The Influence of the Hypophysis and the Thyroid on the Ultimobranchial Body of the Anura of Israel

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WITH ONE PLATE

INTRODUCTION

The ultimobranchial body of *Hyla arborea* L., *Rana ridibunda* Pall., *Pelobates syriacus* Boettger, and *Bufo viridis* Laur., the common anurans of Israel, is a paired organ, situated on both sides of the aditus laryngis. Its development runs parallel to the fluctuating activity of the thyroid (Boschwitz, 1960).

(a) In the premetamorphic period of relative thyroid dormancy, the ultimobranchial body consists of one follicle with single-layered epithelium in *Hyla*, *Rana*, and *Bufo*, and of a coiled tube with parafollicular cells in *Pelobates*. A capsule with capillaries surrounds the organ.

(b) In the period of metamorphosis up to the beginning of tail-resorption, during which thyroidal activity is heightened, the epithelium of the ultimobranchial body becomes pseudostratified, and the size of the follicle enlarges. In *Pelobates* the coiled tube changes into several single-layered follicles with parafollicular cells. The whole organ becomes less dispersed. The follicles of all 4 species contain a small amount of faintly eosinophilic coagulum, and often normal-appearing nuclei are embedded therein.

(c) In the postmetamorphic period, during which thyroid activity declines, the ultimobranchial body enlarges and differentiates. There is one large follicle with pseudostratified epithelium and shallow folds in *Hyla*, and one or two large follicles with similar epithelium but deep folds in *Rana*. There are many small follicles with single-layered epithelium and interspersed clusters of parafollicular cells in *Bufo* and *Pelobates*, concentrated in an ovoid organ. The coagulum in the organ of all 4 species is eosinophilic, and includes nuclei, desquamated from the follicular wall.

Since the development of the ultimobranchial body parallels thyroid activity in these anurans and its postmetamorphic atrophy in *Xenopus laevis* may be influenced by the thyroid and the hypophysis (Sterba 1950; Saxén & Toivonen 1955), the influence of the hypophysis and thyroid on the ultimobranchial body has been experimentally investigated and the results are described in the

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present paper. A similar investigation of urodeles was performed by Steinitz &

**Material and Methods**

Details of the various experiments are shown in Table 1.

The influence of the hypophysis in adults was investigated by means of
hypophysectomy in *R. ridibunda* Pall., whose ultimobranchial body consists of
follicles only, and in *B. viridis* Laur., which has parafollicular cells, too.

**Table 1**

*Details of experiments. The three stages are: I, premetamorphic; II, metamorphic;
and III, postmetamorphic*

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Species</th>
<th>Stage</th>
<th>Number of animals</th>
<th>Maximum duration of experiment (days)</th>
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<tbody>
<tr>
<td>Hypophysectomy</td>
<td><em>Rana</em></td>
<td>III</td>
<td>20</td>
<td>111</td>
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<tr>
<td></td>
<td><em>Bufo</em></td>
<td>III</td>
<td>7</td>
<td>25</td>
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<tr>
<td>Thiourea: 0.03%</td>
<td><em>Hyla</em></td>
<td>I</td>
<td>30</td>
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<td></td>
<td></td>
<td>II</td>
<td>30</td>
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<td></td>
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<td>III</td>
<td>20</td>
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<tr>
<td></td>
<td><em>Rana</em></td>
<td>I</td>
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<td>II</td>
<td>20</td>
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<tr>
<td></td>
<td><em>Rana</em></td>
<td>I</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>10</td>
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<tr>
<td></td>
<td><em>Bufo</em></td>
<td>I</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>20</td>
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<tr>
<td>Thyroidectomy</td>
<td><em>Rana</em></td>
<td>III</td>
<td>6</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td><em>Bufo</em></td>
<td>I</td>
<td>10</td>
<td>30</td>
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<tr>
<td></td>
<td></td>
<td>II</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Hypophysectomy + thyroidectomy</td>
<td><em>Rana</em></td>
<td>III</td>
<td>4</td>
<td>details in text</td>
</tr>
<tr>
<td>Thyroid powder (0.1 g./300 c.c. water)</td>
<td><em>Bufo</em></td>
<td>I</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
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</table>

Under ether anaesthesia the animal was laid on its back and a median incision
made in the mucosa of the roof of the mouth posterior to the eyes. When the
resulting flaps were laid aside, the hypophysis became visible through the floor
of the skull (parasphenoid). A square window was opened in the bone and the
gland excised. Bone and flaps were then returned to their original position.
After varying intervals the animals were killed. Serial sections of the region
determined the degree of success of the operation. As controls, unoperated and
sham-operated animals were used.

The influence of the thyroid, during its three periods of activity, was studied
by means of experimental hypo- and hyper-thyroidism. Hypothyroidism was
caus ed by solutions of thiourea of 0.3 per cent. in tadpoles of *H. arborea* L.,
*R. ridibunda* Pall. and in *B. viridis* Laur. Solutions of thiourea of 0.06 per cent.
were used in *R. ridibunda* Pall. only. Since the goitrogen may influence the ultimo-
branchial body directly and not via the thyroid, thyroidectomy, too, was
performed in *R. ridibunda* Pall. and in *B. viridis* Laur. If the effect was similar to that of thiourea, it would indicate that thyroid hormone deficiency was responsible for the changes in the ultimobranchial body. Hyperthyroidism was produced by administration of thyroid powder in tadpoles of *B. viridis* Laur. Twenty limbless tadpoles and 20 with hind limbs were kept in tap-water containing 0.1 gm. thyroid powder per 300 c.c. during 5 to 10 days. They were then transferred into tap-water and kept alive therein for a further period of 5 to 10 days. If the effect on the ultimobranchial body is opposite to that of both forms of thyroid depletion, it may be assumed that the ultimobranchial body is affected by the extra thyroid hormone.

Two naturally athyreotic giant tadpoles of *P. syriacus* Boettger served for the study of the development of the ultimobranchial body in the complete absence of the thyroid.

As hypophysectomy produced the opposite effect to thyroidectomy, both operations were combined in four adults of *R. ridibunda* Pall.

Serial sections of experimental animals and controls were prepared. The whole region between the optic chiasma and the apex of the heart was cut; this included the hypophysis, the thyroid and the ultimobranchial body or any remnant of the former two after intended extirpation. Sections were 10 μ thick. Staining was by Ehrlich's haematoxylin and eosin.

**EXPERIMENTAL RESULTS**

*Hypophysectomy in Rana and Bufo adults*

Twenty specimens of *Rana* and 7 of *Bufo*, of an initial overall length of 3.0–3.5 cm., survived the operation. One *Rana* specimen was maintained 111 days postoperatively without, according to the histological series, any trace of an hypophysis. Its brain was undamaged. The ultimobranchial (Plate, fig. 5), instead of being ovoid, became elongated and flat, with a thin capsule and few capillaries. The epithelium was no longer folded or pseudostratified. It became simple and the cells lost cytoplasm and their crowded appearance. The nuclei became small or attenuated, and only occasionally protruded somewhat into the lumen. This became so narrow that the cells of one side almost touched those opposite; coagulum and nuclei were missing. The other animals were maintained for shorter periods, ranging from 17 to 63 days. The changes in the ultimobranchial body were similar but less pronounced: a coagulum with nuclei sometimes persisted (follicles lacking coagulum may also occur in unoperated animals). Sometimes the lumina showed narrow diverticula, probably relics of formerly distended branches, like those seen in the controls. In brief, the organ had unmistakably involuted to a more or less inactive state.

In three cases the organ was not very dissimilar to the controls, and histological examination showed that a portion of the pars anterior had remained intact. Hypophysial control over the organ may thus be quantitative. In these
cases, the ultimobranchial body on one side was more affected than on the other. An asymmetry of the remaining hypophysis was not observed.

In *Bufo* the capillary bed was unusually expanded, and the follicles atrophied by shrinking (Plate, figs. 1, 2). Occasionally, a slight amount of coagulum was retained in their lumina; but mostly they were flattened and empty. Hence, the follicles appeared cordlike and could be mistaken for clumps of parafollicular cells.

**Hypothyroidism in Hyla, Rana, and Bufo**

The ultimobranchial body of *Hyla* is exceptional among the four species studied, as it undergoes only slight changes during development. It may, therefore, be presumed that the influence of the thyroid on it is comparatively small. Consequently, experimental reduction of thyroid activity would not be expected to cause as much change as might occur in organs whose growth and differentiation is more conspicuously correlated with the physiological decline of thyroid secretion.

The ultimobranchial body of animals kept in 0.03 per cent. thiourea up to 80 days remained very similar to controls. Only one tadpole and two adults survived for 85 days. When killed, the ultimobranchial body was larger than that of the controls, and its epithelial surface was increased by low folds bulging into the enlarged lumen. The organ resembled that of an older animal.

The development of the ultimobranchial body of *Rana* would seem to augur a relatively more sensitive response to the removal of thyroid influence than in the case of *Hyla*. This was found to be true. The histological changes of the ultimobranchial body of animals kept in 0.03 per cent. or 0.06 per cent. thiourea solution for 30 to 60 days were different if the experiments were performed during the three different periods mentioned in the introduction:

- **Group A**: Tadpoles up to the stage before precartilage develops in the internal forelimb buds; a period of low thyroid activity.
- **Group B**: Tadpoles older than those of group A, up to the beginning of tail-resorption; a period of high thyroid activity.
- **Group C**: Tadpoles older than those of group B; a period of relative thyroidal decline.

In group A, only the lumen of the ultimobranchial body was enlarged. The epithelium remained cuboidal as in the controls: accordingly, the thyroid inhibitor elicited only a weak effect.

In group B, after 30 days in 0.03 per cent. thiourea the unifollicular ultimobranchial body and its lumen were considerably enlarged. Moreover, in two cases a second follicle appeared on each side. After the same length of time in 0.06 per cent. thiourea or 40 days in 0.03 per cent., the organ became enlarged, reaching at least double the control diameter. After 40 days in 0.06 per cent. solution, the organ hypertrophied to almost three times the control diameter. The epithelium in these cases became densely packed and columnar, and
numerous cells protruded into the lumen. The coagulum, however, failed to increase. The effect of thiourea was therefore more marked the stronger the solution and the longer the exposure.

In group C, the ultimobranchial body showed an increase in the epithelial surface area by means of folds protruding into the lumen. Capillaries from the capsule accompanied the epithelium into the folds, but there was no increase in size of the organ.

Thyroidectomy was performed in *Rana* adults only. Where the operation was completely successful, again an increase of epithelial surface area of the ultimobranchial body without recognizable hypertrophy of volume was seen. The epithelium was simple columnar or pseudostratified and distended capillaries invaded the folds protruding into the lumen (Plate, fig. 4). The nuclei were lengthened and surrounded by a large amount of eosinophilic cytoplasm, many bulging into the lumen and some almost completely detached from the epithelial wall. The organ seemed to be in a state of heightened activity on the basis of its increased surface area and the absence of pycnosis, in contrast to its condition in hypophysectomized animals. The lumen was branched and contained an eosinophilic coagulum and many nuclei. If no folds of epithelium were present, the lumen was considerably distended.

The appearance of heightened activity of the ultimobranchial body was less marked where the thyroidectomy was less successful; but the degree of activity could not be correlated with the size of the remnant or the elapsed time: there may have been a period of dormancy of unknown duration following injury of the thyroid follicles or of their blood-supply, after which limited recovery may occur.

The results of thyroidectomy accorded well with those of thiourea treatment.

As the response of the *Bufo* ultimobranchial body to experimental hypothyroidism is like that in *Rana*, the same classification is used.

*Group A*: Tadpoles about 3 cm. long, without limb-buds, in contrast to controls showed no indication of entering metamorphosis even after 48 days in thiourea solution. Their ultimobranchial body of c. 65 μ diameter had a slight elongation, but the lumen was of normal size. The same effect resulted from thyroidectomy after only 30 days if the extirpation was performed on tadpoles of the same group.

*Group B*: Tadpoles with limb-buds kept in thiourea solution continued to develop at a slow rate. Their ultimobranchial body displayed a marked hypertrophy, and, in one case, multifollicularity. The unusual diameter of 140 μ and the enlarged lumen of the follicle, containing increased coagulum and a number of nuclei, is characteristic of the normal toad after metamorphosis. One tadpole, with 1-cm. hind limbs at the beginning of the experiment, was killed after 50 days: an extra pair of large follicles had developed from the original primordium, and these were situated a considerable distance away from, and without connective-tissue links to, the follicle. While the latter had a normal diameter of
70 μ, the additional follicle on one side was almost twice normal size and that on the other side almost three times normal size. Their lumen was enlarged and contained abundant coagulum.

Complete thyroidectomy performed on tadpoles of group B proved more efficacious than thiourea, producing a larger organ and as many as three somewhat smaller follicles with relatively large lumina on each side in extreme cases (Plate, fig. 3). Other tadpoles, only partially thyroidectomized, displayed transitional responses ranging from a somewhat elongated follicle on both sides to 2 follicles on one side and 1 on the other, 2 follicles on each side, and 3 follicles on one side and 2 on the other. In all cases, a common and extremely thin capsule containing wide capillaries and melanophores surrounded the follicles. In two cases the additional follicle was very small, and appeared some distance away, outside the capsule, and closely applied to the epithelium of the gill arch as in the primordium stage. Its structure, however, characterized it as part of the ultimobranchial body. Again, the changes were not proportional to the time elapsed or to the size of the fragments of the thyroid left after the operation.

Only once has a supernumerary follicle been observed in a normal tadpole, due, perhaps, to a malfunctioning thyroid.

Group C: Four-limbed tadpoles, which had completed metamorphosis, were killed after 30 days in thiourea solution. The volume of the ultimobranchial body was normal, but the surface area of its wall was increased by folds, which protrude into the lumen. Parafollicular cells typical of normal Bufo adults were not discerned.

Thyroidless giant tadpoles of P. syriacus

The normal P. syriacus tadpole attains a size of 110 mm. before the appearance of hind limbs. In the spring of 1956, however, some 30 P. syriacus tadpoles of 175-mm. size and still lacking limbs were found in rain-water ponds near the Israel coastal town of Holon (Grid Ref. 1295/1953). Most were kept in aquarium tanks for 9 months. Only three of them produced limbs of minute size.

Giant tadpoles of P. fuscus (Mertens, 1947) are known from cold Alpine lakes, where it is assumed that, owing to the coldness of the water, they continued to grow until metamorphosing in the second year of life. Cold water could not be the cause of gigantism in the Israel tadpoles, as the ponds concerned have a noon temperature of 30° C. They dry up during the summer, and only individuals metamorphosed by then could possibly survive. Serial sections of the entire thyroid region (plus an adequate amount of nearby tissue) of two tadpoles were examined. The thyroid gland was completely lacking (Boschwitz, 1957). Tadpoles of R. pipiens deprived of the thyroid anlage are known to grow to unusual dimensions (Allen, 1918) without ever developing limb buds.

The ultimobranchial body of the giant Pelobates tadpoles displayed the typical response to lack of thyroid. It was twice as large as in controls; having progressed from the coiled tube stage, it assumed the ovoid form of later
metamorphic stages and it was therefore compared with the ultimobranchial body of animals of this stage. Many follicles were more voluminous, as was also the quantity of coagulum. The number of follicles and of parafollicular cells was greater than normal. But the embryonic feature of close association with the epithelium of origin was still retained.

The effect on the ultimobranchial body of hyperthyroidism induced by thyroid powder in *Bufo* tadpoles

The thyroid powder and thiourea effects could be distinguished early by the amount of faeces. Animals treated with thiourea produced more than the controls, while those treated with thyroid powder produced almost none at all. The latter, owing presumably to accelerated metamorphosis, began to live exclusively on their own tissue (for instance the tail).

A number of animals already displayed forelimbs two days after the 5-day thyroid powder treatment. Their ultimobranchial body measured then only 40–60 μ in diameter, instead of the normal 100–120 μ. It retained the embryonic spherical shape, clinging to the branchial arch epithelium, as if but recently budded off. The capsule was meagre, with few capillaries. The epithelium had the usual pseudostratification, but the nuclei were neither crowded together nor protruded into the lumen, which only occasionally contained a little coagulum and a nucleus or two. The extreme under-development indicated that morphogenesis had been halted or had regressed, although metamorphosis progressed.

Animals killed 5 and 10 days after the treatment showed more pronounced degree of shrinking of the ultimobranchial body. The epithelium pushed so many folds into the lumen that the cavity was almost choked, as a result not of hyperplasia but of contraction, as in hypophysectomized *Rana* adults. The cytoplasm was shrunken around pycnotic nuclei. The connective tissue did not accompany the epithelial folds. Melanophores ringed the capsule. A comparison with controls led to the conclusion that these melanophores originally lay against the follicle but that, as the epithelium shrank away and the capsule dwindled, a detached layer of melanophores appeared.

*Hypophysectomy and thyroidectomy in adult Rana*

Since hypophysectomy and thyroidectomy were found to have opposite effects on the ultimobranchial body, it was of interest to carry out both operations in one animal. The effect of subsequent thyroidectomy was expected to reduce the involution produced by an initial hypophysectomy.

Four *Rana* adults were hypophysectomized, and the thyroid excised 40, 42, 48, and 54 days later, respectively. The first two animals were killed three days, the third 10 days, and the fourth 15 days after the second operation. Even the first two animals showed a renewed proliferation of cells and expansion of the lumen as compared with the involution subsequent to hypophysectomy alone.
The blood supply had also increased, but the capillaries did not yet protrude into the folds as in animals only thyroidectomized. The other two animals revealed an increasing number of folds and an eosinophilic coagulum including some cells (Plate, fig. 6).

**DISCUSSION**

Although none of the foregoing results provides a clue to the function of the ultimobranchial body, they suggest that its activity is somehow associated with that of the hypophysis and the thyroid. It is possible to formulate the following tentative generalizations: the hypophysis maintains the ultimobranchial body, since hypophysectomy causes its atrophy; and the thyroid inhibits the organ, which hypertrophies in hypothyroidism. The normal ultimobranchial body may result from a combined effect of antagonistic factors from both glands.

The experiments were performed during different developmental periods, and the results confirmed that the fluctuating activity of the thyroid is not merely coincidental with the changes that take place in the ultimobranchial body during development.

Normally, the ultimobranchial body develops after the rudiment of the thyroid has appeared, but, as seen in the congenitally athyreotic giant tadpoles of *P. syriacus*, this sequence is temporal rather than causal. The growth of their ultimobranchial body was unusual, as it was never interfered with by the inhibitory thyroid hormone (Eggert, 1938; Schaefer, 1938). The ultimobranchial body of human athyreotic neonati, likewise, fails to atrophy (Getzowa, 1911).

Until the appearance of precartilage in the forelimb buds, the inhibition of the ultimobranchial body growth by the thyroid (up to this stage functionally dormant) is negligible, as indicated by its slight expansion after thyroid deprival. A significant response seems not yet possible, confirming that the ultimobranchial body is dependent on the quantity of thyroid hormone circulating in the blood. The increase in thyroid activity at metamorphosis diminishes the growth rate of the ultimobranchial body. The degree of this interference may be measured by the increase of surface area in the ultimobranchial body of tadpoles subsequent to experimental hypothyroidism, produced either by thiourea or by thyroidectomy.

The multifollicular state is connected with low thyroid activity, either during the first developmental stage of the thyroid, when the pharynx epithelium is able to create new follicles, or in the adult (*Bufo*) with the physiological decline of the thyroid. It seems reasonable, therefore, to explain the multifollicularity of the operated animals as caused by the deprivation of thyroid secretion. When the single-layered epithelium of the follicle transmutes into a pseudo-stratified one, the potency of the pharynx epithelium is gradually lost, possibly owing to the inhibitory thyroid hormone, now secreted in increasing amount.
After thyroid deprivation at this time, the single follicle hypertrophies and becomes some two or three times as large as the normal. This increase in secreting surface is enhanced by folds, protruding into the lumen. Follicular cells and coagulum display the features of activity (Hyla, Rana, Bufo). The later the reduction of thyroidal influence the less the added growth attained by the ultimobranchial body. Para-follicular cells (Bufo) never appear before the end of metamorphosis. Apparently, their development depends on factors available only in adults. No obvious changes were found in para-follicular cells in any of the experiments.

Addition of thyroid hormone during metamorphosis supplements the intensive activity of the thyroid. The growth rate of the ultimobranchial body is halted, as evidenced by its shrunken appearance and poor blood-supply. In the post-metamorphic period, experimental repression of thyroid activity reinforces the natural spurt of development of the ultimobranchial body due to the physiological decline of thyroid secretion.

Since thyroidectomy and thiourea treatment have precisely the same effect on the ultimobranchial body, and thyroid powder exactly the opposite, it may be concluded that these substances influence the organ in the same way as the fluctuating secretion of the thyroid. Another explanation of the thyroid–ultimobranchial body relationship could be that after anti-thyroid treatment or after thyroidectomy the TSH-secretion of the pituitary is stimulated and causes the hypertrophy of the ultimobranchial body.

Of course, it is not certain that the hypertrophy of the ultimobranchial body is indicative of its heightened activity, since we know that hypertrophy of the thyroid may be connected with hypofunction as well as with hyperfunction. Additional experiments are needed to confirm that hypertrophy of the ultimobranchial body is a symptom of its heightened secretion.

As expected, it was found that hypophysectomy of adults has the opposite effect to that of thyroidectomy. A combination of both extirpations, i.e. thyroidectomy some days after hypophysectomy, displayed a combination of effects.

Special explanation is needed for the ultimobranchial body of the one frog which survived hypophysectomy for 111 days: here, too the combined effect was expected, as after so long a period the secretion of thyroxine is diminished in consequence of the missing thyreotropic hormone. But the ultimobranchial body atrophied without any sign of renewed activity. A possible explanation seems to be that the ultimobranchial body is controlled by the thyroid gland from the time of appearance of the hind-limb buds until the end of metamorphosis. It reacts to the fluctuations of thyroid secretion as described. In the adult a direct influence of the hypophysis becomes predominant and therefore the involution of the ultimobranchial body after hypophysectomy progresses steadily (Eggert, 1938; Schaefer, 1938). Of course, hypophysectomy in tadpoles is necessary to confirm this assumption. Yet another explanation is possible: if the hypertrophy of the ultimobranchial body after thyroidal decline is caused...
by the heightened TSH-secretion of the pituitary, its extirpation would produce an atrophied ultimobranchial body. Extirpation of both hypophysis and thyroid, with subsequent administration of thyroid powder and/or TSH, would contribute to the solution of this problem. Experiments with thyroxine administration after hypophysectomy are needed to differentiate between the influence of the hypophysis and the thyroid on the ultimobranchial body after metamorphosis.

The structure and the accelerated growth of the ultimobranchial body when the thyroid secretion declines, and its involution effected by rising amounts of thyroid hormone, are proof that the ultimobranchial body has a secretion which is not comparable to that of the thyroid. Hence the assumption (summarized by Lynn & Wachowsky, 1951), that the ultimobranchial body is a 'lateral thyroid', is not acceptable. Another differential feature of the ultimobranchial body is its inability to accumulate I\textsuperscript{131}, as shown in the mouse (Gorbman, 1947) and confirmed for *Xenopus laevis* by Saxén & Toivonen (1955).

**SUMMARY**

1. The ultimobranchial body originates independently of the thyroid, as seen in congenitally athyreotic tadpoles of *P. syriacus*.

2. Experiments concerning the influence of the hypophysis and thyroid on the ultimobranchial body were performed on *H. arborea*, *R. ridibunda*, and *B. viridis*.

3. With the beginning of metamorphosis, the increasing thyroid secretion inhibits the original growth rate of the ultimobranchial body; experimental hyperthyroidism enhances this physiological interference, so that the follicle shrinks.

4. Experimental hypothyroidism causes hypertrophy of the ultimobranchial body, evidenced by an increase in surface area of the follicle. This effect is negligible before metamorphosis, significant during metamorphosis, and less extreme in young adults, when thyroid activity declines.

5. Hypophysectomy in young adults causes atrophy of the organ.

6. It is assumed that the hypophysis maintains the ultimobranchial body and the thyroid inhibits its growth and activity. The antagonistic effects of both glands produce the normal state of the organ.

**RÉSUMÉ**

*Influence de l'hypophyse et de la thyroïde sur le corps ultimobranchial des Anoures d'Israël*

1. L'origine du corps ultimobranchial est indépendante de celle de la thyroïde, comme l'indiquent certains têtards de *Pelobates syriacus* frappés d'agénésie congénitale de la thyroïde.

2. Des expériences qui montrent le rôle de l'hypophyse et de la thyroïde sur
le corps ultimobranchial ont été faites sur *Hyla arborea*, *Rana ridibunda*, et *Bufo viridis*.

3. Au début de la métamorphose, l'augmentation de la sécrétion thyroïdienne entraîne une diminution du taux de croissance du corps ultimobranchial. L'hyperthyroïdisme expérimental exalte cette inhibition et détermine l'étrécissement du follicule.

4. L'hypo-thyroïdisme expérimental amène l'hypertrophie du corps ultimobranchial, révélée par l'augmentation de la surface du follicule. Cette action est négligeable avant la métamorphose, significative pendant cette période et moins importante chez les jeunes adultes dont l'activité thyroïdienne diminue.

5. L'hypophysectomie des jeunes adultes provoque l'atrophie du corps ultimobranchial.

6. On en conclut que l'hypophyse maintient le corps ultimobranchial et que la thyroïde inhibe sa croissance et son fonctionnement. L'état normal de cet organe résulte de l'effet antagoniste de ces deux glandes.

**ACKNOWLEDGEMENT**

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**REFERENCES**


EXPLANATION OF PLATE

FIG. 1. Ultimobranchial body of *Bufo* after metamorphosis. Its diameter, 115 μ; section 8 μ thick; 4 mm. obj.; ×290. Note typical follicles, parafollicular cells, and capillaries.

FIG. 2. Ultimobranchial body of *Bufo* 14 days after hypophysectomy. Its diameter, 110 μ; section 10 μ thick; 4 mm. obj.; ×290. Follicles are compressed and mostly indistinguishable from parafollicular cells. Wide capillaries. Compare with control (fig. 1).

FIG. 3. Ultimobranchial body of *Bufo* tadpole (total length 32 mm.) 31 days after complete thyroidectomy. Section 8 μ thick; 8 mm. obj.; ×250. Three distinct follicles surrounded by capsule with melanophores. Controls have only one follicle.

FIG. 4. Ultimobranchial body of postmetamorphic *Rana* 38 days after partial thyroidectomy. Diameter of ultimobranchial body, 210 μ; section 10 μ thick; 4 mm. obj.; ×290. Pseudostratified epithelium. Unusual amount of protruding and detached cells. Lumen greatly enlarged and capillaries wide: signs of hypertrophy.

FIG. 5. Ultimobranchial body of postmetamorphic *Rana* 111 days after hypophysectomy. Diameter 176 μ; section 8 μ thick; 4 mm. obj.; ×330. Epithelium single-layered. No coagulum in the narrow lumen. Capillaries reduced, capsule thin: signs of atrophy.

FIG. 6. Ultimobranchial body of postmetamorphic *Rana* 54 days after hypophysectomy and 15 days after thyroidectomy. Diameter 190 μ; section 10 μ thick; 4 mm. obj.; ×290. Effect of hypophysectomy: single-layered epithelium of large follicle with few protruding nuclei. No coagulum. Effect of thyroidectomy: lumen is secondarily expanded. The small follicle shows renewed activity: columnar epithelium, eosinophilic coagulum including cells.

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