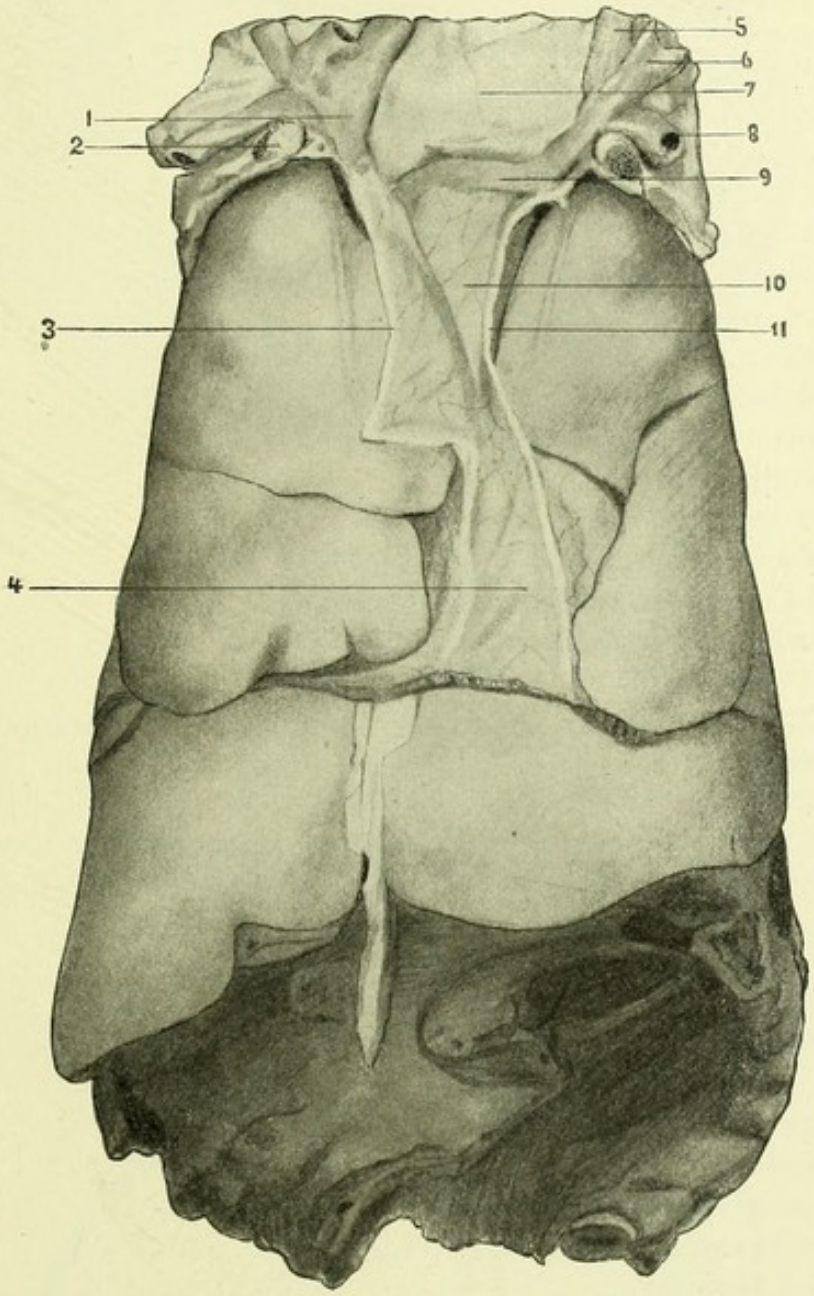

Fig. XXXI.

Fig. XXXII. Fœtus at term (*D*). Lungs and mediastinal contents, viewed from above.

1. Œsophagus.
2. Trachea.
3. Right subclavian artery.
4. Right innominate vein.
5. Right internal mammary artery.
6. Anterior surface right ventricle, parietal pericardium, cut.
7. Left common carotid artery.
8. Left innominate vein.
9. Left subclavian artery.
10. Superior retrovenous cornu of thymus gland.
11. Ascending aorta.
12. Pulmonary artery.
13. Pericardium, divided.
14. Right auricular appendix.
15. Superior prevenous cornu of thymus gland, cervical portion turned forward and downward.

Fig. XXXIII. Fœtus of fourth month (*H*). Anterior view of thoracic viscera.

1. Left innominate vein.

Fig. XXXIV. Schematic transection of thorax below level of pulmonary hilus, to show pleural reflection forming the broad pulmonary ligament (viewed from above).

1. Thoracic aorta.
2. Œsophagus.
3. Left broad ligament.
4. Pericardium.
5. Pericardial division of mediastinal pleura.
6. Pericardium.
7. Visceral pleura, mediastinal surface.
8. Parietal pleura, sternocostal division.
9. Inferior vena cava.
10. Right broad ligament.
11. Azygos vein.

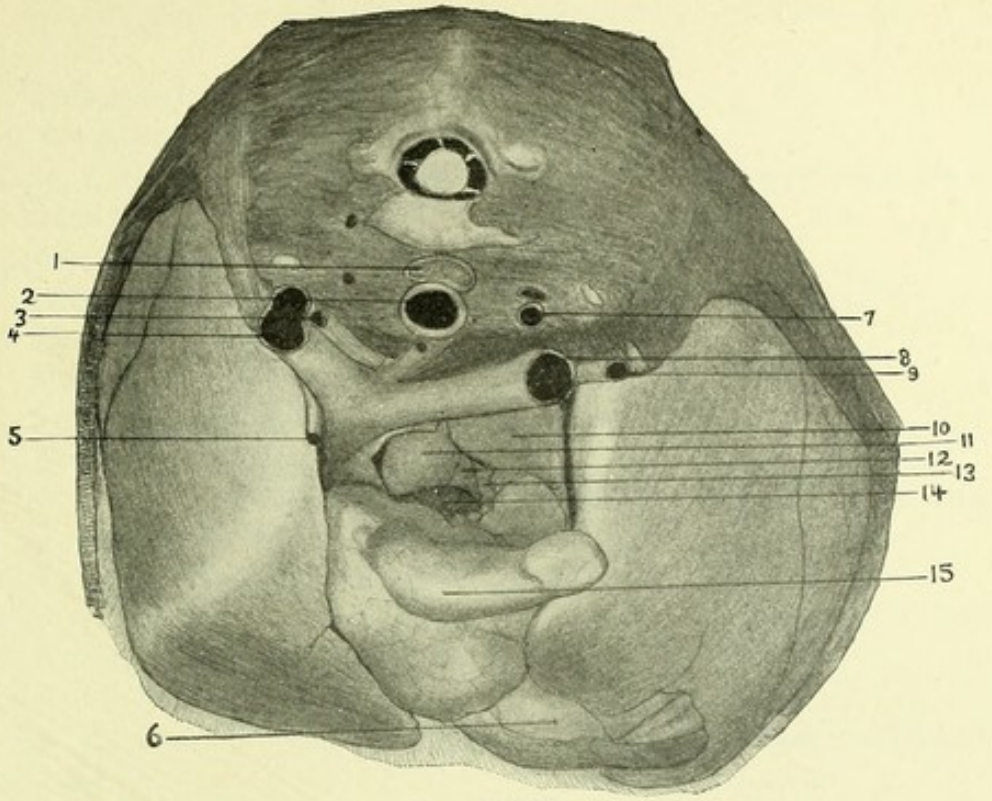

FIG. XXXII.

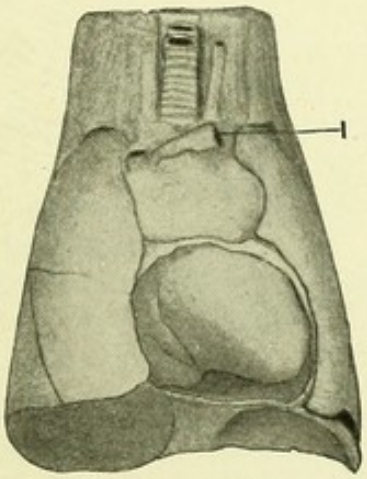

FIG. XXXIII.

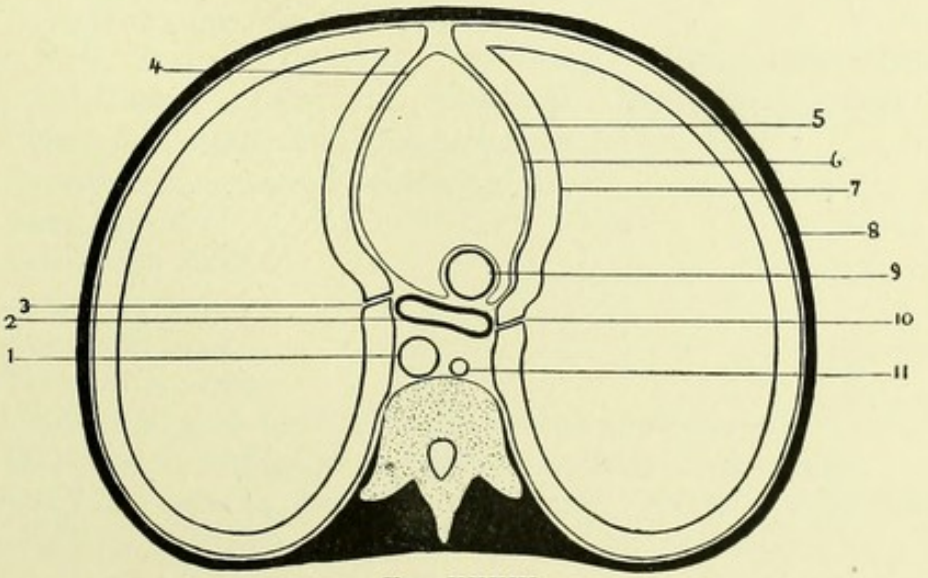

FIG. XXXIV.

4. Anterior marginal fissure.
5. Secondary fissure of cardiac incisure.

Figs. V and VI. Outline representations of the basal surfaces of the same lungs (*A*).

1. Sternocostal surface.
2. Anterior margin.
3. Mediastinal surface.
4. Internal margin.
5. Costovertebral surface.
6. Posterior margin.

Figs. VII to X. Right and left lungs of fœtus of 31 weeks (estimated) (*B*), medial and lateral surfaces.

1. Pulmonary attachment of broad ligament.
2. Posterior apical costal sulcus.
3. Anterior apical costal sulcus.
4. Anterior marginal fissure.

Figs. XI and XII. Outline representations of the basal surfaces of the same lungs (*B*).

1. Sterno-costal surface.
2. Anterior margin.
3. Mediastinal surface.
4. Internal margin.
5. Costovertebral surface.
6. Posterior margin.

Fig. XIII. Fœtus at term (*C*). Basal view of hardened lungs and heart removed together from thorax.

1. Portion of medial margin of phrenic surface in contact with right side of œsophagus.
2. Inferior vena cava.
3. Portion of diaphragm attached to inferior surface of pericardium.
4. Œsophageal tuberosity of left lower lobe, basal surface.
5. Portion of medial margin of phrenic surface in contact with left side of œsophagus.
6. Phrenic margin of aortal surface.

Fig. XIV. Fœtus at term (*D*). Left lung. Sternocostal surface.

Fig XV. Fœtus at term (*D*). Left lung. Mediastinal surface.

1. Pulmonary attachment of ligamentum latum.
2. Pericardio-œsophageal tuberosity.
3. Aortal groove.
4. Subclavian groove.
5. Presubclavian area.
6. Thymic surface.
7. Pericardial surface.
8. Pericardial surface of pericardio-œsophageal tuberosity.
9. Œsophageal surface of pericardio-œsophageal tuberosity.

Fig. XVI. Fœtus at term (*E*). Left lung. Sternocostal surface.

Fig. XVII. Fœtus at term (*E*). Mediastinal surface.

11. Left superior intercostal vein.
12. Left pulmonary artery.
13. Superior left pulmonary vein.
14. Left bronchus (hyparterial) cut just beyond primary division.
15. Left inferior pulmonary vein.
16. Thoracic aorta, covered by 17, parietal pleura.
18. Œsophagus, covered by 17, parietal pleura.

Fig. XXVIII. Fœtus at term (*E*). Mediastinal contents. Right lateral view. Parietal pleura in place.

1. Parietal pleura covering tracheal and superior œsophageal surfaces and right vagus.
2. Azygos vein at junction with right superior intercostal vein.
3. Right sympathetic nerve.
4. Right vagus, inferior œsophageal branches.
5. Right subclavian artery.
6. Right subclavian vein.
7. Left innominate vein.
8. Right phrenic nerve.
9. Right lateral (pleural) surface of thymus gland, thoracic portion.
10. Superior vena cava.
11. Apical branch, right pulmonary artery.
12. Right eparterial bronchus.
13. Apical branch of right pulmonary artery.
14. Main trunk of right pulmonary artery.
15. Right hyparterial bronchus.
16. Superior right pulmonary vein.
17, 18. Inferior right pulmonary vein.
19. Inferior vena cava, intrathoracic segment.

Fig. XXIX. Fœtus at term (*D*). Mediastinal contents *in situ*. Right lateral view, upper part of mediastinal pleura reflected.

1. Vena azygos.
2. Right subclavian artery.
3. Right subclavian vein, cut at junction with right internal jugular.
4. Œsophagus.
5. Right vagus.
6. Trachea.
7. Fatty connective and lymphatic gland tissue between trachea and right innominate vein.
8. Right lateral surface of thymus gland, thoracic portion.
9, 10. Apical branches of right pulmonary artery.
11. Right bronchus, cut at division into eparterial and hyparterial trunks.
12. Right pulmonary artery.
13. Right superior pulmonary vein.
14. Right inferior pulmonary vein.

Fig. XXX. Infant, immediately after birth (*F*). Mediastinal contents, right lateral view, mediastinal parietal pleura reflected.

1. Œsophagus.
2. Right vertebral vein.
3. Trachea.
4. Ayzgos vein.
5. Left parietal pleura, costovertebral division.
6. Thoracic aorta.
7. Hemiazygos vein.
8. Right vertebral artery.
9. Right subclavian artery.
10. Right subclavian vein.
11. Scalenus anticus, cut.
12. Right internal mammary artery.
13. Peritracheal fatty connective and lymphatic tissue.
14. Right vagus.
15. Superior cava.
16. Right phrenic nerve.
17. Right eparterial bronchus.
18, 19. Apical branches right pulmonary artery.
20. Right hyparterial bronchus.
21. Right superior pulmonary vein.
22. Main trunk right pulmonary artery.
23. Right inferior pulmonary vein.
24. Inferior vena cava.

Fig. XXXI. Fœtus at term (*E*). Anterior view of thoracic viscera.

1. Junction of right jugular and subclavian veins.
2. First rib, divided.
3. Right parietal pleura, anterior portion of sternocostal division.
4. Pericardium, portion uncovered by pleura and exposed between right and left mediastinal pleural reflections.
5. Left internal jugular vein.
6. Left external jugular vein.
7. Anterior surface thymus gland, cervical portion.
8. Left subclavian vein.
9. Left innominate vein.
10. Anterior surface thymus gland, thoracic portion.
11. Right mediastinal pleura, passing to lateral surface of thymus gland.

Fig. XXXII. Fœtus at term (*D*). Lungs and mediastinal contents, viewed from above.

1. Œsophagus.
2. Trachea.
3. Right subclavian artery.
4. Right innominate vein.
5. Right internal mammary artery.
6. Anterior surface right ventricle, parietal pericardium, cut.
7. Left common carotid artery.
8. Left innominate vein.

9. Left subclavian artery.
10. Superior retrovenous cornu of thymus gland.
11. Ascending aorta.
12. Pulmonary artery.
13. Pericardium, divided.
14. Right auricular appendix.
15. Superior prevenous cornu of thymus gland, cervical portion turned forward and downward.

Fig. XXXIII. Fœtus of fourth month (*II*). Anterior view of thoracic viscera.

1. Left innominate vein.

Fig. XXXIV. Schematic transection of thorax below level of pulmonary hilus, to show pleural reflection forming the broad pulmonary ligament (viewed from above).

1. Thoracic aorta.
2. Œsophagus.
3. Left broad ligament.
4. Pericardium.
5. Pericardial division of mediastinal pleura.
6. Pericardium.
7. Visceral pleura, mediastinal surface.
8. Parietal pleura, sternocostal division.
9. Inferior vena cava.
10. Right broad ligament.
11. Azygos vein.