

# THE FRAMEWORK OF THE GLANDULA PARATHYROIDEA.

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WITH 3 TEXT FIGURES.

In studying the framework of the thyroid gland in man and the higher mammals, the author was enabled at the same time to make certain observations concerning the supporting tissue of the glandula parathyroidea. These investigations were carried on by means of the destructive digestive methods through which the cytoplasmic elements are all dissolved, leaving the resistant framework of the organ in the form of an opaque skeleton, which reveals its original form and relationships, and demonstrates clearly at the same time, the course of the various interstitial processes in three dimensions of space. The details of the method have already been published in another place.<sup>1</sup> In both the monkey and the dog the parathyroid bodies are situated within the general capsule of the glandula thyroidea. Under normal conditions in both the living organ and in fixed tissues, the small oval gland is scarcely elevated from the surface of the larger organ in which it is contained. The fasciculated capsule of the thyroid practically splits and embraces the gl. parathyroidea which is oval in both longitudinal and transverse dimensions. Accordingly the capsule of the thyroid becomes the capsule of the parathyroidea, with no essential differences in structure. Like the capsules of most organs it is composed of laminated fasciculi of white fibrous tissue, with a considerable amount of reticulum in its inner surface. This capsule contains a small amount of elastic tissue, some of which may accompany the larger septa that follow the greater vessels into the substance of the gland. In piece digestions which have been cut through the thyroid and parathyroid, the organ is clearly shown in three dimensions. In both dog and monkey, the parathyroid is  $2\frac{1}{2}$  mm. broad, about 4 mm. long, and about 2 mm. in thickness. When viewed with a stereoscopic microscope, the organ is seen just within the capsule

<sup>1</sup> Flint: Bulletin of the Johns Hopkins Hospital, 1901; Arch. f. Anat. u. Ent. Anat. Abth., 1903.

of the gl. Thyroidea where its finer structure and limiting envelope bring it out in sharp contrast to the follicles of the thyroid that embrace it on three sides. The little organ is oval in both transverse and longitudinal planes giving it plastically the form of a prolate spheroid. As shown by this method the structure of the thyroid has been previously described<sup>2</sup> and when the plane of section includes both organs, a glance is sufficient to separate them owing to the marked differences in their structure. At first sight in piece digestions, the parathyroid has a homogeneous, ground-glass appearance without showing any very striking features excepting the blood vessels that traverse its substance; but if the specimen is carefully studied with high oculars and rapid alterations in the quantity and

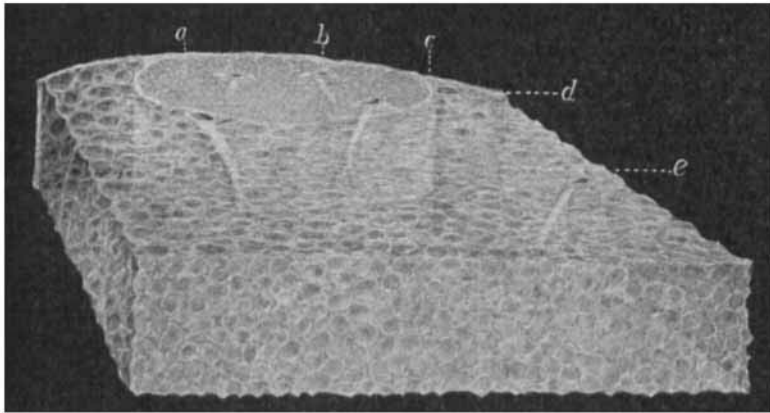


FIG. 1.—Piece Digestion of the Thyroid and Parathyroid of a Monkey. Extracted with ether, digested with trypsin and cleared in glycerine.  $\times 19$ . The general form and arrangement of the thyroid follicles are readily made out. Beneath the capsule and embraced by its split laminae is the parathyroid body. The large septa and vessels as well as the finer septa can be seen on the surface, while the vessels are readily followed into the depths.

a=Finer septa of parathyroid. b=Blood-vessel and coarser septa. c=Capsule of parathyroid at point of splitting. d=Capsule of thyroid. e=Follicles of thyroid.

variety of light with which it is illuminated, delicate, fine septa on the surface of the organ come into view. Owing, however, to their extreme delicacy they are indistinctly shown and the picture accordingly is not as instructive as one from those organs where the connective tissue is accumulated into larger and more definite processes and septa.

Besides the more delicate septa that embrace the cell complexes of the parathyroid we see the blood vessels which are always accompanied by relatively thick connective tissue processes. As a rule these run in the

<sup>2</sup> Flint: The Johns Hopkins Hospital Bulletin, 1903.

central portions of the gland although instances are not uncommon where they are found either in the capsule or its neighborhood indicating their points of entrance and exit to and from the substance of the organ. The quantity of the connective tissue diminishes with the order of ramification until the small arteries, veins and capillaries are reached. These naturally are found in the finer septa or trabeculae about the cell columns.

To Ludwig and his pupils we owe the view that many organs are divided into a series of similar structural units which have constant and definite relations to connective tissue processes, blood vessels, nerves and lymphatics. An organ is composed of a great many of such units which are repeated again and again in its formation. Glands like the pancreas, salivary gland, liver, and spleen express their structural relationships excellently while others as for example the stomach and adrenal cannot

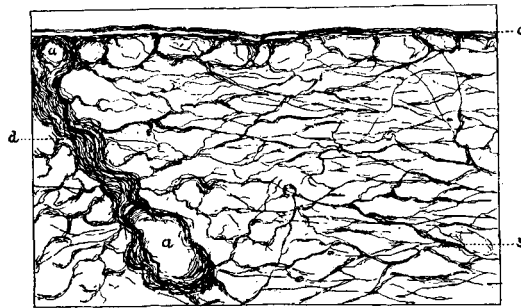


FIG. 2.—Section of block of tissue shown in Fig. 1, about 45 microns thick.  $\times 37$ . Stained with Aniline blue. Drawn over a blue print which was subsequently washed out. The section shows the capsule of the parathyroid, the larger septa and blood-vessels as well as the smaller septa limiting the cell columns. c=Capsule. s=Finer septa. d=Coarser septa. a=Blood-vessel.

be subdivided at all. Accordingly when we know the finer structure of one unit we know the structure of the whole organ with the exception of the relation of these units to each other. In this sense, however, there are no structural units in the parathyroid which bear a constant relationship to connective tissue processes. The ultimate structural integers must be looked upon as the cell columns or cell groups and the adjacent fibrous tissue which supports them.

In thin digested sections the framework appears as irregular septa which do not form a continuous network throughout the organ, but are broken up into smaller processes which support the irregular coiled columns of cells of which the organ is composed. These septa carry the arteries, capillaries, veins, and nerves. They are in some places built up of fasciculi of reticulum fibrils, in others, of a thinner, looser formation

of anastomosing and branching fibrils. When thick, stained, digested sections from 50 microns up are studied, these broken septa are obviously continuous in the third dimension with other processes that turn off and occupy various planes according to the branching of the anastomosing cell columns. In this way in these preparations, especially under the low power, it often appears as though the framework formed a continuum stretching across the gland. In considering the structure and arrangement of the framework in three dimensions, this is, of course, true, the broken irregular septa appearing only in thin sections where the con-

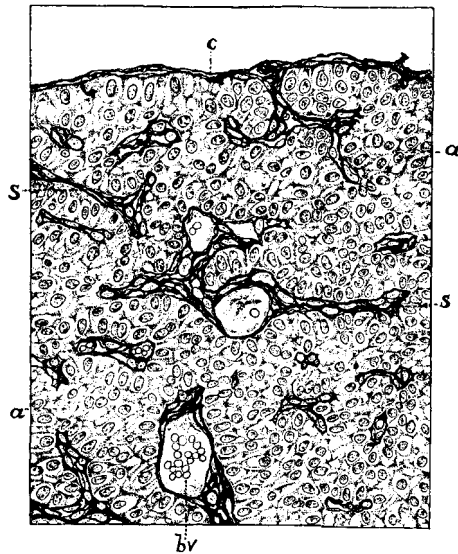


FIG. 3.—Section of parathyroid of dog. Stained by Mallory's method.  $\times 62$ . c=Capsules. s=Finer septa. a=Cell columns. bv=Blood-vessel.

tinuity of the third dimension is broken. Under ordinary circumstances the septa are comparatively fine and delicate. Relatively speaking, however, the framework is not abundant. Occasionally large septa project inwards from the capsule, either in connection with or independent of the blood vessels. The majority of the large vascular trunks, however, as is seen in piece digestions also, are found in the center of the organ. Around the adventitia, the framework is abundant and in these situations large fasciculi of considerable dimensions are often found. When thin sections are studied under the immersion lens, the framework can readily be resolved into the ultimate constituent fibrils of which it is composed. These fibrils branch and anastomose, and are of extreme delicacy. In

sections stained by the ordinary methods and thin sections varying from 3 to 6 microns in thickness, stained by Mallory's connective tissue stain, numerous cells with oval nuclei are found embedded in the fibrils. These are the connective tissue corpuscles, and do not differ in this position from those found in other parts of the body. In Mallory specimens (Fig. 3) the relationship of parenchymatous cells to the connective tissue processes are clearly shown. The cells are polygonal in shape, composed of granular cytoplasm which stains readily with the acid dyes. These cells contain spherical nuclei of medium size, possessing a well marked nuclear membrane with a considerable amount of chromatin along the linin filaments. They are packed together in irregular coiling and anastomosing columns (Fig. 3, *a*) of varying size. In some instances as many as seven or eight cells may be interposed between septa and blood-vessels while in others only two or three are so placed. No connective tissue fibrils pass in between the cells to form a finer framework. They rest against each other, and are supported by the adjacent septa.

### RÉSUMÉ.

(1) In piece digestions, the gl. parathyroidea of the dog and monkey is seen in the form of a prolate spheroid embraced by a capsule formed through a splitting of the capsule of the thyroid gland. Within the gland the larger connective tissue processes accompanying the blood-vessels are easily seen usually in the central portion of the organ which under the low powers of the stereoscopic microscope has a homogeneous ground-glass appearance. Under the higher powers, however, the delicate septa embracing the cell columns can just be made out.

(2) In thin stained digested specimens, the framework appears as irregular broken septa composed of anastomosing and branching fibrils as well as fasciculi or bundles of fibrils. These septa support the irregular anastomosing cell columns of which the gland is composed. In thick, stained, digested specimens, however, septa can be followed in three dimensions where they give almost the appearance of a closed network owing to the change of direction as they follow the cell complexes of the gland in the depths of the section.

(3) The relations of the cells to the connective tissue as shown in these sections, indicates that the cell columns are supported by the septa. Fibrils from the septa do not run in between the individual cells. The cell columns are irregular in thickness, and anastomose with each other. The smaller vessels are found in the smaller septa.