# THE DUCTLESS GLANDS.

By D. J. Cunningham.

Under this title we include a heterogeneous group of organs, the common feature of which is that the products of their activity are not conveyed from them by means of ducts, but are discharged directly into the vascular system through the veins or lymphatic vessels which take origin within them. This physiological process is termed *internal secretion*, and in the case of certain of these organs the secretion has been shown to exert a profound influence upon the nutritive changes of the body.

The ductless glands include the lymphatic glands, which have been already described with the vascular system; the pineal and pituitary bodies, which have been referred to in the account which has been given of the brain; and the spleen, the suprarenal capsules, the thyroid body, the parathyroids, the thymus body, the coccygeal body, the carotid body—all of which still remain to be studied.

## THE SPLEEN.

The **spleen** (lien) is the largest of the ductless glands. It varies greatly in size in different individuals, and also in the same individual under different conditions, consequently it is difficult to give its average dimensions. Roughly speaking, it may be said to be as a rule about five inches in length and three inches in width at its widest part. It is a soft yielding organ, very vascular, and somewhat purple in colour. It lies far back in the abdominal cavity between the stomach and the diaphragm, and its position is such that, whilst the greater part of the organ is situated in the left hypochondrium, its upper end extends inwards beyond the left Poupart plane, and thus comes to lie in the epigastric region. It is placed very obliquely, and its long axis corresponds closely in its direction to that of the back part of the tenth rib.

**Form and Relations of the Spleen.**—The spleen has the shape of an irregular tetrahedron. The **upper end** (extremitas superior) points inwards and backwards, and is curved to some extent forwards on itself. Of the four surfaces the most extensive is the **diaphragmatic** (facies diaphragmatica), which looks backwards and outwards. It rests upon the back part of the diaphragm, to the curvature of which it is accurately adapted. By the diaphragm it is separated from the ninth, tenth, and eleventh ribs. It is necessary also to remember that the pleura descends between this portion of the chest wall and the diaphragm, and thus comes to lie superficially to the greater part of this diaphragmatic surface of the spleen. The thin basal margin of the lung, which occupies the upper part of the pleural recess, likewise intervenes between the upper part of the spleen and the surface of the body.

In the fœtus and infant, in which the liver is relatively very large, the left lobe of that organ extends to the left so far that it comes as a rule to intervene between a portion of the spleen and the diaphragm. Such a relation is sometimes seen in the adult, but, except in childhood, it is usual for the liver to fall short of the spleen.

The remaining three surfaces of the spleen are turned towards the cavity of the abdomen, and are closely applied to the viscera which support the organ in its place. These three surfaces, which may be grouped together under the one term of *visceral aspect* of the organ, are separated from each other by three ridges which radiate from a blunt and often inconspicuous prominence which may be termed the **intermediate angle** and represents the apex of the tetrahedron. One of these ridges, a salient and prominent border (margo intermedius), extends to the upper end of the spleen, and separates an extensive anterior gastric area from a narrower posterior renal area. A second short border passes backwards to the **posterior angle**, and intervenes between the renal and colic surfaces; whilst the third ridge, often obscurely marked, proceeds forwards to the **anterior angle** and separates the gastric

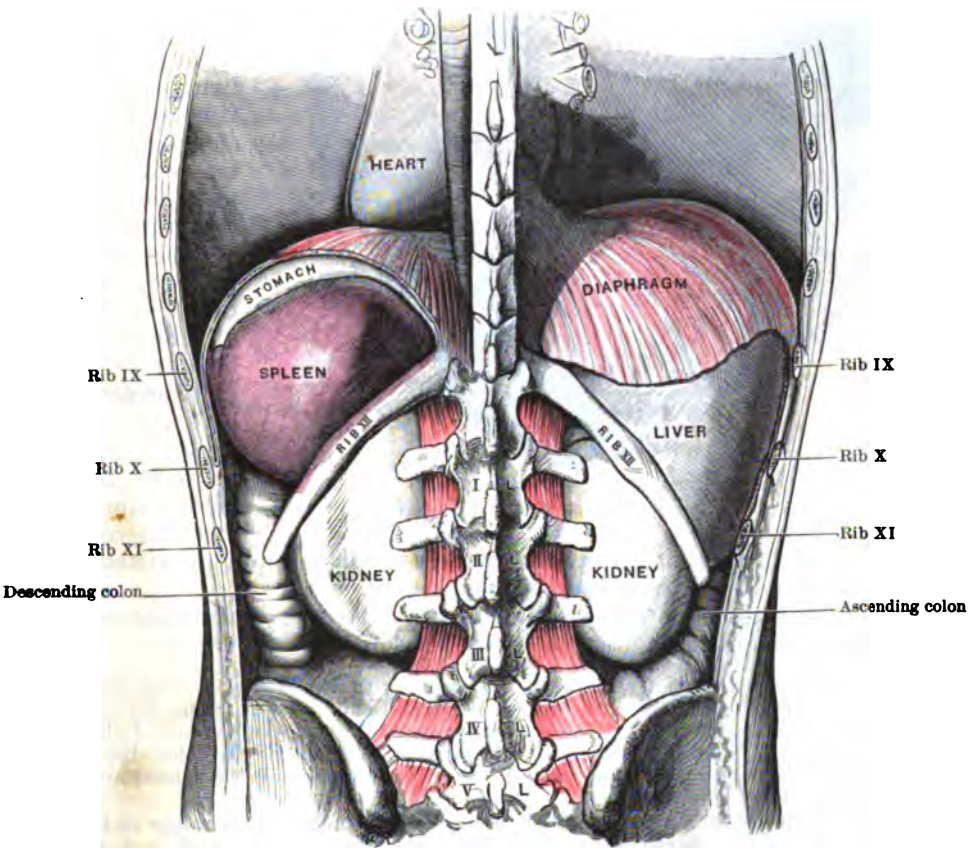


FIG. 867.—DISSECTION OF THE SPLEEN, LIVER, AND KIDNEYS FROM BEHIND, IN A SUBJECT HARDENED BY FORMALIN-INJECTION.

and the colic surfaces from each other. The term colic surface is applied to a triangular area which is mapped out by the two last-named ridges together with the lower border of the organ.

The **gastric surface** (facies gastrica) is the most extensive of the three visceral districts. It is deeply concave, and is moulded on the fundus of the stomach. Within its area, and about an inch or so in front of the margo intermedius, is the **hilum** of the organ. This is a slit, frequently broken up into two or more pieces, which gives passage to the vessels and nerves which enter and leave the spleen. Behind the hilum, and immediately in front of the intermediate angle, there is a depression of variable extent and depth into which the tail of the pancreas is received.

The **renal surface** (facies renalis) is flat and even. It is applied to the anterior surface of the upper part of the kidney, close to its outer border. Sometimes the part of this surface which adjoins the upper end of the organ is applied to the left suprarenal capsule, but as a rule it falls short of that structure.

The **colic surface** (facies basalis) is the smallest of the three visceral areas. It is triangular in form, and looks downwards and inwards, and is in contact with the splenic flexure of the colon and the costo-colic ligament (*vide* p. 1083).

The **anterior border** (margo anterior) of the spleen is sharp and prominent, and intervenes between the gastric and diaphragmatic surfaces. Its leading characteristic is that it is irregularly notched. The **posterior border** (margo posterior) separates the renal from the diaphragmatic surface. It is important to know that, if in the living subject the finger is drawn along the last intercostal space, it will indicate with tolerable accuracy on the surface of the body the position and direction of the posterior border. The **inferior border** (margo inferior) of the spleen intervenes between the diaphragmatic surface and the colic surface. The other margins of the spleen are those which separate the visceral areas from each other, and they have been already noticed.

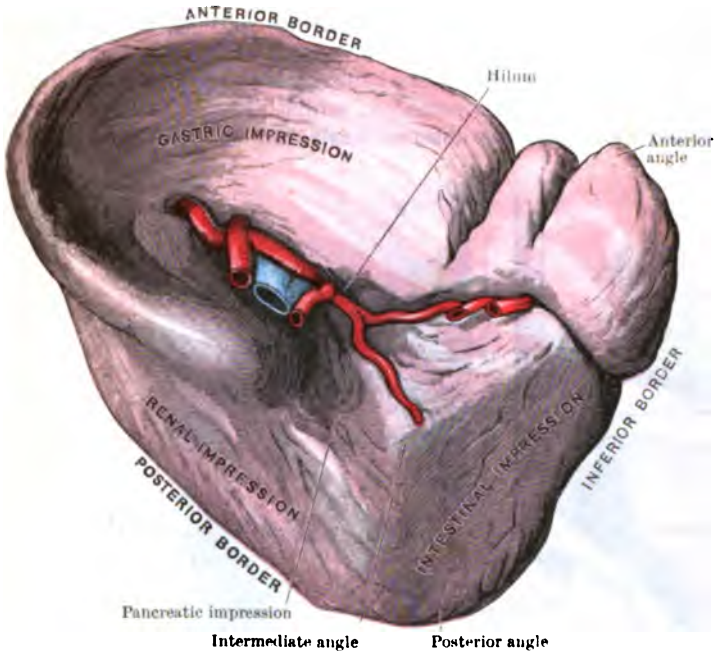


FIG. 868.—THE SPLEEN—VISCERAL ASPECT.

A marked feature of the typically-formed spleen is the great prominence of the **anterior angle**. It forms the most anteriorly-placed part of the organ.

The form of the spleen varies much in accordance with the changing conditions of the neighbouring hollow viscera. Shepherd has shown that there are two extreme forms, viz. the **tetrahedral**, which is described above, and the **orange-segment type**. In the case of the former the colon is distended, and the stomach as a rule more or less empty: the colon displaces the stomach from contact with the lower part of the visceral surface of the spleen, and by its pressure produces the colic impression.

When the spleen presents a form similar to that of the segment of an orange its lower end becomes pointed, and the entire visceral surface is occupied by the renal, gastric, and pancreatic impressions or areas. The colon is as a rule empty and exerts no pressure on the spleen, whilst the stomach is in all probability distended. As Shepherd has shown, every intermediate form of spleen between the two extreme types are met with, and may occur with varying conditions of the hollow viscera, at different times, in the same individual.

**Notches and Fissures.**—The usual number of notches on the anterior border of the spleen is two, although in exceptional cases there may be as many as six or even seven. It is not uncommon to find one or more fissures on the posterior border and also on the parietal surface of the organ (Parsons).

**Peritoneal Relations of the Spleen.**—The spleen is almost completely enveloped by peritoneum, and two folds of peritoneum, viz. the gastro-splenic omentum and the lieno-renal ligament, pass from it. Both of these folds are attached in the neighbourhood of the hilum. The **lieno-renal ligament** proceeds backwards to the anterior surface of the left kidney (p. 1099); the **gastro-splenic omentum** connects the spleen with the fundus of the stomach (p. 1104).

**Accessory Spleens.**—Small globular masses of splenic tissue are not infrequently found in the neighbourhood of the spleen. These are termed **accessory spleens.**

**Blood-vessels, Lymphatics, and Nerves of the Spleen.**—The large **splenic artery** gains the spleen by passing between the two layers of the lieno-renal ligament. It breaks up into several

branches which enter the organ through the hilum. Some twigs proceed from the splenic artery to the stomach, which they gain by insinuating themselves between the two layers of the gastro-splenic omentum. The **splenic vein** is formed in the lieno-renal ligament by the union of the branches which emerge from the hilum of the organ. It joins the superior mesenteric vein to form the vena portæ.

The **splenic plexus of nerves** is an offset from the cœliac part of the solar plexus, and accompanies the arteries into the spleen.

The **lymphatic vessels** leave the spleen at the hilum, and accompany the great vessels. There are no lymphatic channels within the spleen, although they are present in its capsule (Mall).

**Structure of the Spleen.**—In our study of the structure of the spleen we have to consider—(1) the tunica propria, (2) the trabecular framework, (3) the spleen pulp, and (4) the distribution of the blood-vessels and the Malpighian corpuscles.

**Tunica propria** (tunica albuginea).—Subjacent to the serous coating furnished by the peritoneum the spleen is provided with a strong capsule termed the tunica propria. This is formed of fibrous tissue, with a large proportion of elastic fibres and a certain amount of involuntary muscular tissue. It is therefore highly distensible, and perhaps feebly contractile. To the outer surface of this capsule the peritoneum is inseparably attached.

**Trabecular Framework** (trabeculæ lienis).—From the deep surface of the tunica propria numerous processes or trabeculæ are given off, and these penetrate into the substance of the spleen. Some are cord-like, others are in the form of flattened bands, and all are composed of fibrous tissue and involuntary muscular fibres. Within the spleen the trabeculæ branch and re-branch, and join with each other to form a supporting framework for the organ. The blood-vessels, as they enter at the hilum, carry in with them connective tissue sheaths, and these also take part in the formation of the trabecular framework

**Spleen Pulp** (pulpa lienis).—The interstices between the strands of the trabecular framework are filled with spleen pulp. This is supported by a delicate reticulum formed by branching cells. The spaces of the network freely communicate, and are occupied by blood in which there are large numbers of leucocytes, and also large cells special to the spleen. These are termed **splenic cells**, and contain pigment, and not infrequently red blood corpuscles, in their interior.

**Blood-vessels and Malpighian Corpuscles.**—The splenic arteries, as they traverse the spleen, run in the trabeculæ. The small branches ultimately leave these and enter the spleen pulp. As they do so they become ensheathed in a coating of adenoid tissue. At certain points in the course of the arteries this sheath suddenly increases in thickness, and forms small round or oval masses of adenoid tissue upon the vessel. In sections through the spleen these small nodular masses are visible to the naked eye as minute white spots. They are called **Malpighian corpuscles** (noduli lymphatici lienales). The artery rarely passes through the centre of such a corpuscle. As a rule the adenoid tissue is massed chiefly upon one side of the vessel, and a plentiful supply of blood is given to the nodule by means of a capillary network in connexion with the artery on which the Malpighian corpuscle is developed.

The manner in which the minute terminal arteries end in the spleen pulp is peculiar. The wall becomes reduced to the endothelial lining, and the cells forming this gradually separate from each other and become continuous with those of the reticulum of the spleen pulp. The blood therefore flows directly into the meshes of the reticulum of the pulp. The minute radicles of the veins begin in the same way as the arteries end. The walls are gradually built up by the union of cells continuous with the open reticulum, and the blood flowing into the vessels so formed is led away towards the larger veins which occupy the trabeculæ.

**Development of the Spleen.**—It is not until the second month of intrauterine development that the spleen begins to develop. It is formed from mesoderm, and appears in the dorsal mesogastrium in the neighbourhood of the pancreas. After a short time it becomes invaded by blood-vessels, but the Malpighian corpuscles are somewhat late in making their appearance. The spleen grows to the left in the direction of least resistance, protruding the left layer of the mesogastrium before it, and its form is determined by the pressure to which it is subjected by the neighbouring viscera and the abdominal wall.

## THE SUPRARENAL CAPSULES.

The suprarenal capsules (glandulæ suprarenales) are two small flattened organs which lie in the epigastric region, one on either side of the spine, and in intimate relation to the upper end of the corresponding kidney.

The **right suprarenal capsule** is, as a rule, triangular in form, and rests by its base upon the anterior and inner aspect of the upper end of the right kidney. It

is placed between the posterior surface of the right lobe of the liver and that portion of the diaphragm which covers the side of the spine.

The *anterior surface*, which looks outwards as well as forwards, presents two impressions—(1) The one is a narrow flattened strip adjoining the anterior border of the capsule which is overlapped by the inferior vena cava; (2) the second impression comprises the remainder of the anterior surface, and is in contact with

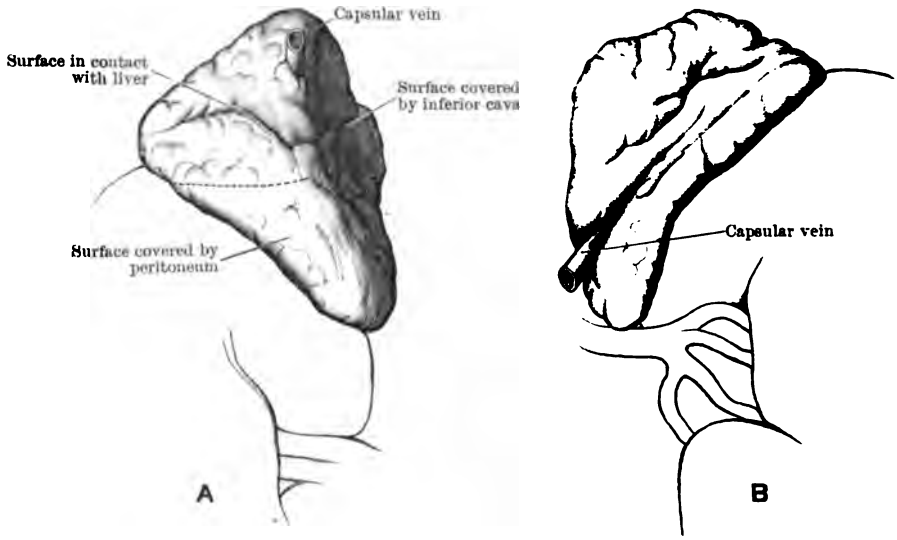


FIG. 869.

A. Anterior surface of right suprarenal capsule. B. Anterior surface of left suprarenal capsule. The upper and inner parts of each kidney are indicated in outline. On the right capsule the dotted line indicates the upper limit of the peritoneal covering.

the liver. Only a small and variable part of the lower portion of the anterior surface of the right suprarenal capsule is covered by peritoneum. On the upper part of the impression for the vena cava, not far from the apex of the capsule, a short fissure termed the **hilum** may be observed. From this issues a short wide vein which immediately enters the vena cava inferior. The *posterior surface* of the right suprarenal capsule is divided by a salient curved ridge into an upper flat

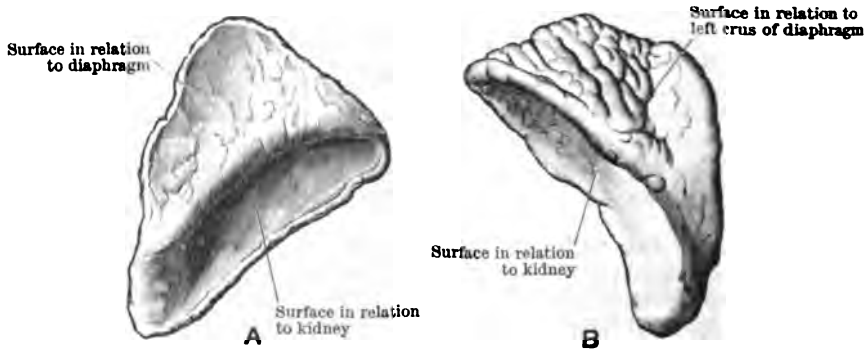


FIG. 870.

A. Posterior surface of right suprarenal capsule. B. Posterior surface of left suprarenal capsule.

part, which is applied to the diaphragm, and a concave lower part, which is occupied by fat and rests upon the kidney.

The **left suprarenal capsule** presents a semilunar form, and as a rule is slightly larger than the right capsule. Its position on the kidney is also somewhat different. It is usually placed on its inner border immediately above the hilum. The *anterior surface* presents, not far from its lower end, a very obvious slit or **hilum** with a large emerging vein. The greater part of this surface is in relation to the

posterior aspect of the stomach, and forms a portion of the bed on which that organ lies. This gastric area of the suprarenal capsule is clothed by peritoneum derived from the lesser sac. The lower portion of the anterior surface is covered by the pancreas and crossed by the splenic vessels, and is not in relation to the peritoneum. Sometimes the spleen extends inwards so as to lie in relation to the upper part of the anterior surface of the left suprarenal capsule, but this cannot be said to be the rule. The *posterior surface* is subdivided into two areas, as on the right side, by a curved ridge. The upper area is flat, and applied to the left crus of the diaphragm; the lower area is hollowed out, and is in relation to the kidney, a considerable amount of fat intervening.

In the fœtus the suprarenal capsules are relatively very much larger than in the adult. Indeed, on the left side the capsule extends downwards on the kidney so far that the spleen is completely shut out by it from that organ.

**Vessels of the Suprarenal Bodies.**—Each capsule receives three arteries—viz. from the inferior phrenic, from the aorta, and from the renal artery. One large vein, emerging from the hilum on

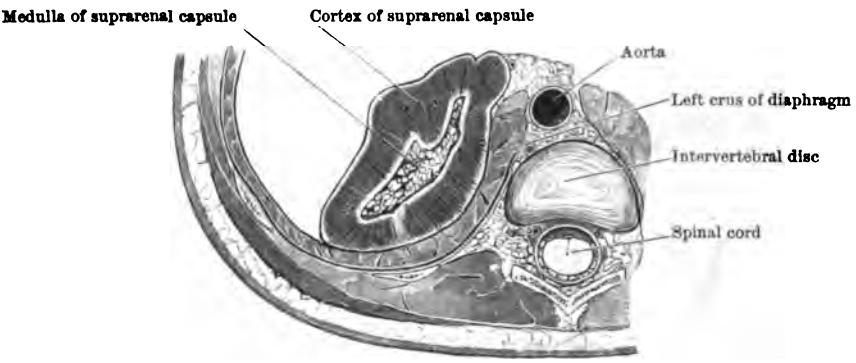


FIG. 871.—TRANSVERSE SECTION THROUGH THE SUPRARENAL CAPSULE OF A NEW-BORN CHILD *IN SITU*.

the anterior surface, as a rule conveys all the blood from the organ. On the right side it opens at once into the inferior vena cava, and on the left side into the left renal vein.

The **nerves of the suprarenal bodies** are very numerous. They come from the solar plexus, and constitute the suprarenal plexus.

**Structure of the Suprarenal Capsule.**—The suprarenal capsule is surrounded by a thin connective tissue sheath, from the deep surface of which fine processes are given off which enter the substance of the organ, and form within it a supporting stroma or framework.

The gland-substance is composed of—(1) an external cortical portion, firm in consistence, of a yellowish hue, and forming the chief bulk of the organ; and (2) an internal medullary part, very soft and pulpy, and dark brown in colour. In the bulky organ of the fœtus the appearance presented by these constituent parts is very different. The cortex is dark purple in colour, whilst the medulla presents a light yellow tint (Fig. 871).

The **cortical substance** (substantia corticalis) consists of groups of cells occupying the interstices of the stroma. These cell-groups present different forms at different levels from the surface. Thus, subjacent to the connective tissue sheath, there is a thin stratum, termed the *zona glomerulosa*, in which the cell-masses are more or less rounded; next comes the *zona fasciculata*, which constitutes the chief part of the cortex, and in which the cells are grouped in long columns which are arranged radially with reference to the surface; and lastly, there is the deepest layer, the *zona reticularis*, in which the cells are disposed in a reticular manner amidst the stroma.

The **medullary part** (substantia medullaris) is also pervaded by a fibrous stroma continuous with that of the cortex. This forms an irregular meshwork, the spaces of which are occupied by cells of very variable shape. When treated with chromic salts they assume a dark brown colour, and have consequently been termed *chromaffin* or *chromogenic cells*.

The arteries enter the cortex and break up into capillaries which are arranged around the cell-groups. In the medulla there are large thin-walled capillaries into which the whole blood of the organ passes. These capillaries are closely surrounded by the medullary cells. Proceeding from them are the radicles of the capsular vein.

**Development of the Suprarenal Capsule.**—It would appear that the cortical and medullary parts of the suprarenal body have a totally different origin. The **medulla** is derived as a mass of cells which grows out from the ganglia of the sympathetic cord, and becomes in the process of development encapsulated within the cortex. It is important to note in this connexion that a certain number of chromaffin cells are found within the sympathetic ganglia. Although nervous in its origin, the medulla of the suprarenal becomes glandular and gives to the blood an internal secretion which exercises a most potent physiological action.

The **cortical part** of the suprarenal body is formed from a mass of mesodermic cells which on the right side become grouped together in the immediate vicinity of the inferior vena cava soon after that vessel is formed. The cells thus accumulated together are said to be derived directly or indirectly from the epithelial cells which line the body cavity in the region of the Wolffian ridge.

As we ascend the scale of vertebrates, the suprarenal bodies show an interesting series of evolutionary stages. "In fishes the two constituents (*i.e.* medulla and cortex) are quite separate; in amphibians they come into contact; in reptiles they are beginning to be intermixed; in birds the cortex and medulla interlace; whilst in mammals the medulla is surrounded by the cortex" (Swale Vincent).

## THE THYROID BODY.

The **thyroid body** (glandula thyreoidea) is a highly vascular, pliant structure which clasps the upper part of the trachea and extends upwards for some distance upon each side of the larynx. In size it varies greatly in different individuals, and in the female and child it is always relatively larger than in the adult male. It consists of three well-marked subdivisions—viz. two lateral lobes, joined across the middle line by the isthmus.

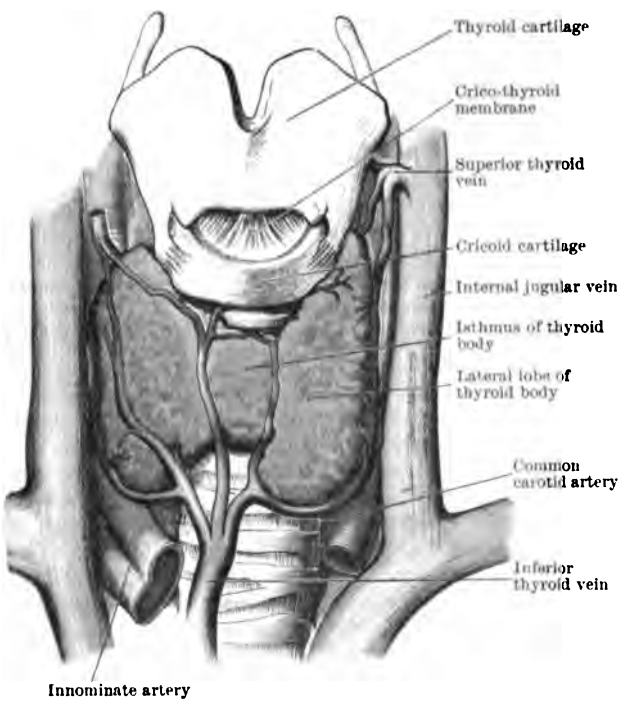


FIG. 872.—DISSECTION OF THE THYROID BODY AND OF THE PARTS IN IMMEDIATE RELATION TO IT.

Each **lateral lobe** is conical in form. Its base extends downwards upon the side of the trachea as far as the fifth or sixth tracheal ring, whilst its apex rests upon the ala of the thyroid cartilage. Its *superficial surface* is somewhat flattened, and is clothed by the pretracheal layer of cervical fascia, from which the organ derives a sheath, and also by the sterno-thyroid, sterno-hyoid, and omo-hyoid muscles. It is also overlapped by the sterno-mastoid muscle. Its *deep surface* is adapted to the parts upon which it lies—viz. to the side of the trachea, to the cricoid cartilage, and to the inferior cornu and adjoining part of the surface of the ala of the thyroid cartilage; whilst its *posterior border* extends backwards so as to touch the œsophagus and pharynx and overlap the common carotid artery (Fig. 694, p. 974).

The **isthmus** of the thyroid body is a narrow band of varying width which lies in front of the second, third, and fourth rings of the trachea, and unites the bases or lower ends of the two lateral lobes.

A third lobe is frequently found in connexion with the thyroid body. This is the **pyramidal** or **middle lobe** (Fig. 873). When present it assumes the form of an

elongated slender process which springs from the upper border of the isthmus on one or other side of the mesial plane (more usually on the left side) and extends upwards for a variable distance towards the hyoid bone upon the cricoid and thyroid cartilages. A strand of fibrous tissue, or perhaps a narrow slip composed of muscular fibres (levator glandulæ thyreoideæ), connects it to the body of the hyoid bone.

The thyroid body is firmly attached to the parts on which it lies, and therefore follows the larynx in all its movements.

**Variations.**—Small detached portions of the thyroid tissue placed in the neighbourhood of the lateral lobes or in the vicinity of the hyoid bone are not uncommon. Such glandular masses are termed **accessory thyroid bodies.** The isthmus is the part of the organ which is most subject to variation. Its size differs greatly in different individuals, and it not infrequently happens that it is absent.

**Blood-vessels.**—Four large **arteries,** and occasionally a fifth smaller vessel, convey blood to the thyroid body. Two **superior thyroid branches** spring from the external carotid arteries. Each of these divides at the apex of the lateral lobe into three branches for its supply. Two **inferior thyroid branches** from the thyroid axes of the subclavian arteries distribute their terminal branches to the basal portions and deep surfaces of the lateral lobes. The occasional artery is the **thyroidea ima,** a branch of the innominate, which ascends upon the trachea to reach the isthmus of the thyroid body. The thyroid arteries anastomose freely with each other.

The **veins** which drain the blood from the thyroid body are still more numerous. They are three in number on each side—viz. the **superior** and **middle thyroid veins,** which join the internal jugular; and the **inferior thyroid,** which descends in front of the trachea and joins its fellow of the opposite side to form a large common stem which opens into the left innominate vein. Numerous large veins ramify on the surface of the organ and lie in grooves in its substance. It is from this plexus that the inferior thyroid veins take origin.

The **nerves** which go to the thyroid body accompany the vessels. They are derived from the middle and inferior cervical ganglia of the sympathetic.

**Structure of the Thyroid Body.**—The thyroid body is enveloped by a closely-applied thin capsule of connective tissue. From the deep surface of this numerous processes penetrate into the substance of the organ, and divide it into lobes and lobules. From the septa which separate the lobules fine lamellæ proceed which form the boundaries of vast numbers of closed vesicles or alveoli of different sizes and shapes. Some of the vesicles are spherical or polyhedral, whilst others are oval or flattened and branching. All are lined by a layer of cubical or columnar epithelial cells, and most of them contain a viscid semi-fluid colloid material.

The blood-vessels traverse the organ in the fibrous-tissue septa, whilst the capillary network is disposed on the outer surface of the various vesicles. Numerous lymphatic vessels arise external to the alveoli, and Baber has shown that they frequently contain colloid material similar to that in the interior of the vesicles.

**Development of the Thyroid Body.**—The thyroid body is formed from three originally separate and distinct rudiments which arise independently of each other—viz. a median rudiment and two lateral rudiments.

The **median thyroid rudiment** arises as a hypoblastic outgrowth from the floor or ventral wall of the pharynx (Fig. 30, F.C, p. 36). The point at which this occurs is in front of the second visceral arches, at the junction between the basal portion of the tongue and that part of the organ which is developed from the tuberculum impar (see pp. 37 and 1013). The foramen cæcum on the dorsum of the adult tongue represents the upper persistent part of the median thyroid diverticulum. The median thyroid rudiment extends downwards towards the front of the larynx. It rapidly elongates, and its distal extremity bifurcates and comes to lie in front of the upper part of the trachea. This bifurcated extremity forms the isthmus of the thyroid body, and also a portion of each lateral lobe.

The portion of the diverticulum which intervenes between the dorsum of the tongue and the isthmus is termed the **thyro-glossal duct.** As already explained, its upper end persists as the *foramen cæcum* of the tongue. Its opposite extremity is usually retained as the *pyramidal lobe* of the thyroid body, whilst the intervening portion disappears. Such is the usual course of development, but in certain cases more or less extensive sections of the thyro-glossal duct may persist. The rare occurrence of a *lingual duct* which extends downwards through the tongue towards the hyoid bone is accounted for in this manner. Thyro-glossal cysts situated in any part of the path of the duct owe their origin to a similar cause.

The **lateral thyroid rudiment** of each side arises as a saccular hypoblastic diverticulum from the pharyngeal side of the fourth visceral cleft (see p. 35). It comes into relation with the lateral aspect of the larynx, and becoming cut off from the cavity of the pharynx,

it joins with the isthmus or median rudiment to form the greater part of the lateral lobe of the thyroid body.

The thyroid body in its primitive condition, and in each of its three parts, is epithelial. Soon it is invaded by connective tissue and blood-vessels, but the hypoblastic epithelium is retained as the cellular lining of its constituent vesicles.

## PARATHYROIDS.

The **parathyroid glands** are two minute structures which lie in more or less close relation to each lateral lobe of the thyroid body. They are apt to be mistaken for accessory thyroids, but in structure they are different. One, more constant in position than the other, is situated on the posterior aspect of the œsophagus at the level of the lower border of the cricoid cartilage, and in more or less intimate relation to the posterior border of the lateral lobe of the thyroid body. The second parathyroid body is placed either in close apposition with the lower border of the lateral lobe of the thyroid, or on the trachea at a varying distance below it. The inferior thyroid artery intervenes between the two parathyroid bodies (Welsh).

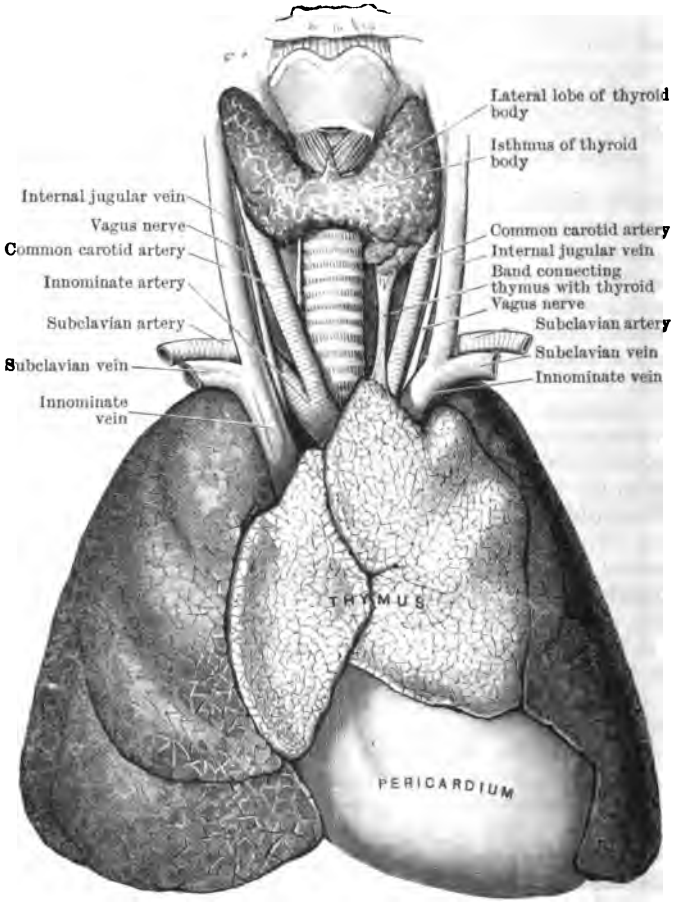


FIG. 873.—THYMUS GLAND IN A FULL-TIME FŒTUS HARDENED BY FORMALIN-INJECTION.

The parathyroid bodies are composed of reticulating rows of cells, with blood-vessels arranged between them. In structure they bear a close resemblance to that of the anterior lobe of the pituitary body. The upper parathyroid body is derived as a hypoblastic bud, which grows out from the bottom of the pharyngeal side of the third visceral cleft; the lower body has a similar origin from the fourth visceral cleft.

It has been shown that the removal of the four parathyroids from the cat is followed by very severe symptoms, and in two cases out of three death ensued in the course of a few days (Welsh).

## THYMUS GLAND.

The **thymus gland** can only be studied to advantage in the later period of fœtal life or in early childhood. It attains its maximum development towards the end of the second year, and from this time on it dwindles away until only a comparatively small portion of it is left. In the new-born child it is of a pinkish colour, and is composed of two lateral lobes, very seldom of equal size, and separated by an intervening fissure. The main portion of the gland is placed within the thorax, but the two lobes end above in two blunt prolongations which are carried upwards for a varying distance into the neck.

The thoracic portion of the thymus gland, in its fully-developed condition, is placed in the superior and anterior mediastinal spaces, and as a rule it extends downwards as far as the level of the fourth costal cartilages. The mediastinal pleura and the lung are applied to it on either side, whilst the sternum and costal cartilages are in close relation to it in front. The deep surface of the thymus is moulded upon the pericardium and upon the vessels in the front part of the superior mediastinum. Thus, when it is hardened *in situ* and removed, it presents on its posterior surface a deep pericardial concavity, with impressions on the upper part of this hollow corresponding to the pulmonary artery and vena

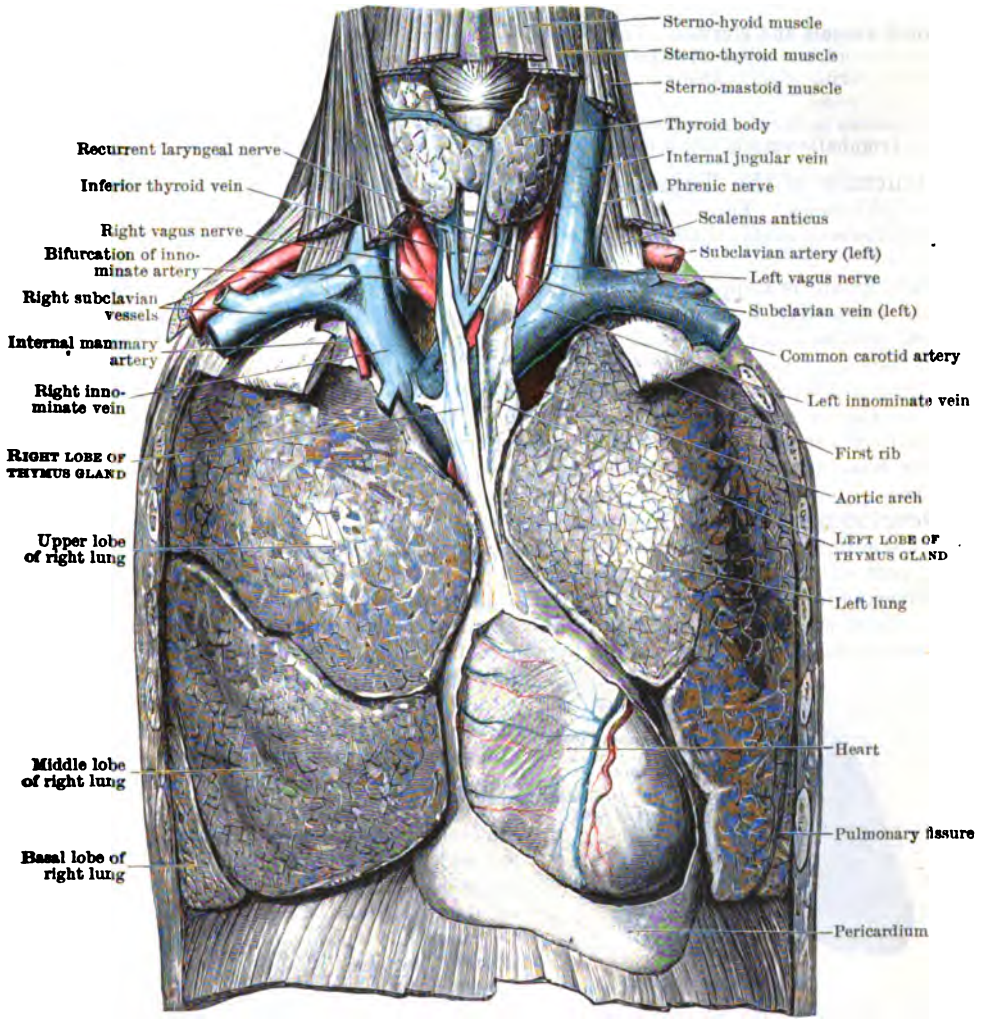


FIG. 874.—DISSECTION TO SHOW THE THYMUS GLAND IN AN ADULT FEMALE.

cava superior (Fig. 875). Above the pericardial surface deep grooves indicate the intimate manner in which it is adapted to the two innominate veins. Above the left innominate vein the two lobes of the thymus ascend to an unequal height into the neck. They are placed in front of the trachea, and extend outwards so as to overlap the termination of the innominate artery on the right side and the left common carotid artery on the left side. One or other of the lobes may rise as high as the thyroid gland, but as a rule both fall somewhat short of this organ, and the lobe which ascends highest is usually attached to the corresponding lateral lobe of the thyroid body by a strand of connective tissue.

After the second year the thymus gland remains stationary, or it begins slowly to diminish in size, but when puberty is reached a rapid degeneration sets in. Its lobules become infiltrated with fat and loose strands of connective tissue. Waldeyer has shown, however, that throughout the whole of life it not only retains something of its old form, but also that the degeneration is never complete. Preserved within its substance (either uniformly diffused through it or in distinct masses) there may always be found remains of the original thymus-tissue. Indeed, more of the gland is retained in the adult than is generally supposed. It is easy to demonstrate in subjects hardened by formalin-injection that as a rule both lobes are present in the front part of the superior mediastinum in the form of two elongated finger-like bodies.

**Blood-vessels and Nerves.**—The **arteries** which carry blood to the thymus come from the inferior thyroid, the internal mammary, and perhaps also from other sources. The **veins** join the neighbouring venous trunks—viz. the inferior thyroid, the internal mammary, and the two innominate veins.

The **nerves** to the thymus are derived from the vagus and sympathetic trunks.

The **lymphatic vessels** are of large size, and accompany the blood-vessels.

**Structure of the Thymus.**—The thymus is composed of a large number of small polyhedral lobules. The sheath which envelops the organ sends off from its deep surface fine partitions or septa which pass into the gland and separate the different lobules from each other.

Each lobule is composed of clusters of lymphoid follicles, with a small amount of delicate connective tissue intervening between them. A follicle consists of an outer **cortical** and an inner or central **medullary portion**. Both are formed of adenoid tissue, but in the cortex the lymphoid cells are packed much more closely, whilst in the medulla the retiform matrix is coarser and the lymphoid cells less numerous. Further, the medulla contains the *concentric corpuscles of Hassall*. These are curious bodies, composed of flattened cells arranged concentrically around a granular nucleated corpuscle.

The blood-vessels form a fine plexus around the various follicles, and from this capillaries penetrate into the central medulla.

**Development of the Thymus Body.**—The thymus gland is derived from the hypoblastic lining of the pharynx. It takes origin as a tubular diverticulum from the dorsal part of the pharyngeal aspect of the third visceral cleft on each side (see p. 35). This diverticulum has thick epithelial walls, and it grows by rapid proliferation of its cells. It extends downwards on the side of the trachea towards the pericardium, and coming into contact with the corresponding hypoblastic outgrowth of the opposite side, the two lobes of the organ are formed—one from each lateral diverticulum. The narrow upper part of the outgrowth remains for a time tubular, and connected with the pharyngeal cleft from which it originates. Ultimately this connexion is broken through, and the expanded lower end sends out solid bud-like branches after the manner of an acinous gland. The connective tissue sheath and framework of the thymus are derived from the surrounding mesoblast.

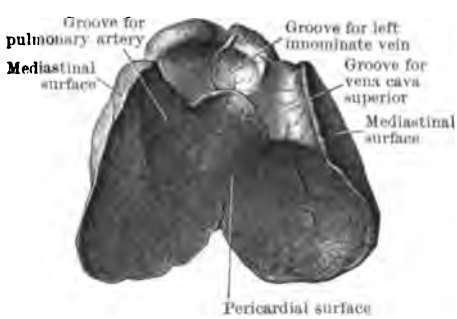


FIG. 875.—DEEP SURFACE OF THYMUS GLAND, TAKEN FROM A FŒTUS HARDENED BY FORMALIN-INJECTION.

Originally epithelial in its composition, the thymus becomes lymphoid by the rapid proliferation of its cells. The products of this division become the lymphoid cells of the follicles of the gland. The corpuscles of Hassall were formerly believed to be epithelial remnants, but this is now known not to be the case, as the transformation of the original elements of the organ into lymphoid cells is complete. The corpuscles of Hassall are derived from the repeated divisions of one cell, the products of which remain attached to each other.

## THE CAROTID AND COCCYGEAL BODIES.

The **carotid body** is a minute oval reddish-brown structure placed on the deep aspect of the common carotid artery at the point where it bifurcates into its two terminal branches. It is closely connected with the sympathetic nerve filaments which twine around the carotid vessels, and numerous minute arterial twigs

enter it. In structure the carotid body is composed of nodular masses of poly-

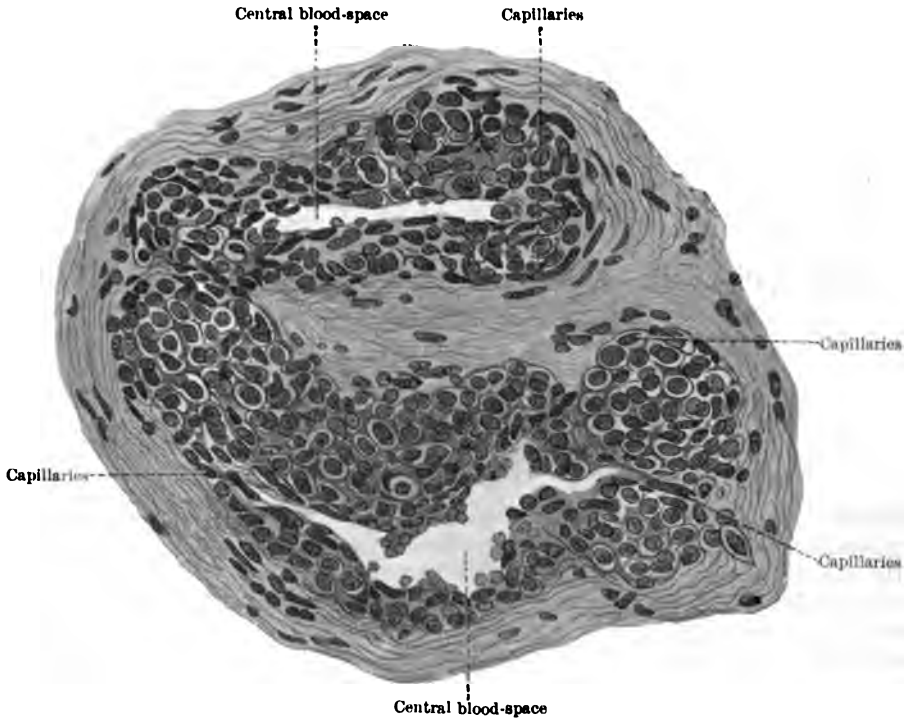


FIG. 876.—SECTION THROUGH CAROTID BODY (highly magnified). After J. W. Thomson Walker.

hedral epithelial-like cells, separated from each other by strands of connective tissue. Wide, thin-walled tortuous capillaries are brought into intimate relation with the cells.

The carotid body contains chromaffin cells, and Swale Vincent believes that it should be associated as regards both origin and function with the medulla of the suprarenal capsule.

The **coccygeal body** is a small structure placed in front of the tip of the coccyx. Branches from the middle sacral artery enter it, and its structure is similar to that of the carotid body.

Thomson Walker, who has made an exhaustive investigation into the constitution of the coccygeal gland, has shown, by means of serial sections through the region, that in addition to the main body usually described, there are numerous other minute outlying subsidiary portions of the gland grouped around the middle sacral artery and its branches. In structure the gland, as well as its accessory parts, consists of collections of round or polyhedral cells with large nuclei arranged around a central blood-space (*Archiv f. mikroscop. Anatomie*, Bd. lxiv.).

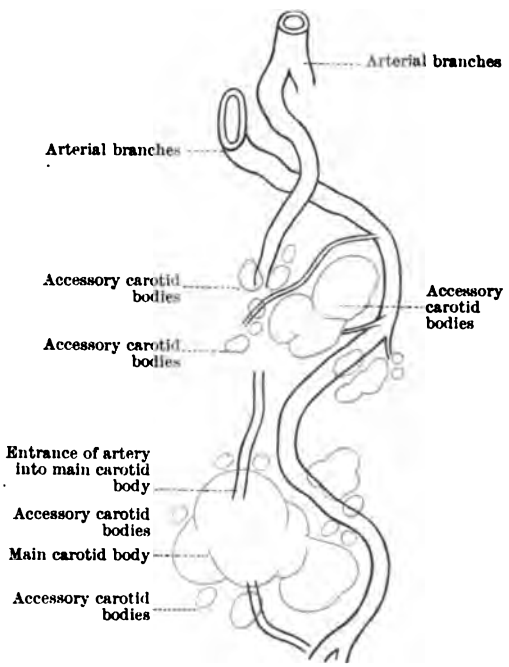


FIG. 877.—SCHEMA OF THE RELATION PRESENTED BY THE CAROTID GLAND AND ITS ACCESSORY OUTLYING PARTS TO THE BRANCHES OF THE MIDDLE SACRAL ARTERY. (Reconstructed from serial sections through the region.) After J. W. Thomson Walker.