The Development of the Thymus, Epithelial Bodies, and Thyroid in the Marsupialia. Part I.—Trichosurus vulpecula.

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(Abstract.)

In recent years much attention has been paid to the development of the thymus and thyroid glands in the higher Mammalia but no observations on the development of these structures are extant in the case of the Marsupialia. In this memoir the authors have attempted to fill this blank in our knowledge so far as the Diprotodont Trichosurus is concerned. They have had at their disposal an extensive material of that form comprising both uterine and fœtal specimens, grouped in 22 stages.

In the adult, the thymus is remarkable in that it consists of three pairs of glands, viz., a large paired superficial cervical thymus situated posteriorly to the submaxillary salivary glands and internally to the platysma on the ventral side of the anterior region of the neck, and two pairs of smaller thoracic or posterior cervical glands, situated the one behind the other, cranially to the pericardium and in relation to the corresponding common carotid arteries. These latter glands represent respectively paired thymus III and IV. They may remain separate or the two glands of the same side may unite with each other on one or both sides of the body.

The epithelial bodies (parathyroids so-called) comprise two pairs which are constantly present, viz., the primary epithelial bodies III and IV and in addition a variable number of accessory bodies, not necessarily paired, which are frequently found in connection both with the cervical and thoracic thymus glands. Epithelial body III lies adjacent to the fork of the common carotid artery, whilst epithelial body IV is usually situated in the proximity of thymus IV.

The thyroid is situated just caudally to the larynx and consists of two lateral lobes connected by a median bridge.

As concerns the development of the thymus, our observations show that the epithelial basis of the cervical gland is derived mainly at least from the ectodermal walls of the cranial portion of the closed-off cervical sinus, and to a smaller extent from the distal portion of the ductus ecto-entobranchialis II. The second gill-pouch in early stages is well developed and possesses an extensive area of fusion (closing membrane) with the second ectodermal groove. As development proceeds, however, the pouch becomes drawn out to

form an elongated tubular structure and its closing membrane becomes reduced in extent. At the same time, the portion of the ectodermal groove situated immediately above the sinus separates off from the ectoderm in continuity with the distal extremity of the second pouch. As the result, the latter comes to be connected with the sinus by a short distal segment, the ductus ecto-entobranchialis II above mentioned, formed partly of groove-ectoderm, partly of pouch-entoderm, the line of junction of the two parts being of the nature of an oblique overlap. The cervical sinus has meantime closed, partly, and indeed mainly, as the result of the growth forward of its dorso-caudal margins, partly as the result of the backgrowth of the hyoid arch, its original wide opening becoming reduced to a narrow slit-like passage, the cervical duct.

The primordium of the cervical thymus first appears in the form of a bulbous enlargement of the coalesced and thickened walls of the dorso-cranial angle of the sinus, which passes above into direct continuity with the ductus ecto-entobranchialis II, whilst below it extends down as far as the junction of pouch 3 with the sinus-ectoderm. As development proceeds, the primordium increases in size at the expense of the remainder of the cranial portion of the sinus, which completely closes up. It thus assumes the form of a solid pear-shaped mass composed of epithelial cells. It is connected for a time with the ectoderm of the cervical groove by a thin cellular cord but that eventually disappears and the primordium lies free in the mesoderm. It is thus evident that the epithelial basis of the cervical thymus is in greater part of ectodermal origin, but it seems probable that a small amount of entoderm derived from the ventral continuation of the second pouch is also included in it.

As concerns the differentiation of the third pouch, the connection of the latter with the pharynx gradually becomes narrowed, and at the same time its connection with the sinus-ectoderm becomes reduced to a thin cord (the ductus ecto-entobranchialis III), which eventually disappears. The dorsal part of the pouch retains its lumen, its ventral part on the contrary becomes solid and grows ventrally as a solid prolongation. Over the cranial wall of its dorsal portion the cells assume a regular columnar arrangement and stain deeply with eosin. This part constitutes the primordium of epithelial body III. Over the remainder of the pouch, including the entire caudal wall of its dorsal part and the solid ventral prolongation, the cells assume a less regular, looser arrangement and stain rather less deeply. This portion constitutes the primordium of thymus III. The two primordia so differentiated soon separate from each other. Epithelial body III, at first luminated, becomes solid and moves slightly forwards to take up its permanent position.

near the bifurcation of the common carotid artery, whilst thymus III moves backwards.

The fourth gill-pouch is smaller than the third, but undergoes a corresponding development. Here, however, epithelial body IV is derived from the dorsal portion of the pouch, including both its cranial and caudal walls, whilst thymus IV takes origin from its ventral portion, including its solid ventral prolongation.

Trichosurus is the first mammal to be described in which a fully-developed thymus derived from the fourth gill-pouch is constantly present. Rudiments of a thymus IV have, however, been observed in a number of Eutheria (calf, cat, man, etc.), whilst thymus IV is regularly present in some reptiles, *e.g.*, Coluber and Tropidonotus. In respect of the constant presence of thymus IV, Trichosurus would appear to exhibit more primitive relations than any mammal hitherto investigated, whilst in respect of the mode of origin of thymus III, from the whole extent of the caudal wall of the pouch as well as from the ventral prolongation, Trichosurus would seem to furnish an example of the transitional stage between the Reptilian mode of thymus development (the thymus being an exclusively dorsal product of the gill-pouch) and the Eutherian mode (the thymus arising as a ventral product of the pouch).

The developmental history of the median thyroid primordium in Trichosurus does not differ essentially from that of other mammals. It gives origin without doubt to the main mass of the adult thyroid. It is probable, however, that the ultimo-branchial (post-branchial) bodies also contribute in some degree to the formation of the lateral thyroid lobes. The ultimo-branchial body appears in our earliest stage as a ventral prolongation of the small fifth gill-pouch. It very soon attains a considerable size and, after separating from the pharynx, it moves forwards and becomes closely connected with the dorso-medial surface of the corresponding lateral lobe of the thyroid. It then proliferates actively and gives off cellular sprouts which penetrate amongst, and become indistinguishable from, the cellular cords of the lateral lobe.