ACTIVITY OF THE THYROID AND THE PITUITARY GLAND IN THE VIVIPAROUS CYPRINODONTS LEBISTES RETICULATUS (PETERS), XIPHOPHORUS HELLERI HECKEL AND XIPHOPHORUS MACULATUS GÜNTHER DURING THE DEVELOPMENT OF THE GONOPODIUM

by

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I. INTRODUCTION

In our investigations concerning the activity of the thyroid and the pituitary gland in viviparous fishes we found that this activity can show cyclic changes. Thus the gestation period of the viviparous Cyprinodont *Lebistes reticulatus* (PETERS) and of the Hemiramphid *Dermogenys pusillus* (VAN HASSELT) is characterized by a low thyroid activity during the first and the fourth week and an increased activity during the second and the third week (STOLK, 1950 *b*, 1951 *a* and 1956 g), whereas during the last part of the gestation period, from the 20th day onwards, the embryonic thyroid gland shows a gradual increase in activity (STOLK, 1951 *c* and 1957 *b*).

The glandular lobe of the pituitary gland in these species shows two distinct maxima of the quotients c_h and c_s (representing the ratio of the average height of the glandular lobe to that of the pituitary gland, and c_s the ratio of the middle transversal section of the glandular lobe to that of the middle transversal section of the pituitary gland, respectively) coinciding with the alpha and the gamma phase of the corpus luteum cycle (STOLK, 1950 *b*, 1951 *b* and 1957 *a*), on the strength of which a functional relation between the glandular lobe of the pituitary gland and the corpus luteum seems likely.

Besides, also during the overlapping of the eyes by skin folds in the Characid *Anoptichthys jordani* (HUBBS et INNES) the activity of the thyroid and the pituitary gland (lobus anterior and lobus intermedius) shows a gradual increase in activity (STOLK, 1958 *b*).

In continuation of these investigations we have analysed the activity of the thyroid and the pituitary gland during a process which is closely related to the gestation, viz. the development of the gonopodium by means of a transformation of the anal fin in the male sex of the guppy or millionfish *Lebistes reticulatus* (PETERS), the swordtail *Xiphophorus helleri* HECKEL and the platyfish *Xiphophorus maculatus* GÜNTHER.

The way in which the anal fin is transformed into the gonopodium is typical of the various families of the viviparous Cyprinodonts. In the Poeciliidae, to which the above-mentioned species belong, only part of the anal fin forms the gonopodium. The gonopodium is in these species built of the third, the fourth and the fifth anal fin ray. During this fusion process the anal fin shifts somewhat in the cranial direction.

As the ductus deferens of the Poeciliidae ends freely before the beginning of the chute and tubularly fused gonopodium the latter can be best considered as a true extension of the ductus deferens.

Concerning the function of the gonopodium it can be observed that in general the end of the gonopodium is provided with small hooks and teeth, which ensure close contact with the female. An important point for the copulation is that the gonopodium of the Poeciliidae can be moved to all sides. Through co-operation of the gonopodium and the also characteristically fused abdominal fins the sperm is brought by the male in the form of spermiophores into the genital pore of the female.

When one or more spermiophores have arrived in the female oviduct, the capsule is dissolved by a liquid present in the oviduct. The spermia are liberated and, since they are attracted by certain substances, they move actively via the oviduct and the occlusion apparatus (STOLK, 1950 *a* and 1950 *b*) to the lumen of the paired ovary, which when full-grown becomes fused, where they are stored in the so-called sperm chambers (PHILIPPI, 1908; WINGE, 1922 and 1937; STOLK, 1950 *b*).

After a number of large, ripe, yolk-rich oocytes have been fertilized, they can develop. JASKI (1939) was of opinion that in *Lebistes* a litter consisted of an equal number of young fishes; however, a microscopical examination of the ovaries showed us that litters with an unequal number of young fishes also occurred (STOLK, 1950 *b*).

Shortly before parturition the oocytes with embryos pass the occlusion apparatus (STOLK, 1950 *a* and 1950 *b*) and reach a dilated part of the oviduct. After the embryos have left the egg capsule, they leave the body of the mother, passing the genital pore both with the head and the tail (STOLK, 1950 *b*). Sometimes, however, in *Lebistes* the young fishes can be born in a transverse position, in which either the trunk, or the head and the tail come first (STOLK, 1950 *b*).

The egg capsules also leave the oviduct via the genital pore, in so far as they have not yet been dissolved. Sometimes it can be observed that the young fishes are born within the egg capsule, from which they free themselves as a rule immediately after parturition. This egg capsule parturition is dependent on certain conditions, such as the chemical composition of the water, the temperature of the water, etc.

As in a number of species the spermia stored in the sperm chambers continue to be viable for a considerable time, various gestations may succeed each other without the female having been in contact with the male.

It seemed important to us to establish whether the development of an organ like the gonopodium, whose function it is pre-eminently to promote reproduction, is actually regulated endocrinally. For this purpose the activity of the thyroid and the pituitary gland was determined with the aid of the quotients d/n and D/n and the quotients c_h and c_s, respectively, and moreover with the aid of the nucleus size, the mitotic activity, the nucleus structure, the chondriome and the GOLGI apparatus.

II. TECHNIQUE

The experiments were performed with young males of *Lebistes reticulatus, Xiphophorus helleri* and *Xiphophorus maculatus.* Of each species 90 animals were used.

The fishes were kept in moderately heated tanks (27° C) with a liberal amount of aquatic plants (*Vallisneria spiralis, Sagittaria sinensis, Myriophyllum brasiliense, Bacopa amplexicaulis, Elodea canadensis, Limnophila sessiliflora, Hygrophila sp., Ludwigia natans, Acorus gramineus* var. *pusillus, Ceratopteris thalictroides, Cryptocoryne beckettii, Cryptocoryne nevillii, Cryptocoryne haerteliana, Echinodorus tenellus, Nitella sp., Salvinia auriculata* and *Riccia fluitans*) and green algae. The position of the tanks was such that the fishes occasionally got some direct sunlight, which is recommendable to keep the animals in a good condition. The food was varied and consisted of *Tubifex, Enchytraeus, Chironomus, Daphnia, Cyclops, Drosophila* and red mosquito larvae. Moreover, from time to time the liver-cereal wet food was administered according to the direction of GORDON (1943 and 1950). The ingredients of this food are:

100 grams of fresh beef liver,
4 tablespoonfuls of Ceravim or Pablum,
0.4 teaspoonful of table salt.

For the preparation of this food see the publications of GORDON (1943 and 1950).

The material was fixed in BOUIN d'Hollande fluid, decalcified in the usual way with trichloroacetic acid and embedded in paraffin. The transversal, serial sections (4–6 μ) were stained with hematoxylin and eosin, hematoxylin and eosin-azure, hematoxylin and azophloxin, MASSON trichrome stain, and moreover according to the VAN GIESON method and the MALLORY-Azan method.

The chondriome was studied in sections, which were fixed according to the method of REGAUD and the method of REGAUD modified by HIRSCH and BRETSCHNEIDER and were stained with iron hematoxylin, while for the investigation of the GOLGI apparatus osmic acid impregnation was performed.

Moreover, the chondriome was studied in sections stained vitally with JANUS green.

The activity of the thyroid gland of the animals was determined by the mathematical method of LEVER (1948 and 1950; cf. LEVER, MILTENBURG and VAN OORDT, 1949; and STOLK, 1951 *c*, 1956 *g*, 1957 *b* and 1958 *b*).

This method is based on the relations between the number of the follicle cells (n), the inner diameter of the follicle (d), the outer diameter of the follicle (D)

and the height of the follicle epithelium cells (h) of circular or almost circular follicles.

The quotient d/n seems to be a suitable criterion in determining the activity of the thyroid gland. In this quotient d represents the inner diameter of a medially cut, circular follicle, and n the number of the follicle cells in the medium section.

According to LEVER four follicles of the medium section of each thyroid gland must be measured, after which the average value of the measurements is calculated.

If the thyroid gland did not contain any circular follicles at all, oval follicles were used and the average of the small and the large diameter of the follicles was taken.

For the determination of the activity of the pituitary gland the volumetric method of STOLK (1950 *b* and 1951 *b*) was used, some minor differences being applied. As in the publications of STOLK (1954, 1955 *a*, 1956 *a*, 1956 *c*, 1956 *d*, 1956 *e*, 1956 *f*, 1957 *a*, 1958 *a* and 1958 *b*) we did not use the median section of the pituitary gland and the anterior lobe for the measurements, but for practical purposes a transversal section and the glandular lobe (lobus anterior and lobus intermedius).

In this volumetric method the quotient c_h represents the ratio of the average height of the glandular lobe to that of the pituitary gland. The quotient c_s represents the ratio of the area of the middle transversal section of the glandular lobe to that of the middle transversal section of the pituitary gland.

In the thyroid follicle cells and the cells of the pituitary lobes the nucleus size was determined according to the method of LEVER (1950). This nucleus size is defined in this publication as the surface of a median section of the nucleus. The nuclei are not perfectly spherical, so that starting from the value of the nucleus size it is impossible to calculate the volume of the nucleus. For the determination of the nucleus size preparations were drawn with a drawing prism on drawing paper, then cut out and weighed to an accuracy of one milligram.

The mitotic activity of the tissues was studied by determining the number of mitoses to a number of nuclei.

The nucleus structure was evaluated on the size of the nucleoli and the staining capacity of the nucleus. At a magnification of 2700 four representative nuclei were copied with the drawing prism.

The state of the chondriome and of the GOLGI apparatus was exclusively evaluated on the morphological structure.

III. RESULTS

a. Thyroid gland

The quotients $\overline{d/n}$ and $\overline{D/n}$ were estimated for *Lebistes reticulatus, Xiphophorus helleri* and *Xiphophorus maculatus* during the development of the gonopodium. The results of these measurements are given in Tables 1, 2 and 3 and in Figures 1 and 2. The values of the quotients d/n and D/n as well as the average values of the quotients d/n and D/n ($\overline{d/n}$ and $\overline{D/n}$, respectively) are designated in Tables 1, 2 and 3; Figures 1 and 2 show the relationship between the quotients d/n and D/n on the one hand and the time on the other.

These results demonstrate that during the development of the gonopodium the values of the quotients $\overline{d/n}$ and $\overline{D/n}$ gradually decrease, which corresponds with an increase in thyroid activity.

The three curves have some special features. In the initial period of the development of the gonopodium the curves lie further apart than in the final period; consequently they show a certain convergence. Furthermore, in the initial and the middle period the thyroid gland in general shows the greatest activity in *Lebistes reticulatus* and the lowest in *Xiphophorus maculatus*. However, in the final period the thyroid activities of the three species correspond, which is manifested by some crossing-over of the curves in this period.

The maximum values of $\overline{d/n}$ amount in *Lebistes reticulatus* to 2.100, in *Xiphophorus helleri* to 2.233, and in *Xiphophorus maculatus* to 2.467, respectively, the minima of these values amounting to 0.933, 0.933 and 1.000, respectively. The maximum values of $\overline{D/n}$ are in *Lebistes reticulatus* 2.400, in *Xiphophorus helleri* 2.533, and in *Xiphophorus maculatus* 2.800, respectively, their minima being 1.300, 1.333 and 1.300, respectively.

The size of the thyroid follicle cell nuclei has a distinct optimum curve with an optimum in *Lebistes reticulatus* during the period of 21–27 days, in *Xiphophorus helleri* during the period of 27–36 days and in *Xiphophorus maculatus* during the period of 30–33 days (Tables 4, 5 and 6; Figures 3, 4 and 5).

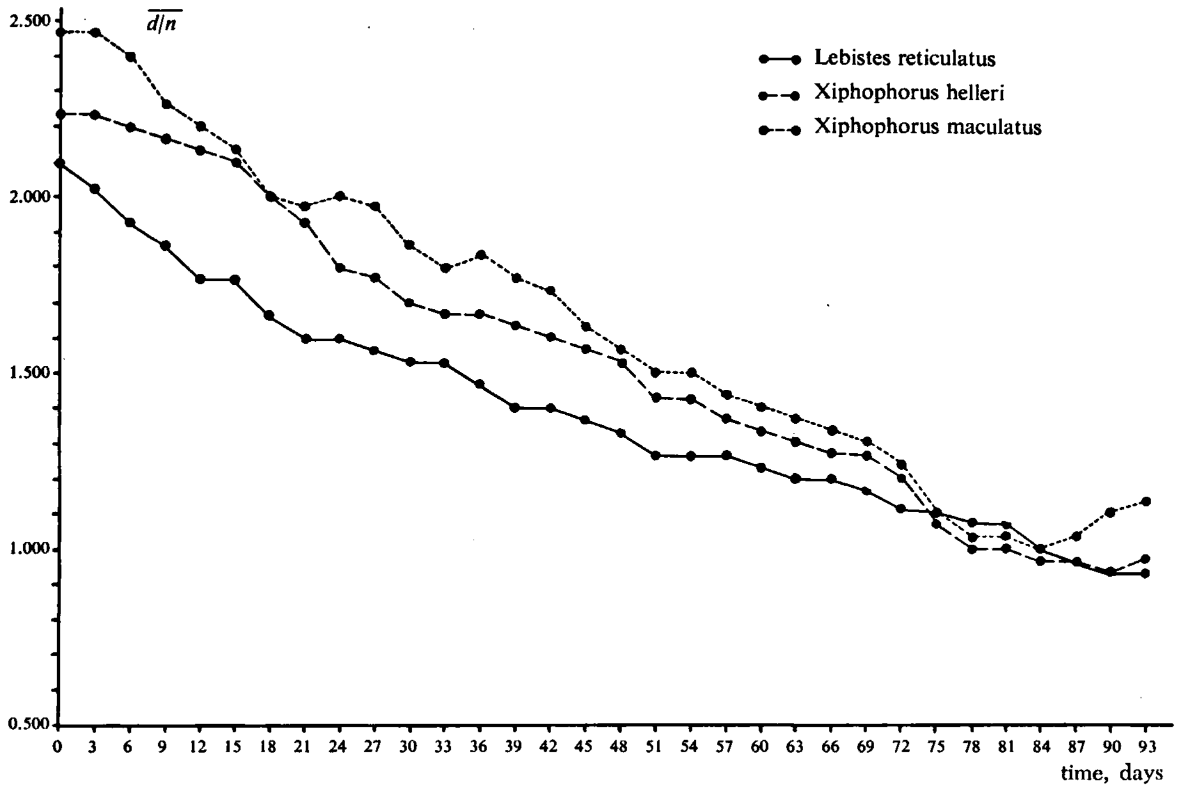


Fig. 1. Variability of the quotient $\overline{d/n}$ during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: quotient $\overline{d/n}$.

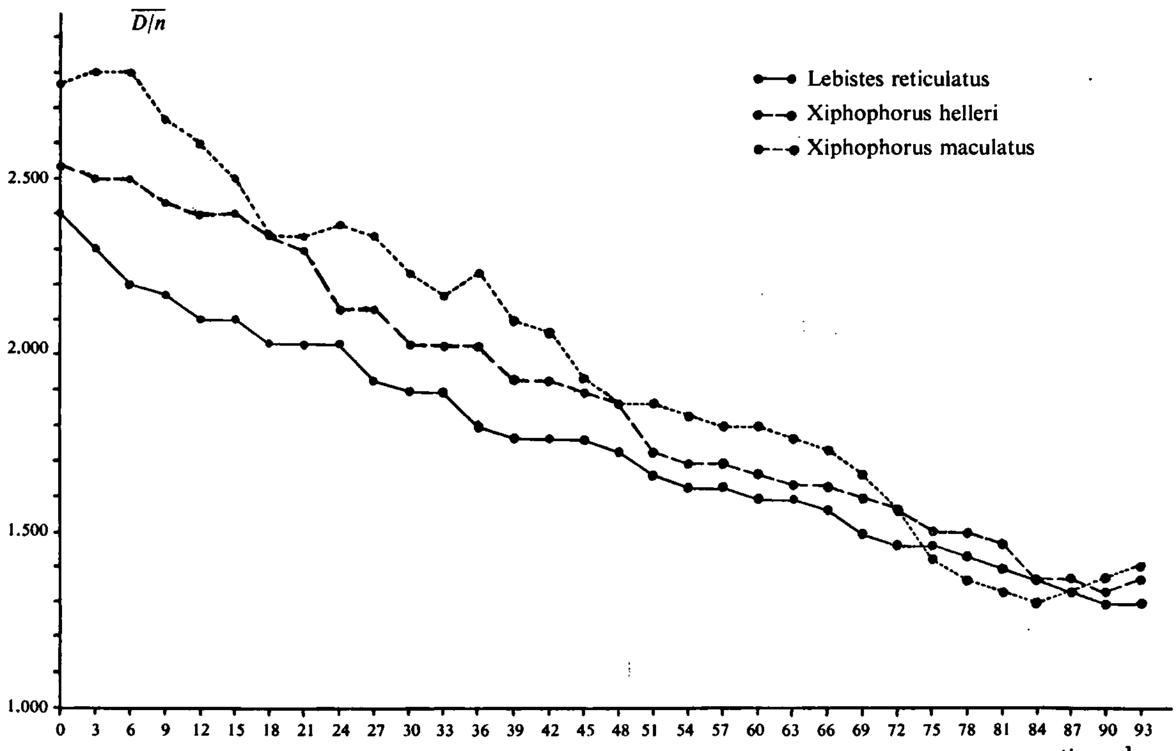


Fig. 2. Variability of the quotient $\overline{D/n}$ during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus hellen* and *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: quotient $\overline{D/n}$.

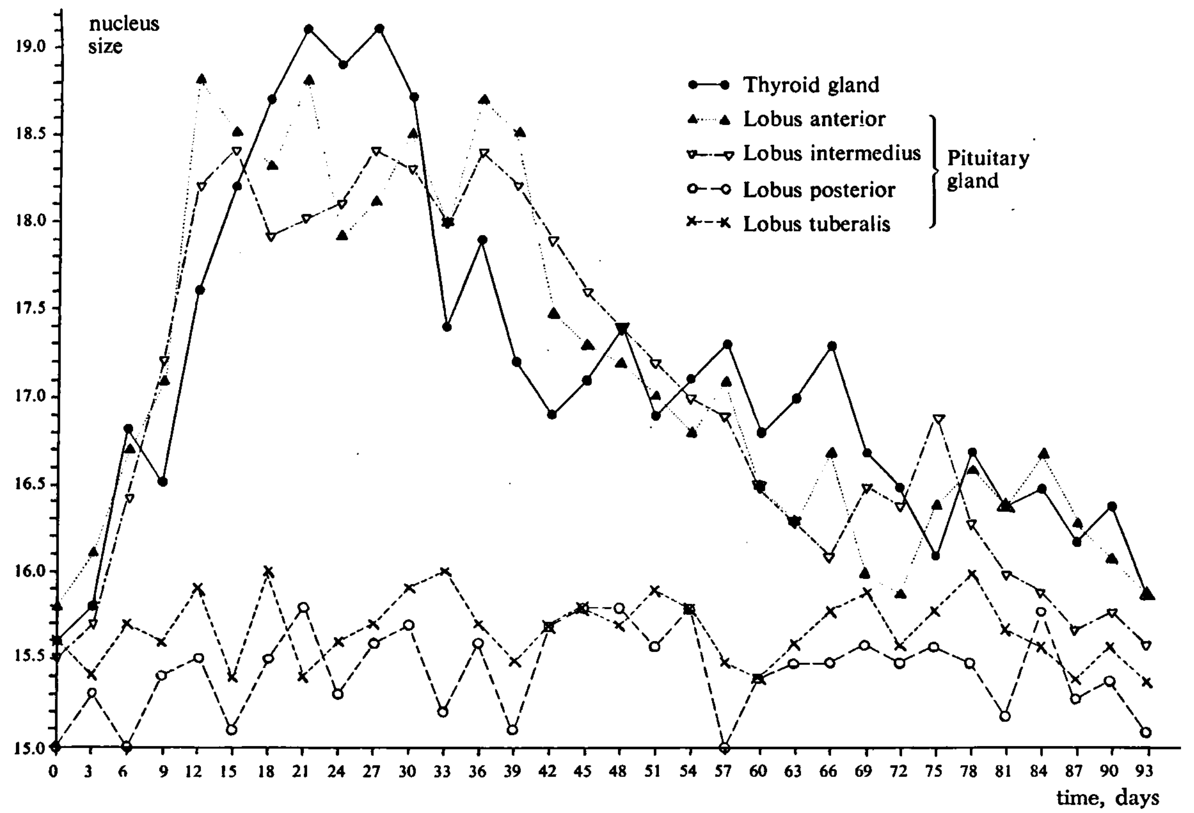


Fig. 3. Variability of the nucleus size in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Lebistes reticulatus*. Abscissa: duration of the experiments in days. Ordinate: mean values of the nucleus size.

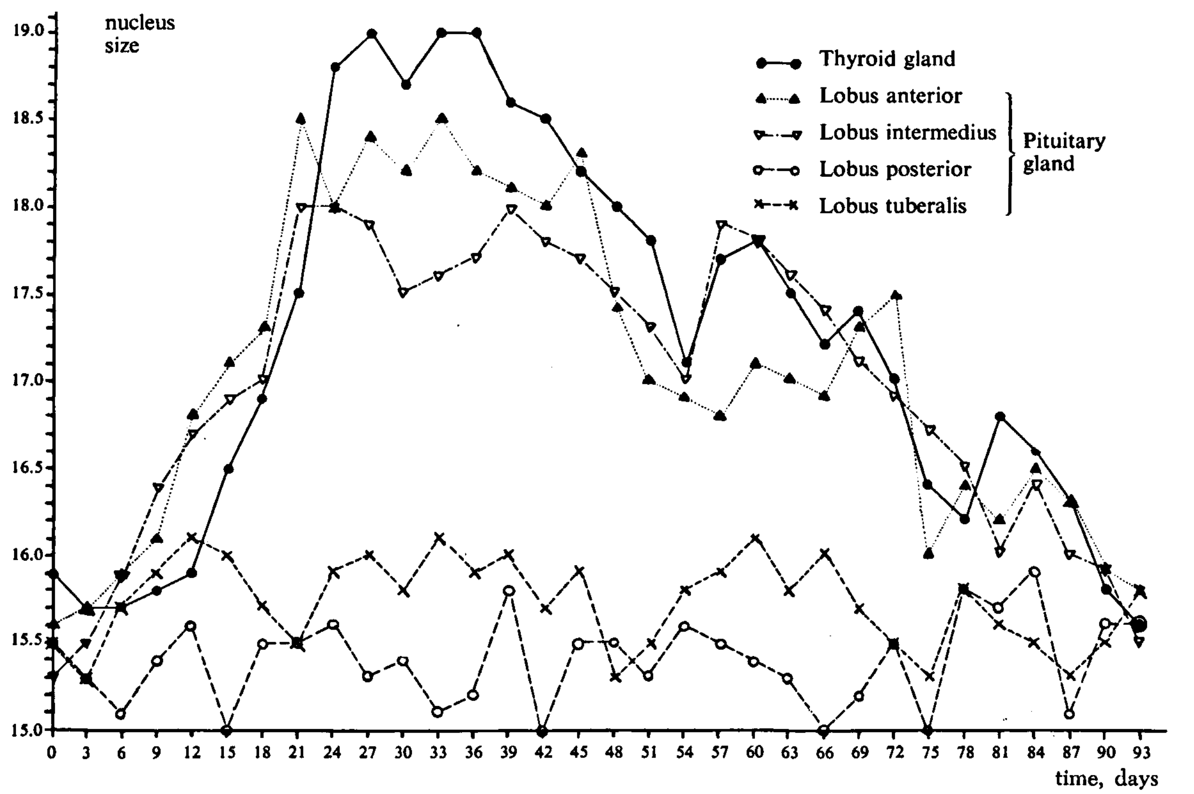


Fig. 4. Variability of the nucleus size in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus helleri*. Abscissa: duration of the experiments in days. Ordinate: mean values of the nucleus size.

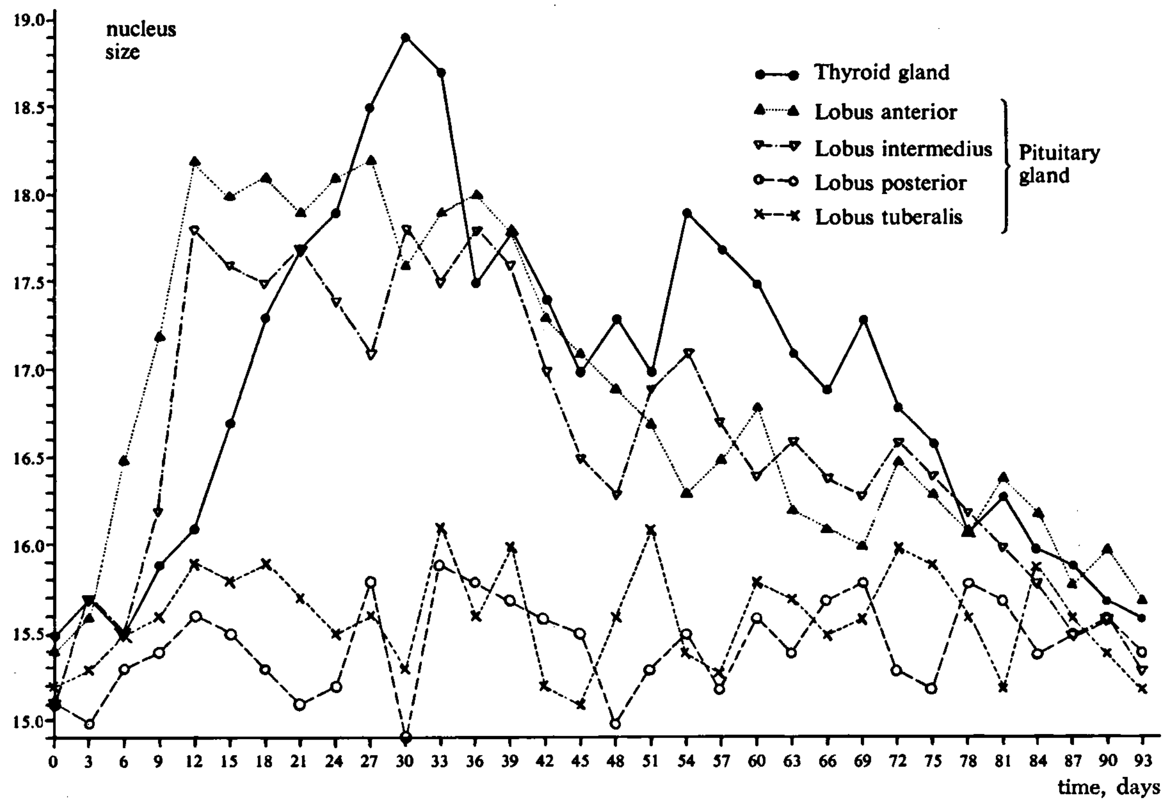


Fig. 5. Variability of the nucleus size in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: mean values of the nucleus size.

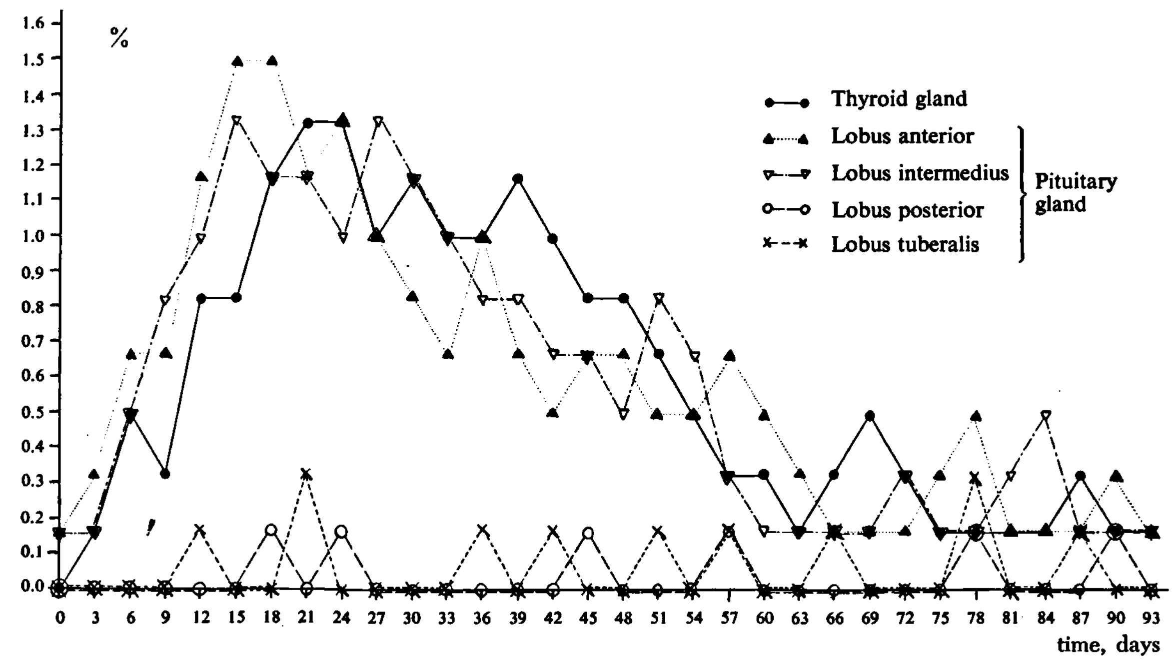


Fig. 6. Variability of the number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Lebistes reticulatus*. Abscissa: duration of the experiments in days. Ordinate: number of mitoses in percentages.

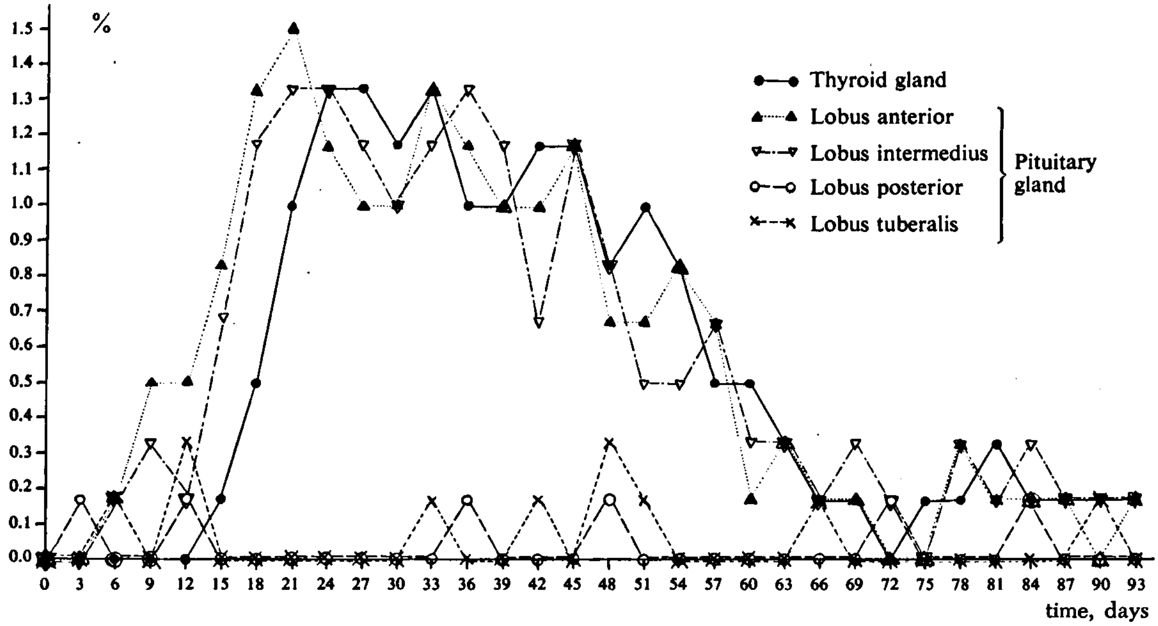


Fig. 7. Variability of the number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus helleri*. Abscissa: duration of the experiments in days. Ordinate: number of mitoses in percentages.

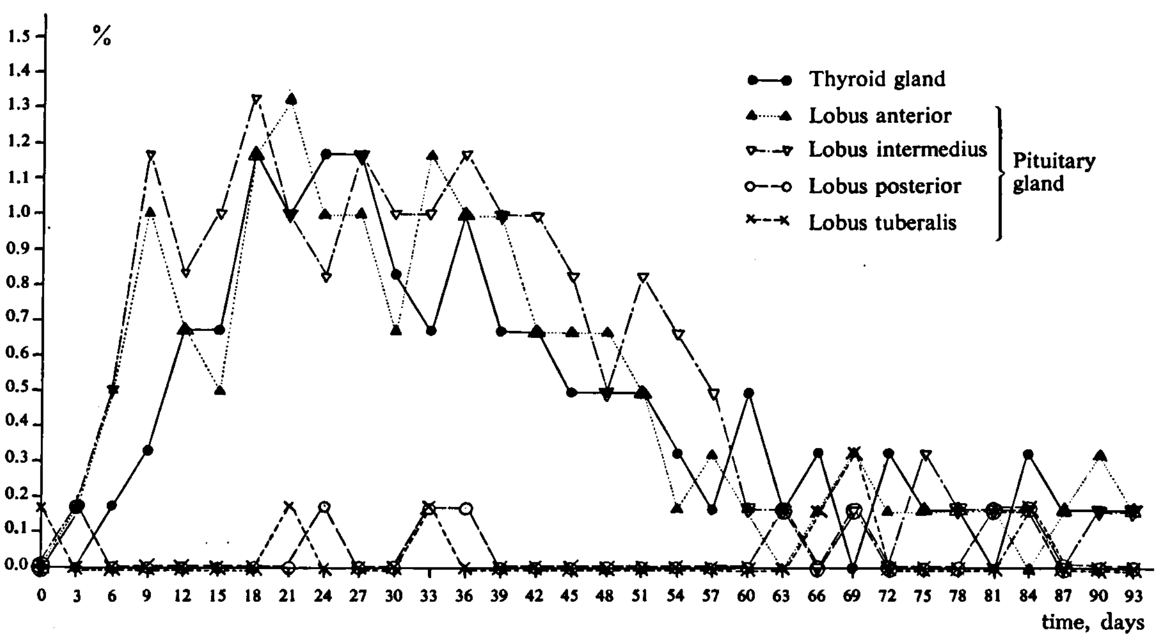


Fig. 8. Variability of the number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: number of mitoses in percentages.

As appears from Tables 7, 8 and 9 and Figures 6, 7 and 8, also the mitotic activity shows a distinct optimum curve. The optimum is observed in *Lebistes reticulatus* during the 21–24 day period, in *Xiphophorus helleri* during the 24–33 day period, and in *Xiphophorus maculatus* during the 18–27 day period.

Concerning the nucleus structure some changes were found, viz. a decrease in the number of nucleoli and in the staining capacity of the nucleoplasm. Particularly during the optimum periods of the nucleus size and the mitotic activity the formation of the nucleoli is somewhat inhibited, whereas the nucleoplasm stains less strongly with the nuclear stains (Figure 9).

The chondriome of the thyroid epithelial cells shows a distinct cycle. The normal short mitochondria grow to long, strongly, filamental chondrioconts, particularly in the activated cells during the optimum periods (Figures 10 and 11).

As in *Anoptichthys jordani* (STOLK, 1958 *b*), the impression was that the long chondrioconts tied off small parts on the apical side, whereas on the basal side a regeneration occurs.

It can be clearly seen from Figures 12 and 13, that also the GOLGI apparatus undergoes cyclic changes. During the optimum periods the GOLGI apparatus of the activated thyroid follicle cells was enlarged and hypertrophied. In some cells the GOLGI apparatus had shifted from the apical side of the nucleus to the basal side (Figures 12 and 13). Sometimes in the enlarged and hypertrophied GOLGI apparatus a fine fibrillar network appeared to be visible (Figure 13).

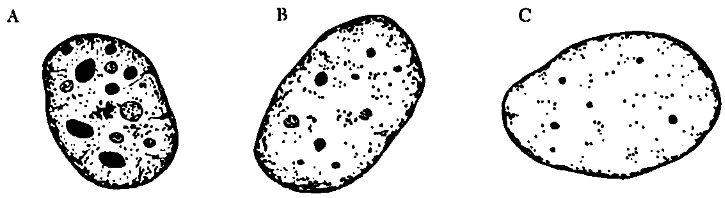


Fig. 9. Nuclei of thyroid epithelial cells taken from *Lebistes reticulatus* males during the development of the gonopodium. Hematoxylin and azophloxin. Very high magnification. A. 6 days. B. 12 days. C. 30 days.

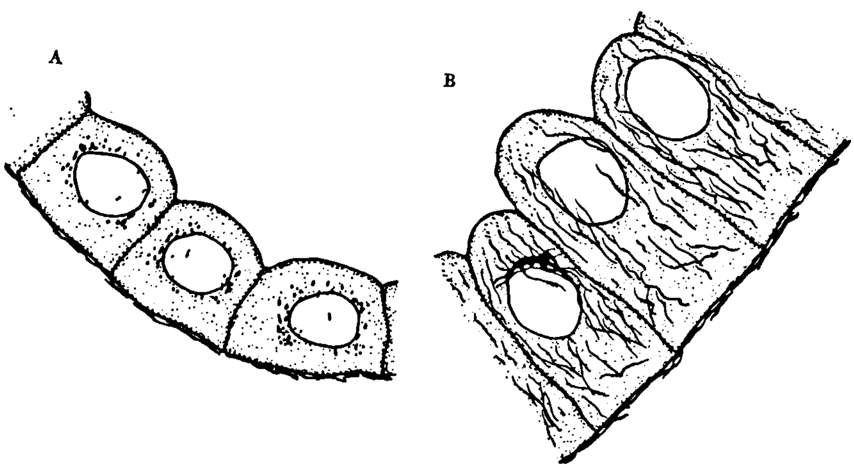


Fig. 10. Thyroid epithelial cells taken from *Xiphophorus helleri* males during the development of the gonopodium, REGAUD fixation modified by HIRSCH and BRETSCHNEIDER, iron hematoxylin stain. Very high magnification.

A. 9 days. Low follicle epithelial cells with short mitochondria.

B. 39 days. High columnar follicle epithelial cells with long filamental chondrioconts.

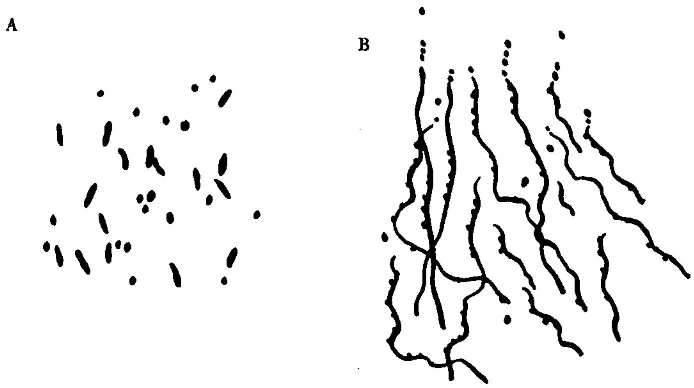
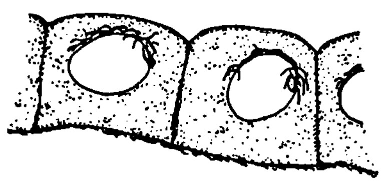
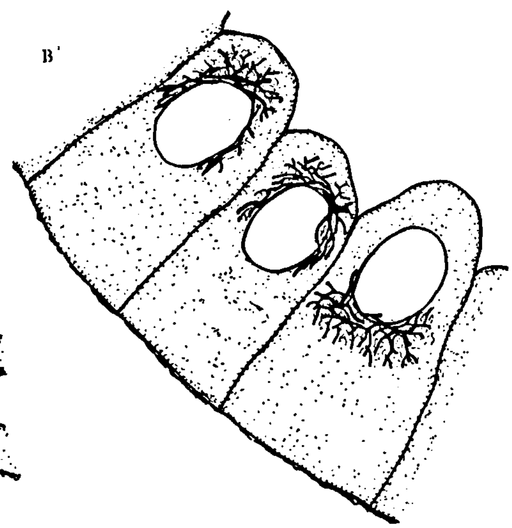


Fig. 11. Mitochondria of thyroid epithelial cells taken from *Xiphophorus maculatus* males during the development of the gonopodium, REGAUD fixation modified by HIRSCH and BRETSCHNEIDER, iron hematoxylin stain. Very high magnification.
A. 12 days. Short mitochondria.
B. 36 days. Long filamental chondrioconts. Some chondrioconts tied off small parts on the apical side of the cell (above in the Figure).

Fig. 12. Thyroid epithelial cells taken from *Xiphophorus maculatus* males during the development of the gonopodium. Osmic acid impregnation. Very high magnification.
A. 9 days. Low follicle epithelial cells with GOLGI apparatus at the apical side of the nucleus.
B. 27 days. High columnar epithelial cells with enlarged and hypertrophied GOLGI apparatus. In one cell the GOLGI apparatus had shifted from the apical side of the nucleus to the basal side.

A





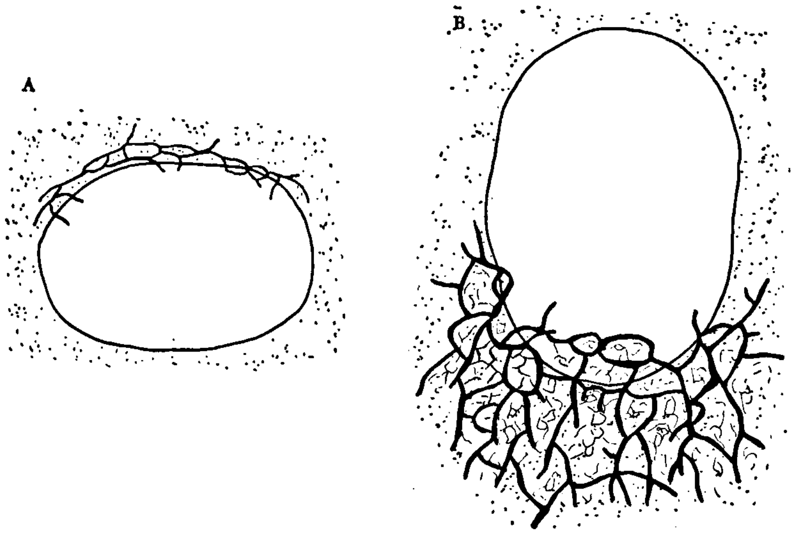


Fig. 13. GOLGI apparatus of thyroid epithelial cells from *Xiphophorus helleri* males during the development of the gonopodium. Osmic acid impregnation. Very high magnification.
A. 3 days. GOLGI apparatus ot the apical side of the nucleus.
B. 36 days. Enlarged and hypertrophied GOLGI apparatus at the basal side of the nucleus. In the GOLGI apparatus a fine fibrillar network is visible.

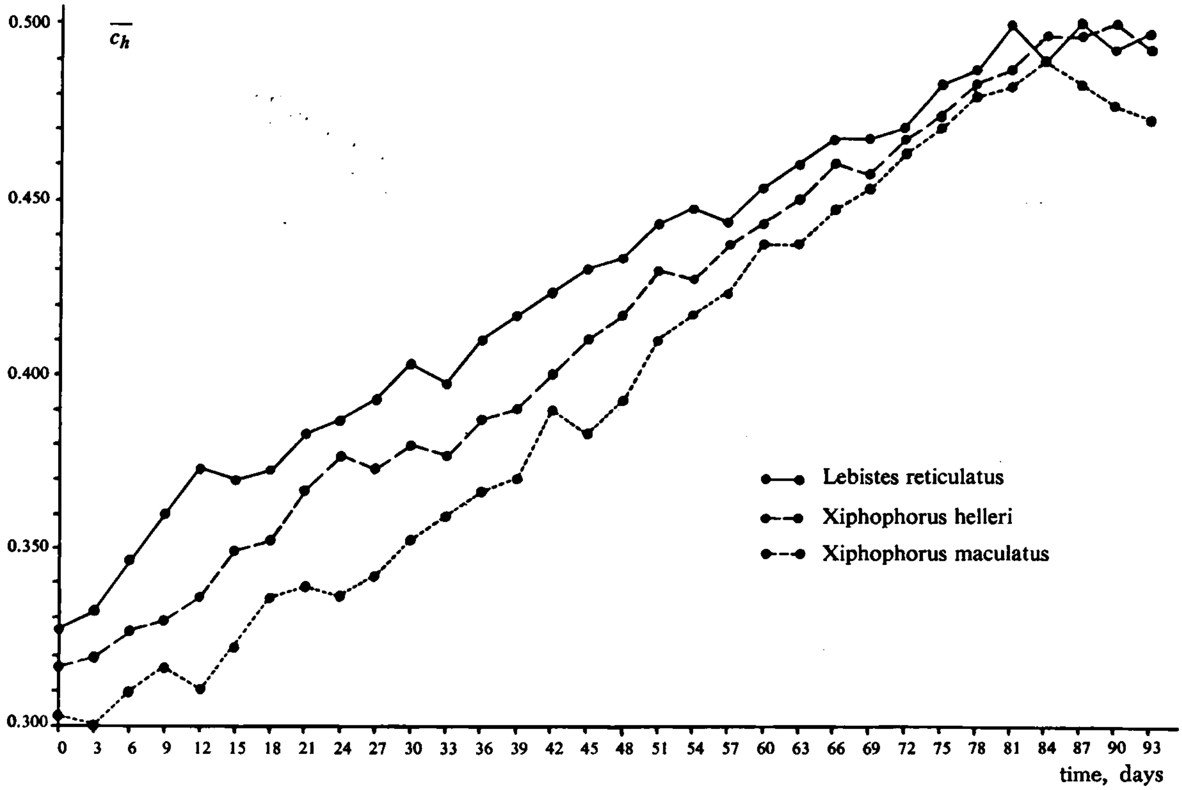


Fig. 14. Variability of the quotient $\overline{c_h}$ during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: quotient c_h.

b. **Pituitary gland**

The quotients $\overline{c_h}$ and $\overline{c_s}$ were determined for *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* during the development of the gonopodium. The variability of these quotients is shown in Tables 1, 2 and 3 and in Figures 14 and 15. In Table 1 the values of the quotients c_h and c_s as well as the average values of the quotients c_h and c_s ($\overline{c_h}$ and $\overline{c_s}$, respectively) are given. The relationship between the quotient $\overline{c_h}$ and the quotient $\overline{c_s}$ on the one hand, and the time on the other is represented in Figures 14 and 15.

These results show that during the development of the gonopodium the values of the quotients $\overline{c_h}$ and $\overline{c_s}$ increase fairly regularly, which corresponds with an increase of the glandular lobe of the pituitary gland, probably accompanied by increased production of thyreotrophic and gonadotrophic hormones.

Also these three curves display some special features. Since also here in the initial period of the development of the gonopodium the curves are wider apart then in the final period, there is again a certain convergence of the curves. The greatest activity in the initial and the middle period in general occurs in *Lebistes reticulatus* and the lowest activity in *Xiphophorus maculatus*. In the final period also in this case the thyroid activities of the three species correspond, which closely relates to some crossing-over of the curves in this period.

The minimum values of $\overline{c_h}$ are in *Lebistes reticulatus* 0.327, in *Xiphophorus helleri* 0.317, and in *Xiphophorus maculatus* 0.300, respectively, the maxima of these values being 0.500, 0.500, and 0.490, respectively. The minimum values of c_s amount in *Lebistes reticulatus* to 0.360, in *Xiphophorus helleri* to 0.350, and in *Xiphophorus maculatus* to 0.330, respectively, the maxima being 0.523, 0.520, and 0.517, respectively.

The size of the pituitary gland cell nuclei shows optimum curves in the lobus anterior and the lobus intermedius, but not in the lobus posterior and the lobus tuberalis. The relative data are given in Tables 4, 5 and 6 and in Figures 3, 4 and 5. For the lobus

Fig. 15. Variability of the quotient $\overline{c_s}$ during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus*. Abscissa: duration of the experiments in days. Ordinate: quotient $\overline{c_s}$.

anterior and the lobus intermedius the optima are in *Lebistes reticulatus* observed in the 12–21 day and the 15–36 day periods, in *Xiphophorus helleri* in the 21–33 day and the 21–39 day periods, and in *Xiphophorus maculatus* in the 12–27 day and the 12–36 day periods, respectively.

The investigation into the mitotic activity of the pituitary gland yielded optimum curves in the lobus anterior and the lobus intermedius. These optimum curves fall in *Lebistes reticulatus* in the 15–18 day and 15–27 day periods, in *Xiphophorus helleri* in the 18–21 day and 21–36 day periods, and in *Xiphophorus maculatus* in the 18–21 day and 18 day periods, respectively (Tables 7, 8 and 9; Figures 6, 7 and 8).

Concerning the mitotic activity of the lobus posterior as well as of the lobus tuberalis it can be observed that in these lobes only an insignificant fluctuation was observed (Tables 7, 8 and 9; Figures 6, 7 and 8).

In the nucleus structure some changes were observed during the optimum periods of the nucleus size and the mitotic activity of the lobus anterior and the lobus intermedius. The formation of the nucleoli is somewhat inhibited, while the nucleoplasm stained less intensely with the nuclear stains (Figures 16 and 17). These changes are absent from the cells of the lobus posterior and of the lobus tuberalis.

Also the chondriome of the cells of the lobus anterior and the lobus intermedius shows distinct cyclic changes in the optimal periods. In the large activated cells strongly elongated filamental chondrioconts are present, which were formed from the normal, small mitochondria (Figures 18 and 19). A tying-off of small parts of the long chondrioconts, as found in the activated thyroid follicle cells, was not observed.

The chondriomes of the lobus posterior and of the lobus tuberalis were invariably of the short type and did not show any elongation.

In the activated cells of the lobus anterior and the lobus intermedius the Golgi apparatus showed a distinct hypertrophy during the optimum period (Figure 20). Shifting of the Golgi apparatus, which occurred in some thyroid follicle cells, was not observed here. Neither was an enlargement of the Golgi apparatus found in the cells of the lobus posterior and the lobus tuberalis.

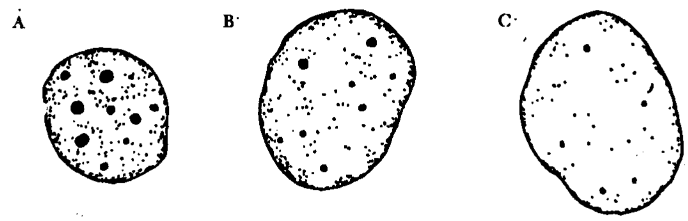


Fig. 16. Nuclei of cells of the lobus anterior of the pituitary gland taken from *Lebistes reticulatus* males during the development of the gonopodium. Hematoxylin and azophloxin. Very high magnification.
A. 3 days. B. 9 days. C. 18 days.

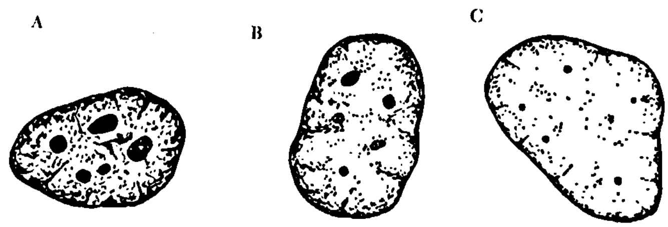


Fig. 17. Nuclei of cells of the lobus intermedius of the pituitary gland taken from *Xiphophorus maculatus* males during the development of the gonopodium. Hematoxylin and azophloxin. Very high magnification.
A. 6 days. B. 24 days. C. 36 days.

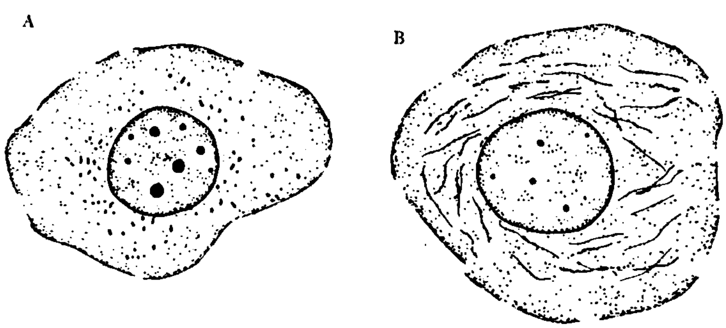


Fig. 18. Cells of the lobus anterior of the pituitary gland taken from *Lebistes reticulatus* males during the development of the gonopodium, Regaud fixation modified by Hirsch and Bretschneider, iron hematoxylin. Very high magnification.
A. 3 days. Cell with short mitochondria.
B. 27 days. Enlarged cell with enlarged nucleus and long filamental chondrioconts.

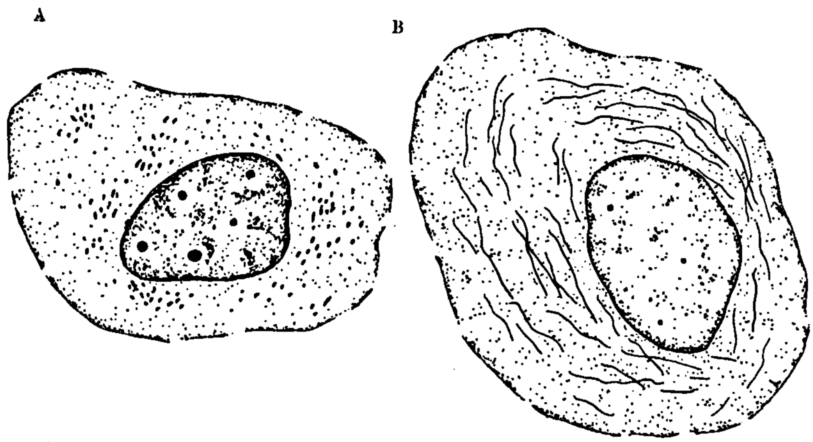


Fig. 19. Cells of the lobus intermedius of the pituitary gland taken from *Xiphophorus maculatus* males during the development of the gonopodium, REGAUD fixation modified by HIRSCH and BRETSCHNEIDER, iron hematoxylin. Very high magnification.
A. 3 days. Cell with short mitochondria.
B. 18 days. Enlarged cell with enlarged nucleus and long filamental chondrioconts.

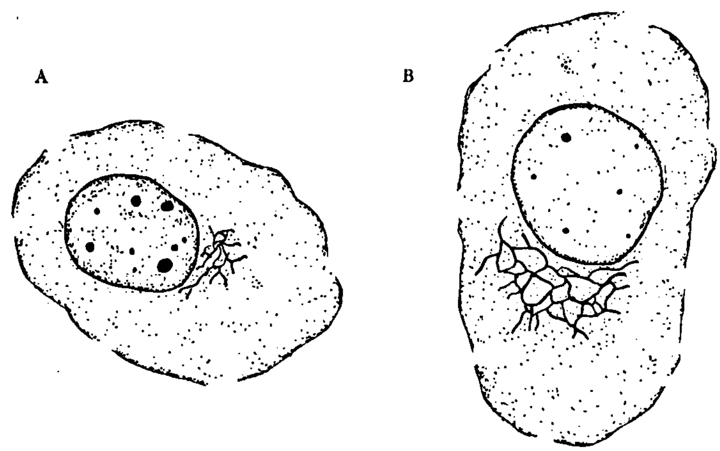


Fig. 20. Cells of the lobus anterior of the pituitary gland taken from *Xiphophorus helleri* males during the development of the gonopodium. Osmic acid impregnation. Very high magnification.
A. 9 days. Cell with GOLGI apparatus.
B. 33 days. Enlarged cell with enlarged nucleus and hypertrophy of the GOLGI apparatus.

IV. DISCUSSION

Hitherto we have determined the values of d/n, D/n, c_h and c_s during the gestation period in *Lebistes reticulatus* (STOLK, 1950 *b* and 1951 *a*), during the last part of the embryonic development in *Lebistes reticulatus* (STOLK, 1951 *c* and 1954), during the gestation period in *Dermogenys pusillus* (STOLK, 1956 g and 1957 *a*), during the last part of the embryonic development in *Dermogenys pusillus* (STOLK, 1957 *b* and 1958 *a*), during the overlapping of the eyes by skin folds in *Anoptichthys jordani* (STOLK, 1958 b), during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* (this publication), and moreover the values of c_h and c_s alone during a treatment for 54 to 183 days with 0.05% thiouracil solutions in *Lebistes reticulatus* (STOLK, 1955 *a*), during a treatment for 54 to 183 days with nitrofurazone solutions (concentration: 69 mg per 5000 ml tap water) in *Lebistes* *reticulatus* (STOLK, 1956 *c*), during a treatment for 45 to 114 days with 0.05% thiouracil solutions in *Xiphophorus helleri* (STOLK, 1955 *a*), during a treatment for 45 to 114 days with nitrofurazone solutions (concentration: 69 mg per 5000 ml tap water) in *Xiphophorus helleri* (STOLK, 1956 *c*), in *Tanichthys albonubes* with thyroidal tumour (STOLK, 1956 *a* and 1956 *b*), in *Barbus tetrazona* with *Ichthyophonus* disease (STOLK, 1956 *d*), in *Trichogaster trichopterus* with *Ichthyophonus* disease (STOLK, 1956 *d*), in *Cichlasoma biocellatum* with thyroidal tumour (STOLK, 1956 *e*).

The results of these investigations are listed in Table 10. These data show that the values of the quotients d/n and D/n during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* are in general of the same order of magnitude as the d/n and D/n values during the gestation period in *Lebistes reticulatus* and *Dermogenys pusillus* and during the last part of the embryonic development in *Lebistes reticulatus* and *Dermogenys pusillus;* however, values are lower than during the overlapping of the eyes by skin folds in *Anoptichthys jordani.*

The values of the quotients c_h and c_s during the development of the gonopodium in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* are in general of the same magnitude as the d/n and D/n values of the untreated specimens of *Lebistes reticulatus*, *Xiphophorus helleri*, the normal *Tanichthys albonubes*, the normal *Barbus tetrazona*, the normal *Trichogaster trichopterus* and the normal *Cichlasoma biocellatum*; however, the values are lower than during the embryonic development in *Lebistes reticulatus* and in *Dermogenys pusillus* and in the thiouracil-treated and nitrofurazone-treated specimens of *Lebistes reticulatus* and *Xiphophorus helleri*, in *Tanichthys albonubes* with thyroidal tumour, in *Barbus tetrazona* with *Ichthyophonus* disease, in *Trichogaster trichopterus* with *Ichthyophonus* disease and in *Cichlasoma biocellatum* with thyroidal tumour. Finally, the values are larger than during the overlapping of the eyes by skin folds in *Anoptichthys jordani.*

The changes in the nucleus size in the thyroid gland and the lobus anterior and the lobus intermedius of the pituitary gland of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* are in good agreement with the corresponding changes in the characid cave fish *Anoptichthys jordani* (HUBBS et INNES) during the overlapping of the eyes by skin folds (STOLK, 1958 *b*). Besides, there was good agreement with the results of RERABEK and RERABEK (1947) and LEVER (1950), who worked with the methyl-thiouracil activated thyroid gland of the rat and the thyroid gland of the cockerel, which was activated with preparation 6834 (Ciba), methyl-thiouracil, thiouracil, thioureum and propyl-thiouracil.

The increased mitotic activity in the cells of the lobus anterior and the lobus intermedius of the pituitary gland of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* was more pronounced than was stated by RERABEK and RERABEK (1947) and LEVER (1950) in the thyroid glands of the rat and the cockerel, respectively. As maximum value we found 1.5 per cent in the lobus anterior of *Lebistes reticulatus* and *Xiphophorus helleri*, which shows good agreement with the 1.6 per cent observed in the thyroid gland of the male as well as of the female *Anoptichthys jordani* (STOLK, 1958 *b*).

Just as in *Anoptichthys jordani*, in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* no abnormalities in shape and configurations of the chromosomes were observed. The opinion of RERABEK and RERABEK (1947) that, on the strength of the fact that the mitoses show an abnormality in shape and configuration of the chromosomes and their course was inhibited in the metaphase, the increase in mitotic activity is not a consequence of a mitosis-stimulating influence of the substance, but of a toxic influence, does not apply to the thyroid gland of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus*. This opinion does not apply either to the thyroid gland of the cockerel (LEVER, 1950) and of *Anoptichthys* (STOLK, 1958 *b*).

The changes in the nucleus structure (the inhibition of the formation of the nucleoli and the decrease in staining capacity of the nucleoplasm) of the cells of the thyroid gland and the lobus anterior and the lobus intermedius of the pituitary gland of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* during the optimum periods are an important indication that in these periods the formation of ribose nucleic acid is obviously inhibited.

For literature data concerning the enlargement of the mitochondria in the activated cells of the thyroid gland and the lobus anterior and the lobus intermedius of the pituitary gland reference is made to the publications of SEVERINGHAUS (1933 *a* and 1933 *b*), LEVER (1950), STOLK (1957 *c* and 1958 *b*).

The tying-off of small parts on the apical side of the long filamentous chondrioconts of the thyroid epithelial cells in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* was also observed in the filamental chondrioconts of the thyroid follicle cells in cockerels activated with methyl-thiouracil

(LEVER, 1950) and of *Anoptichthys jordani* during the overlapping of the eyes by skin folds (STOLK, 1958 *b*).

Just as in *Anoptichthys*, in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* the chondriome shows a functional cycle though it is simpler than the chondriome cycle in the hepatic cells of the viviparous Cyprinodont *Cnesterodon decemmaculatus* (ROJAS, DE ROBERTIS and CASTELLENGO, 1934; see also the summarizing publication of DE ROBERTIS, NOWINSKI and SAEZ, 1948, 1949 and 1950) and the chondriome cycle in the columnar secretory cells of the pharyngeal glands in the Cichlid *Haplochromis multicolor* (STOLK, 1957 *c*).

On the strength of the enlargement of the GOLGI apparatus in the activated cells of the thyroid gland and of the lobus anterior and the lobus intermedius of the pituitary gland in *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* during the optimum periods it might be concluded that an increased protein synthesis takes place during these periods. For literature data concerning the shift of the GOLGI apparatus from the apical side of the nucleus to the basal side, see the paper of STOLK (1958 *b*).

The GOLGI cycles in the thyroid epithelial cells, the anterior and the intermedius cells of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* during the development of the gonopodium is in good agreement with the corresponding GOLGI cycles of *Anoptichthys jordani* during the overlapping of the eyes by skin folds. Also in this case the GOLGI cycles of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* are simpler than the GOLGI cycle in the follicular cells in the ovary of a teleostean fish (ROJAS and DE ROBERTIS, 1935; see also the summarizing publication of DE ROBERTIS, NOWINSKI and SAEZ, 1948, 1949 and 1950) and the GOLGI cycle in the columnar secretory cells of the pharyngeal glands in *Haplochromis multicolor* (STOLK, 1957 *c*).

The purely histological data in our opinion justify the conclusion that during the development of the gonopodium the thyroid gland and the glandular lobe of the pituitary gland of *Lebistes reticulatus*, *Xiphophorus helleri* and *Xiphophorus maculatus* show a gradual increase in activity and that this process is probably regulated endocrinally.

SUMMARY

A description is given of the activity of the thyroid and of the pituitary gland during the development of the gonopodium in the viviparous Cyprinodonts *Lebistes reticulatus* (PETERS), *Xiphophorus helleri* (HECKEL) and *Xiphophorus maculatus* (GÜNTHER). During this process the thyroid gland and the glandular lobe (lobus anterior and lobus intermedius) show a gradual increase in activity. This activity was in general most pronounced in *Lebistes reticulatus* (PETERS) and weakest in *Xiphophorus maculatus* (GÜNTHER). This increase in activity suggests that the developement of the gonopodium is probably regulated endocrinally.

For the determination of the state of thyroid and pituitary activity use was made of the quotients d/n and D/n (LEVER, 1948 and 1950; cf. LEVER, MILTENBURG and VAN OORDT, 1949, and STOLK, 1951 *c*, 1956 *g*, 1957 *b* and 1958 *b*) and the quotients c_h and c_s (STOLK, 1954, 1955 *a*, 1956 *a*, 1956 *c*, 1956 *d*, 1956 *e*, 1956 *f*, 1957 *a*, 1958 *a* and 1958 *b*), respectively, and moreover of the nucleus size, the mitotic activity, the nucleus structure, the chondriome and the GOLGI apparatus.

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Number of the animal	Duration of the experiments, days	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
1		2.0		2.3		0.31		0.34	
2	0	2.1	2.100	2.4	2.400	0.33	0.327	0.36	0.360
3		2.2		2.5		0.34		0.38	
4		1.9		2.1		0.30		0.33	
5	3	2.0	2.033	2.3	2.300	0.34	0.333	0.38	0.363
6		2.2		2.5		0.36		0.38	
7		1.7		1.9		0.31		0.33	
8	6	2.0	1.933	2.3	2.200	0.35	0.347	0.38	0.373
9		2.1		2.4		0.38		0.41	
10		1.7		1.9		0.32		0.35	
11	9	1.9	1.867	2.3	2.167	0.36	0.360	0.38	0.387
12		2.0		2.3		0.40		0.43	
13		1.6		1.9		0.34		0.37	
14	12	1.8	1.767	2.2	2.100	0.37	0.373	0.39	0.397
15		1.9		2.2		0.41		0.43	
16		1.5		1.8		0.32		0.34	
17	15	1.9	1.767	2.2	2.100	0.37	0.370	0.39	0.387
18		1.9		2.3		0.42		0.43	
19		1.4		1.7		0.32		0.35	
20	18	1.8	1.667	2.1	2.033	0.36	0.373	0.38	0.393
21		1.8		2.3		0.44		0.45	
22		1.3		1.7		0.33		0.36	
23	21	1.7	1.600	2.1	2.033	0.36	0.383	0.38	0.407
24		1.8		2.3		0.46		0.48	
25		1.4		1.6		0.36		0.38	
26	24	1.6	1.600	2.2	2.033	0.35	0.387	0.38	0.410
27		1.8		2.3		0.45		0.47	
28		1.4		1.6		0.36		0.39	
29	27	1.6	1.567	2.0	1.933	0.38	0.393	0.40	0.417
30		1.7		2.2		0.44		0.46	
31		1.4		1.7		0.37		0.39	
32	30	1.6	1.533	2.0	1.900	0.39	0.403	0.42	0.430
33		1.6		2.0		0.45		0.48	
34		1.3		1.6		0.36		0.38	
35	33	1.6	1.533	2.0	1.900	0.38	0.397	0.41	0.420
36		1.7		2.1		0.45		0.47	
37		1.2		1.5		0.37		0.39	
38	36	1.6	1.467	1.9	1.800	0.39	0.410	0.42	0.433
39		1.6		2.0		0.47		0.49	
40		1.1		1.4		0.38		0.40	
41	39	1.5	1.400	1.9	1.767	0.39	0.417	0.41	0.437
42		1.6		2.0		0.48		0.50	
43		1.2		1.4		0.38		0.40	
44	42	1.5	1.400	1.9	1.767	0.40	0.423	0.43	0.447
45		1.5		2.0		0.49		0.51	
46		1.2		1.4		0.38		0.41	
47	45	1.4	1.367	1.9	1.767	0.42	0.430	0.44	0.453
48		1.5		2.0		0.49		0.51	

TABLE 1. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Lebistes reticulatus*. The duration of the experiments is given as well.

Number of the animal	*Duration of the experiments, days*	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
49		1.2		1.4		0.38		0.40	
50	48	1.4	1.333	1.9	1.733	0.43	0.433	0.45	0.457
51		1.4		1.9		0.49		0.52	
52		1.1		1.4		0.39		0.42	
53	51	1.3	1.267	1.7	1.667	0.44	0.443	0.46	0.470
54		1.4		1.9		0.50		0.53	
55		1.2		1.5		0.39		0.42	
56	54	1.2	1.267	1.6	1.633	0.45	0.447	0.47	0.473
57		1.4		1.8		0.50		0.53	
58		1.1		1.5		0.39		0.41	
59	57	1.2	1.267	1.6	1.633	0.45	0.443	0.47	0.463
60		1.5		1.8		0.49		0.51	
61		1.1		1.4		0.40		0.43	
62	60	1.2	1.233	1.6	1.600	0.46	0.453	0.48	0.477
63		1.4		1.8		0.50		0.52	
64		1.1		1.4		0.41		0.43	
65	63	1.2	1.200	1.6	1.600	0.45	0.460	0.48	0.483
66		1.3		1.8		0.52		0.54	
67		1.1		1.4		0.42		0.44	
68	66	1.2	1.200	1.6	1.567	0.45	0.467	0.47	0.487
69		1.3		1.7		0.53		0.55	
70		1.1		1.4		0.41		0.43	
71	69	1.2	1.167	1.5	1.500	0.45	0.467	0.48	0.490
72		1.2		1.6		0.54		0.56	
73		1.1		1.4		0.43		0.46	
74	72	1.1	1.113	1.5	1.467	0.45	0.470	0.47	0.493
75		1.2		1.5		0.53		0.55	
76		1.0		1.4		0.44		0.47	
77	75	1.1	1.100	1.5	1.467	0.47	0.483	0.49	0.507
78		1.2		1.5		0.54		0.56	
79		1.0		1.3		0.45		0.47	
80	78	1.1	1.067	1.5	1.433	0.46	0.487	0.48	0.507
81		1.1		1.5		0.55		0.57	
82		1.0		1.3		0.46		0.49	
83	81	1.1	1.067	1.4	1.400	0.48	0.500	0.50	0.523
84		1.1		1.5		0.56		0.58	
85		0.9		1.3		0.45		0.47	
86	84	1.0	1.000	1.4	1.367	0.48	0.490	0.50	0.510
87		1.1		1.4		0.54		0.56	
88		0.8		1.3		0.46		0.48	
89	87	0.9	0.967	1.3	1.333	0.49	0.500	0.52	0.523
90		1.2		1.4		0.55		0.57	
91		0.8		1.2		0.45		0.48	
92	90	0.9	0.933	1.3	1.300	0.48	0.493	0.49	0.513
93		1.1		1.4		0.55		0.57	
94		0.8		1.2		0.46		0.49	
95	93	0.9	0.933	1.3	1.300	0.49	0.497	0.51	0.520
96		1.1		1.4		0.54		0.56	

TABLE 1. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Lebistes reticulatus*. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
97 98 99	0	2.1 2.2 2.4	2.233	2.4 2.5 2.7	2.533	0.30 0.32 0.33	0.317	0.33 0.35 0.37	0.350
100 101 102	3	2.1 2.3 2.3	2.233	2.4 2.5 2.6	2.500	0.31 0.32 0.33	0.320	0.32 0.36 0.37	0.350
103 104 105	6	2.1 2.2 2.3	2.200	2.4 2.5 2.6	2.500	0.32 0.32 0.34	0.327	0.34 0.35 0.38	0.357
106 107 108	9	2.1 2.2 2.2	2.167	2.4 2.4 2.5	2.433	0.31 0.33 0.35	0.330	0.34 0.36 0.39	0.363
109 110 111	12	2.1 2.1 2.2	2.133	2.3 2.4 2.5	2.400	0.32 0.34 0.35	0.337	0.34 0.37 0.39	0.367
112 113 114	15	2.0 2.1 2.2	2.100	2.3 2.4 2.5	2.400	0.33 0.35 0.37	0.350	0.35 0.37 0.40	0.373
115 116 117	18	1.9 2.0 2.1	2.000	2.2 2.4 2.4	2.333	0.32 0.36 0.38	0.353	0.34 0.39 0.41	0.380
118 119 120	21	1.8 2.0 2.0	1.933	2.2 2.3 2.4	2.300	0.33 0.37 0.40	0.367	0.36 0.38 0.42	0.387
121 122 123	24	1.7 1.8 1.9	1.800	2.0 2.1 2.3	2.133	0.34 0.38 0.41	0.377	0.37 0.39 0.43	0.397
124 125 126	27	1.7 1.8 1.8	1.767	2.1 2.1 2.2	2.133	0.33 0.38 0.41	0.373	0.36 0.39 0.43	0.393
127 128 129	30	1.6 1.7 1.8	1.700	2.0 2.0 2.1	2.033	0.34 0.39 0.41	0.380	0.36 0.41 0.42	0.397
130 131 132	33	1.6 1.7 1.7	1.667	2.0 2.0 2.1	2.033	0.34 0.38 0.41	0.377	0.36 0.39 0.42	0.390
133 134 135	36	1.6 1.7 1.7	1.667	2.0 2.0 2.1	2.033	0.35 0.38 0.43	0.387	0.37 0.39 0.45	0.403
136 137 138	39	1.6 1.6 1.7	1.633	1.9 1.9 2.0	1.933	0.34 0.39 0.44	0.390	0.37 0.41 0.45	0.410
139 140 141	42	1.5 1.6 1.7	1.600	1.9 1.9 2.0	1.933	0.35 0.40 0.45	0.400	0.37 0.42 0.47	0.420
142 143 144	45	1.5 1.5 1.7	1.567	1.8 1.9 2.0	1.900	0.35 0.42 0.46	0.410	0.37 0.43 0.48	0.427

TABLE 2. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Xiphophorus helleri*. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
145		1.4		1.8		0.36		0.38	
146	48	1.5	1.533	1.8	1.867	0.43	0.417	0.44	0.430
147		1.7		2.0		0.46		0.47	
148		1.3		1.6		0.37		0.39	
149	51	1.5	1.433	1.7	1.733	0.45	0.430	0.48	0.450
150		1.5		1.9		0.47		0.48	
151		1.3		1.6		0.36		0.38	
152	54	1.4	1.433	1.7	1.700	0.44	0.427	0.45	0.440
153		1.6		1.8		0.48		0.49	
154		1.3		1.6		0.37		0.39	
155	57	1.3	1.367	1.7	1.700	0.45	0.437	0.47	0.457
156		1.5		1.8		0.49		0.51	
157		1.3		1.6		0.39		0.41	
158	60	1.3	1.333	1.7	1.667	0.45	0.443	0.46	0.460
159		1.4		1.7		0.49		0.51	
160		1.2		1.6		0.40		0.42	
161	63	1.3	1.300	1.6	1.633	0.46	0.450	0.47	0.467
162		1.4		1.7		0.49		0.51	
163		1.2		1.6		0.41		0.43	
164	66	1.2	1.267	1.6	1.633	0.47	0.460	0.48	0.473
165		1.4		1.7		0.50		0.51	
166		1.2		1.5		0.39		0.40	
167	69	1.2	1.267	1.6	1.600	0.47	0.457	0.48	0.467
168		1.4		1.7		0.51		0.52	
169		1.1		1.5		0.40		0.42	
170	72	1.2	1.200	1.5	1.567	0.48	0.467	0.49	0.480
171		1.3		1.7		0.52		0.53	
172		0.9		1.4		0.41		0.43	
173	75	1.1	1.067	1.5	1.500	0.49	0.473	0.51	0.490
174		1.2		1.6		0.52		0.53	
175		0.9		1.4		0.43		0.45	
176	78	1.0	1.000	1.5	1.500	0.48	0.483	0.50	0.503
177		1.1		1.6		0.54		0.56	
178		0.9		1.4		0.44		0.47	
179	81	1.0	1.000	1.5	1.467	0.47	0.487	0.49	0.510
180		1.1		1.5		0.55		0.57	
181		0.8		1.2		0.46		0.48	
182	84	1.0	0.967	1.4	1.367	0.47	0.497	0.49	0.513
183		1.1		1.5		0.56		0.57	
184		0.8		1.2		0.46		0.48	
185	87	1.0	0.967	1.4	1.367	0.48	0.497	0.50	0.517
186		1.1		1.5		0.55		0.57	
187		0.8		1.2		0.47		0.49	
188	90	0.9	0.933	1.3	1.333	0.49	0.500	0.51	0.520
189		1.1		1.5		0.54		0.56	
190		0.9		1.2		0.46		0.47	
191	93	0.9	0.967	1.4	1.367	0.47	0.493	0.49	0.513
192		1.1		1.5		0.55		0.58	

TABLE 2. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Xiphophorus helleri*. The duration of the experiments is given as well.

Number of the animal	*Duration of the experiments, days*	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
193 194 195	0	2.3 2.5 2.6	2.467	2.6 2.8 2.9	2.767	0.29 0.30 0.32	0.303	0.32 0.33 0.36	0.337
196 197 198	3	2.4 2.5 2.5	2.467	2.7 2.8 2.9	2.800	0.29 0.29 0.32	0.300	0.31 0.32 0.36	0.330
199 200 201	6	2.3 2.4 2.5	2.400	2.7 2.8 2.9	2.800	0.29 0.31 0.33	0.310	0.33 0.34 0.36	0.343
202 203 204	9	2.2 2.2 2.4	2.267	2.6 2.6 2.8	2.667	0.29 0.32 0.34	0.317	0.33 0.35 0.37	0.350
205 206 207	12	2.1 2.2 2.3	2.200	2.5 2.6 2.7	2.600	0.29 0.31 0.33	0.310	0.31 0.34 0.39	0.347
208 209 210	15	2.0 2.2 2.2	2.133	2.4 2.5 2.6	2.500	0.30 0.32 0.35	0.323	0.33 0.36 0.38	0.357
211 212 213	18	1.8 2.1 2.1	2.000	2.2 2.4 2.4	2.333	0.31 0.34 0.36	0.337	0.33 0.37 0.40	0.363
214 215 216	21	1.8 2.0 2.1	1.967	2.1 2.4 2.5	2.333	0.31 0.34 0.37	0.340	0.34 0.37 0.39	0.367
217 218 219	24	1.9 2.0 2.1	2.000	2.2 2.4 2.5	2.367	0.32 0.33 0.36	0.337	0.34 0.37 0.38	0.363
220 221 222	27	1.8 2.0 2.1	1.967	2.1 2.4 2.5	2.333	0.33 0.33 0.37	0.343	0.36 0.35 0.40	0.370
223 224 225	30	1.7 1.9 2.0	1.867	2.0 2.3 2.4	2.233	0.33 0.35 0.38	0.353	0.35 0.38 0.42	0.383
226 227 228	33	1.6 1.8 2.0	1.800	1.9 2.2 2.4	2.167	0.32 0.36 0.40	0.360	0.34 0.39 0.44	0.390
229 230 231	36	1.6 1.8 2.1	1.833	2.0 2.2 2.5	2.333	0.33 0.37 0.40	0.367	0.36 0.40 0.44	0.400
232 233 234	39	1.6 1.7 2.0	1.767	1.9 2.0 2.4	2.100	0.33 0.38 0.40	0.370	0.36 0.41 0.45	0.407
235 236 237	42	1.5 1.8 1.9	1.733	1.8 2.1 2.3	2.067	0.34 0.41 0.42	0.390	0.37 0.44 0.46	0.423
238 239 240	45	1.4 1.7 1.8	1.633	1.7 2.0 2.1	1.933	0.35 0.39 0.41	0.383	0.38 0.42 0.44	0.413

TABLE 3. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Xiphophorus maculatus*. The duration of the experiments is given as well.

Number of the animal	*Duration of the experiments, days*	d/n	$\overline{d/n}$	D/n	$\overline{D/n}$	c_h	$\overline{c_h}$	c_s	$\overline{c_s}$
241 242 243	48	1.4 1.6 1.7	1.567	1.7 1.9 2.0	1.867	0.35 0.40 0.43	0.393	0.38 0.43 0.45	0.420
244 245 246	51	1.3 1.6 1.6	1.500	1.7 1.9 2.0	1.867	0.38 0.42 0.43	0.410	0.41 0.44 0.45	0.433
247 248 249	54	1.3 1.5 1.7	1.500	1.6 1.9 2.0	1.833	0.39 0.41 0.45	0.417	0.42 0.44 0.47	0.443
250 251 252	57	1.2 1.4 1.7	1.433	1.5 1.9 2.0	1.800	0.40 0.43 0.44	0.423	0.43 0.46 0.47	0.453
253 254 255	60	1.2 1.4 1.6	1.400	1.5 1.9 2.0	1.800	0.41 0.44 0.46	0.437	0.45 0.47 0.49	0.470
256 257 258	63	1.2 1.4 1.5	1.367	1.5 1.9 1.9	1.767	0.39 0.45 0.47	0.437	0.43 0.48 0.51	0.473
259 260 261	66	1.1 1.4 1.4	1.300	1.4 1.9 1.9	1.733	0.40 0.46 0.48	0.447	0.43 0.48 0.52	0.477
262 263 264	69	1.1 1.3 1.5	1.300	1.4 1.7 1.9	1.667	0.41 0.45 0.50	0.453	0.44 0.47 0.53	0.480
265 266 267	72	1.0 1.3 1.4	1.233	1.3 1.6 1.8	1.567	0.42 0.46 0.51	0.463	0.45 0.49 0.53	0.490
268 269 270	75	0.9 1.1 1.3	1.100	1.3 1.4 1.6	1.433	0.41 0.49 0.51	0.470	0.44 0.52 0.54	0.500
271 272 273	78	0.8 1.0 1.3	1.033	1.1 1.4 1.6	1.367	0.44 0.48 0.52	0.480	0.46 0.52 0.54	0.507
274 275 276	81	0.8 1.1 1.2	1.033	1.2 1.3 1.5	1.333	0.45 0.49 0.51	0.483	0.48 0.52 0.54	0.513
277 278 279	84	0.9 1.0 1.1	1.000	1.2 1.3 1.4	1.300	0.45 0.50 0.52	0.490	0.48 0.53 0.54	0.517
280 281 282	87	0.9 1.0 1.2	1.033	1.2 1.3 1.5	1.333	0.44 0.49 0.52	0.483	0.47 0.51 0.54	0.507
283 284 285	90	0.9 1.0 1.4	1.100	1.2 1.4 1.5	1.367	0.43 0.49 0.51	0.477	0.45 0.52 0.54	0.503
286 287 288	93	0.9 1.2 1.3	1.133	1.2 1.4 1.6	1.400	0.42 0.50 0.50	0.473	0.44 0.52 0.53	0.497

TABLE 3. Values of the quotients d/n, $\overline{d/n}$, D/n, $\overline{D/n}$, c_h, $\overline{c_h}$, c_s and $\overline{c_s}$ during the development of the gonopodium in *Xiphophorus maculatus*. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of measured nuclei of one cell type	Mean value of nucleus-size ± standard error				
				Thyroid gland	Pituitary gland			
					Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
1, 2, 3	0	3	60	15.6±0.31	15.8±0.29	15.5±0.27	15.0±0.25	15.6±0.27
4, 5, 6	3	3	60	15.8±0.31	16.1±0.31	15.7±0.35	15.3±0.37	15.4±0.35
7, 8, 9	6	3	60	16.8±0.27	16.7±0.27	16.4±0.25	15.0±0.29	15.7±0.27
10, 11, 12	9	3	60	16.5±0.35	17.1±0.37	17.2±0.39	15.4±0.35	15.6±0.39
13, 14, 15	12	3	60	17.6±0.25	18.8±0.39	18.2±0.25	15.5±0.27	15.9±0.37
16, 17, 18	15	3	60	18.2±0.29	18.5±0.33	18.4±0.37	15.1±0.37	15.4±0.27
19, 20, 21	18	3	60	18.7±0.35	18.3±0.27	17.9±0.27	15.5±0.27	16.0±0.37
22, 23, 24	21	3	60	19.1±0.27	18.8±0.31	18.0±0.37	15.8±0.31	15.4±0.39
25, 26, 27	24	3	60	18.9±0.31	17.9±0.25	18.1±0.33	15.3±0.25	15.6±0.29
28, 29, 30	27	3	60	19.1±0.25	18.1±0.35	18.4±0.31	15.6±0.33	15.7±0.31
31, 32, 33	30	3	60	18.7±0.27	18.5±0.27	18.3±0.27	15.7±0.27	15.9±0.27
34, 35, 36	33	3	60	17.4±0.33	18.0±0.25	18.0±0.33	15.2±0.39	16.0±0.33
37, 38, 39	36	3	60	17.9±0.29	18.7±0.35	18.4±0.35	15.6±0.37	15.7±0.29
40, 41, 42	39	3	60	17.2±0.33	18.5±0.25	18.2±0.27	15.1±0.25	15.5±0.25
43, 44, 45	42	3	60	16.9±0.31	17.5±0.29	17.9±0.31	15.7±0.27	15.7±0.35
46, 47, 48	45	3	60	17.1±0.25	17.3±0.37	17.6±0.29	15.8±0.35	15.8±0.33
49, 50, 51	48	3	60	17.4±0.25	17.2±0.25	17.4±0.31	15.8±0.37	15.7±0.29
52, 53, 54	51	3	60	16.9±0.37	17.0±0.33	17.2±0.29	15.6±0.25	15.9±0.35
55, 56, 57	54	3	60	17.1±0.33	16.8±0.31	17.0±0.37	15.8±0.27	15.8±0.27
58, 59, 60	57	3	60	17.3±0.25	17.1±0.25	16.9±0.27	15.0±0.33	15.5±0.37
61, 62, 63	60	3	60	16.8±0.39	16.5±0.37	16.5±0.31	15.4±0.27	15.4±0.33
64, 65, 66	63	3	60	17.0±0.25	16.3±0.33	16.3±0.25	15.5±0.35	15.6±0.29
67, 68, 69	66	3	60	17.3±0.29	16.7±0.27	16.1±0.35	15.5±0.37	15.8±0.37
70, 71, 72	69	3	60	16.7±0.33	16.0±0.39	16.5±0.25	15.6±0.29	15.9±0.25
73, 74, 75	72	3	60	16.5±0.27	15.9±0.27	16.4±0.39	15.5±0.37	15.6±0.39
76, 77, 78	75	3	60	16.1±0.31	16.4±0.35	16.9±0.27	15.6±0.39	15.8±0.37
79, 80, 81	78	3	60	16.7±0.35	16.6±0.37	16.3±0.25	15.5±0.33	16.0±0.29
82. 83, 83	81	3	60	16.4±0.31	16.4±0.33	16.0±0.33	15.2±0.27	15.7±0.33
85, 86, 87	84	3	60	16.5±0.29	16.7±0.25	15.9±0.37	15.8±0.31	15.6±0.27
88, 89, 90	87	3	60	16.2±0.37	16.3±0.29	15.7±0.35	15.3±0.25	15.4±0.31
91, 92, 93	90	3	60	16.4±0.31	16.1±0.31	15.8±0.29	15.4±0.25	15.6±0.25
94, 95, 96	93	3	60	15.9±0.27	15.9±0.29	15.6±0.27	15.1±0.35	15.4±0.33

TABLE 4. Size of the nuclei of the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Lebistes reticulatus*. Mean values of nucleus size ± standard error. Of each stage three animals were used, of which 60 nuclei of one cell type were measured, consequently 20 nuclei per animal. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of measured nuclei of one cell type	Mean value of nucleus-size ± standard error				
				Thyroid gland	Pituitary gland			
					Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
97, 98, 99	0	3	60	15.9±0.31	15.6±0.25	15.3±0.33	15.5±0.33	15.5±0.33
100, 101, 102	3	3	60	15.7±0.27	15.7±0.33	15.5±0.25	15.3±0.25	15.3±0.27
103, 104, 105	6	3	60	15.7±0.39	15.9±0.31	15.9±0.31	15.1±0.31	15.7±0.37
106, 107, 108	9	3	60	15.8±0.31	16.1±0.29	16.4±0.27	15.4±0.37	15.9±0.33
109, 110, 111	12	3	60	15.9±0.25	16.8±0.37	16.7±0.35	15.6±0.39	16.1±0.25
112, 113, 114	15	3	60	16.5±0.35	17.1±0.35	16.9±0.37	15.0±0.27	16.0±0.33
115, 116, 117	18	3	60	16.9±0.33	17.3±0.25	17.0±0.29	15.5±0.27	15.7±0.37
118, 119, 120	21	3	60	17.5±0.29	18.5±0.27	18.0±0.39	15.5±0.35	15.5±0.39
121, 122, 123	24	3	60	18.8±0.29	18.0±0.39	18.0±0.35	15.6±0.33	15.9±0.27
124, 125, 126	27	3	60	19.0±0.37	18.4±0.37	17.9±0.37	15.3±0.29	16.0±0.37
127, 128, 129	30	3	60	18.7±0.33	18.2±0.25	17.5±0.29	15.4±0.29	15.8±0.25
130, 131, 132	33	3	60	19.0±0.25	18.5±0.35	17.6±0.33	15.1±0.37	16.1±0.29
133, 134, 135	36	3	60	19.0±0.31	18.2±0.35	17.7±0.25	15.2±0.39	15.9±0.33
136, 137, 138	39	3	60	18.6±0.27	18.1±0.29	18.0±0.31	15.8±0.27	16.0±0.27
139, 140, 141	42	3	60	18.5±0.37	18.0±0.33	17.8±0.27	15.0±0.37	15.7±0.31
142, 143, 144	45	3	60	18.2±0.27	18.3±0.27	17.7±0.33	15.5±0.25	15.9±0.25
145, 146, 147	48	3	60	18.0±0.35	17.5±0.25	17.5±0.27	15.5±0.35	15.3±0.25
148, 149, 150	51	3	60	17.8±0.25	17.0±0.31	17.3±0.33	15.3±0.37	15.5±0.35
151, 152, 153	54	3	60	17.1±0.35	16.9±0.27	17.0±0.27	15.6±0.25	15.8±0.25
154, 155, 156	57	3	60	17.7±0.33	16.8±0.37	17.9±0.39	15.5±0.33	15.9±0.39
157, 158, 159	60	3	60	17.8±0.27	17.1±0.39	17.8±0.25	15.4±0.33	16.1±0.27
160, 161, 162	63	3	60	17.5±0.25	17.0±0.35	17.6±0.37	15.3±0.29	15.8±0.37
163, 164, 165	66	3	60	17.2±0.33	16.9±0.27	17.4±0.25	15.0±0.27	16.0±0.39
166, 167, 168	69	3	60	17.4±0.25	17.3±0.33	17.1±0.35	15.2±0.35	15.7±0.29
169, 170, 171	72	3	60	17.0±0.37	17.5±0.25	16.9±0.27	15.5±0.37	15.5±0.29
172, 173, 174	75	3	60	16.4±0.27	16.0±0.29	16.7±0.31	15.0±0.29	15.3±0.37
175, 176, 177	78	3	60	16.2±0.39	16.4±0.33	16.5±0.33	15.8±0.35	15.8±0.35
178, 179, 180	81	3	60	16.8±0.25	16.2±0.37	16.0±0.31	15.7±0.25	15.6±0.33
181, 182, 183	84	3	60	16.6±0.27	16.5±0.27	16.4±0.25	15.9±0.37	15.5±0.27
184, 185, 186	87	3	60	16.3±0.27	16.3±0.27	16.0±0.37	15.1±0.25	15.3±0.31
187, 188, 189	90	3	60	15.8±0.31	15.9±0.35	15.9±0.35	15.6±0.39	15.5±0.25
190, 191, 192	93	3	60	15.6±0.29	15.8±0.29	15.5±0.29	15.6±0.27	15.8±0.33

TABLE 5. Size of the nuclei of the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus helleri*. Mean values of nucleus size ± standard error. Of each type three animals were used, of which 60 nuclei of one cell type were measured, consequently 20 nuclei per animal. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of measured nuclei of one cell type	Mean value of nucleus-size ± standard error				
				Thyroid gland	Pituitary gland			
					Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
193, 194, 195	0	3	60	15.5±0.25	15.4±0.29	15.1±0.25	15.1±0.25	15.2±0.37
196, 197, 198	3	3	60	15.7±0.27	15.6±0.31	15.7±0.29	15.0±0.27	15.3±0.25
199, 200, 201	6	3	60	15.5±0.25	16.5±0.25	15.5±0.39	15.3±0.31	15.5±0.39
202, 203, 204	9	3	60	15.9±0.31	17.2±0.27	16.2±0.37	15.4±0.29	15.6±0.27
205, 206, 207	12	3	60	16.1±0.25	18.2±0.33	17.8±0.33	15.6±0.33	15.9±0.35
208, 209, 210	15	3	60	16.7±0.35	18.0±0.35	17.6±0.35	15.5±0.29	15.8±0.37
211, 212, 213	18	3	60	17.3±0.31	18.1±0.31	17.5±0.25	15.3±0.27	15.9±0.35
214, 215, 216	21	3	60	17.7±0.27	17.9±0.37	17.7±0.31	15.1±0.37	15.7±0.27
217, 218, 219	24	3	60	17.9±0.29	18.1±0.25	17.4±0.37	15.2±0.39	15.5±0.33
220, 221, 222	27	3	60	18.5±0.35	18.2±0.25	17.1±0.33	15.8±0.35	15.6±0.37
223, 224, 225	30	3	60	18.9±0.37	17.6±0.29	17.8±0.31	14.9±0.33	15.3±0.27
226, 227, 228	33	3	60	18.7±0.37	17.9±0.35	17.5±0.27	15.9±0.35	16.1±0.33
229, 230, 231	36	3	60	17.5±0.29	18.0±0.27	17.8±0.33	15.8±0.25	15.6±0.25
232, 233, 234	39	3	60	17.8±0.33	17.8±0.37	17.6±0.29	15.7±0.27	16.0±0.31
235, 236, 237	42	3	60	17.4±0.29	17.3±0.29	17.0±0.35	15.6±0.29	15.2±0.29
238, 239, 240	45	3	60	17.0±0.35	17.1±0.39	16.5±0.27	15.5±0.31	15.1±0.27
241, 242, 243	48	3	60	17.3±0.25	16.9±0.27	16.3±0.29	15.0±0.25	15.6±0.25
244, 245, 246	51	3	60	17.0±0.31	16.7±0.31	16.9±0.33	15.3±0.31	16.1±0.33
247, 248, 249	54	3	60	17.9±0.27	16.3±0.25	17.1±0.31	15.5±0.27	15.4±0.27
250, 251, 252	57	3	60	17.7±0.37	16.5±0.35	16.7±0.27	15.2±0.25	15.3±0.31
253, 254, 255	60	3	60	17.5±0.31	16.8±0.39	16.4±0.25	15.6±0.37	15.8±0.29
256, 257, 258	63	3	60	17.1±0.35	16.2±0.29	16.6±0.25	15.4±0.33	15.7±0.37
259, 260, 261	66	3	60	16.9±0.25	16.1±0.37	16.4±0.35	15.7±0.33	15.5±0.35
262, 263, 264	69	3	60	17.3±0.35	16.0±0.25	16.3±0.39	15.8±0.27	15.6±0.33
265, 266, 267	72	3	60	16.8±0.33	16.5±0.31	16.6±0.25	15.3±0.29	16.0±0.31
268, 269, 270	75	3	60	16.6±0.29	16.3±0.35	16.4±0.35	15.2±0.39	15.9±0.27
271, 272, 273	78	3	60	16.1±0.27	16.1±0.29	16.2±0.37	15.8±0.27	15.6±0.29
274, 275, 276	81	3	60	16.3±0.39	16.4±0.37	16.0±0.27	15.7±0.37	15.2±0.35
277, 278, 279	84	3	60	16.0±0.37	16.2±0.33	15.8±0.33	15.4±0.25	15.9±0.39
280, 281, 282	87	3	60	15.9±0.29	15.8±0.29	15.5±0.25	15.5±0.27	15.6±0.27
283, 284, 285	90	3	60	15.7±0.35	16.0±0.31	15.6±0.33	15.6±0.35	15.4±0.37
286, 287, 288	93	3	60	15.6±0.27	15.7±0.27	15.3±0.27	15.4±0.25	15.2±0.33

TABLE 6. Size of the nuclei of the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus maculatus*. Of each stage three animals were used, of which 60 nuclei of one cell type were measured, consequently 20 nuclei per animal. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of investigated nuclei of one cell type	Number of mitoses					Percentage of mitoses				
					Pituitary gland					Pituitary gland			
				Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis	Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
1, 2, 3	0	3	600	0	1	1	0	0	0.00	0.17	0.17	0.00	0.00
4, 5, 6	3	3	600	1	2	1	0	0	0.17	0.33	0.17	0.00	0.00
7, 8, 9	6	3	600	3	4	3	0	0	0.50	0.67	0.50	0.00	0.00
10, 11, 12	9	3	600	2	4	5	0	0	0.33	0.67	0.83	0.00	0.00
13, 14, 15	12	3	600	5	7	6	0	1	0.83	1.17	1.00	0.00	0.17
16, 17, 18	15	3	600	5	9	8	0	0	0.83	1.50	1.33	0.00	0.00
19, 20, 21	18	3	600	7	9	7	1	0	1.17	1.50	1.17	0.17	0.00
22, 23, 24	21	3	600	8	7	7	0	2	1.33	1.17	1.17	0.00	0.33
25, 26, 27	24	3	600	8	8	6	1	0	1.33	1.33	1.00	0.17	0.00
28, 29, 30	27	3	600	6	6	8	0	0	1.00	1.00	1.33	0.00	0.00
31, 32, 33	30	3	600	7	5	7	0	0	1.17	0.83	1.17	0.00	0.00
34, 35, 36	33	3	600	6	4	6	0	0	1.00	0.67	1.00	0.00	0.00
37, 38, 39	36	3	600	6	6	5	0	1	1.00	1.00	0.83	0.00	0.17
40, 41, 42	39	3	600	7	4	5	0	0	1.17	0.67	0.83	0.00	0.00
43, 44, 45	42	3	600	6	3	4	0	1	1.00	0.50	0.67	0.00	0.17
46, 47, 48	45	3	600	5	4	4	1	0	0.83	0.67	0.67	0.17	0.00
49, 50, 51	48	3	600	5	4	3	0	0	0.83	0.67	0.50	0.00	0.00
52, 53, 54	51	3	600	4	3	5	0	1	0.67	0.50	0.83	0.00	0.17
55, 56, 57	54	3	600	3	3	4	0	0	0.50	0.50	0.67	0.00	0.00
58, 59, 60	57	3	600	2	4	2	1	1	0.33	0.67	0.33	0.17	0.17
61, 62, 63	60	3	600	2	3	1	0	0	0.33	0.50	0.17	0.00	0.00
64, 65, 66	63	3	600	1	2	1	0	0	0.17	0.33	0.17	0.00	0.00
67, 68, 69	66	3	600	2	1	1	0	1	0.33	0.17	0.17	0.00	0.17
70, 71, 72	69	3	600	3	1	1	0	0	0.50	0.17	0.17	0.00	0.00
73, 74, 75	72	3	600	2	1	2	0	0	0.33	0.17	0.33	0.00	0.00
76, 77, 78	75	3	600	1	2	1	0	0	0.17	0.33	0.17	0.00	0.00
79, 80, 81	78	3	600	1	3	1	1	2	0.17	0.50	0.17	0.17	0.33
82, 83, 84	81	3	600	1	1	2	0	0	0.17	0.17	0.33	0.00	0.00
85, 86, 87	84	3	600	1	1	3	0	0	0.17	0.17	0.50	0.00	0.00
88, 89, 90	87	3	600	2	1	1	0	1	0.33	0.17	0.17	0.00	0.17
91, 92, 93	90	3	600	1	2	1	1	0	0.17	0.33	0.17	0.17	0.00
94, 95, 96	93	3	600	1	1	1	0	0	0.17	0.17	0.17	0.00	0.00

TABLE 7. Number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Lebistes reticulatus*. Of each stage three animals were used, of which 600 nuclei of one cell type were investigated, consequently 200 nuclei per animal. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of investigated nuclei of one cell type	Number of mitoses					Percentage of mitoses				
					Pituitary gland					Pituitary gland			
				Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis	Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
97, 98, 99	0	3	600	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
100, 101, 102	3	3	600	0	0	0	1	0	0.00	0.00	0.00	0.00	0.00
103, 104, 105	6	3	600	0	1	1	0	1	0.00	0.17	0.17	0.00	0.17
106, 107, 108	9	3	600	0	3	2	0	0	0.00	0.50	0.33	0.00	0.00
109, 110, 111	12	3	600	0	3	1	1	2	0.00	0.50	0.17	0.17	0.33
112, 113, 114	15	3	600	1	5	4	0	0	0.17	0.83	0.67	0.00	0.00
115, 116, 117	18	3	600	3	8	7	0	0	0.50	1.33	1.17	0.00	0.00
118, 119, 120	21	3	600	6	9	8	0	0	1.00	1.50	1.33	0.00	0.00
121, 122, 123	24	3	600	8	7	8	0	0	1.33	1.17	1.33	0.00	0.00
124, 125, 126	27	3	600	8	6	7	0	0	1.33	1.00	1.17	0.00	0.00
127, 128, 129	30	3	600	7	6	6	0	0	1.17	1.00	1.00	0.00	0.00
130, 131, 132	33	3	600	8	8	7	0	1	1.33	1.33	1.17	0.00	0.17
133, 134, 135	36	3	600	6	7	8	1	0	1.00	1.17	1.33	0.17	0.00
136, 137, 138	39	3	600	6	6	7	0	0	1.00	1.00	1.17	0.00	0.00
139, 140, 141	42	3	600	7	6	4	0	1	1.17	1.00	0.67	0.00	0.17
142, 143, 144	45	3	600	7	7	7	0	0	1.17	1.17	1.17	0.00	0.00
145, 146, 147	48	3	600	5	4	5	1	2	0.83	0.67	0.83	0.17	0.33
148, 149, 150	51	3	600	6	4	3	0	1	1.00	0.67	0.50	0.00	0.17
151, 152, 153	54	3	600	5	5	3	0	0	0.83	0.83	0.50	0.00	0.00
154, 155, 156	57	3	600	3	4	4	0	0	0.50	0.67	0.67	0.00	0.00
157, 158, 159	60	3	600	3	1	2	0	0	0.50	0.17	0.33	0.00	0.00
160, 161, 162	63	3	600	2	2	2	0	0	0.33	0.33	0.33	0.00	0.00
163, 164, 165	66	3	600	1	1	1	0	1	0.17	0.17	0.17	0.00	0.17
166, 167, 168	69	3	600	1	1	2	0	0	0.17	0.17	0.33	0.00	0.00
169, 170, 171	72	3	600	0	0	1	1	0	0.00	0.00	0.17	0.17	0.00
172, 173, 714	75	3	600	1	0	0	0	0	0.17	0.00	0.00	0.00	0.00
175, 176, 177	78	3	600	1	2	2	0	0	0.17	0.33	0.33	0.00	0.00
178, 179, 180	81	3	600	2	1	1	0	0	0.33	0.17	0.17	0.00	0.00
181, 182, 183	84	3	600	1	1	2	1	0	0.17	0.17	0.33	0.17	0.00
184, 185, 186	87	3	600	1	1	1	0	0	0.17	0.17	0.17	0.00	0.00
187, 188, 189	90	3	600	1	0	1	0	1	0.17	0.00	0.17	0.00	0.17
190, 191, 192	93	3	600	1	1	1	0	0	0.17	0.17	0.17	0.00	0.00

TABLE 8. Number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus helleri*. Of each cell type three animals were used, of which 600 nuclei of one cell type were investigated, consequently 200 nuclei per animal. The duration of the experiments is given as well.

Number of the animal	Duration of the experiments, days	Number of animals	Number of investigated nuclei of one cell type	Number of mitoses					Percentage of mitoses				
					Pituitary gland					Pituitary gland			
				Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis	Thyroid gland	Lobus anterior	Lobus intermedius	Lobus posterior	Lobus tuberalis
193, 194, 195	0	3	600	0	0	0	0	1	0.00	0.00	0.00	0.00	0.17
196, 197, 198	3	3	600	0	1	1	1	0	0.00	0.17	0.17	0.17	0.00
199, 200, 201	6	3	600	1	3	3	0	0	0.17	0.50	0.50	0.00	0.00
202, 203, 204	9	3	600	2	6	7	0	0	0.33	1.00	1.17	0.00	0.00
205, 206, 207	12	3	600	4	4	5	0	0	0.67	0.67	0.83	0.00	0.00
208, 209, 210	15	3	600	4	3	6	0	0	0.67	0.50	1.00	0.00	0.00
211, 212, 213	18	3	600	7	7	8	0	0	1.17	1.17	1.33	0.00	0.00
214, 215, 216	21	3	600	6	8	6	0	1	1.00	1.33	1.00	0.00	0.17
217, 218, 219	24	3	600	7	6	5	1	0	1.17	1.00	0.83	0.17	0.00
220, 221, 222	27	3	600	7	6	7	0	0	1.17	1.00	1.17	0.00	0.00
223, 224, 225	30	3	600	5	4	6	0	0	0.83	0.67	1.00	0.00	0.00
226, 227, 228	33	3	600	4	7	6	1	1	0.67	1.17	1.00	0.17	0.17
229, 230, 231	36	3	600	6	6	7	1	0	1.00	1.00	1.17	0.17	0.00
232, 233, 234	39	3	600	4	6	6	0	0	0.67	1.00	1.00	0.00	0.00
235, 236, 237	42	3	600	4	4	6	0	0	0.67	0.67	1.00	0.00	0.00
238, 239, 240	45	3	600	3	4	5	0	0	0.50	0.67	0.83	0.00	0.00
241, 242, 243	48	3	600	3	4	3	0	0	0.50	0.67	0.50	0.00	0.00
244, 245, 246	51	3	600	3	3	5	0	0	0.50	0.50	0.83	0.00	0.00
247, 248, 249	54	3	600	2	1	4	0	0	0.33	0.17	0.67	0.00	0.00
250, 251, 252	57	3	600	1	2	3	0	0	0.17	0.33	0.50	0.00	0.00
253, 254, 255	60	3	600	3	1	1	0	0	0.50	0.17	0.17	0.00	0.00
256, 257, 258	63	3	600	1	0	1	1	0	0.17	0.00	0.17	0.17	0.00
259, 260, 261	66	3	600	2	1	0	0	1	0.33	0.17	0.00	0.00	0.17
262, 263, 264	69	3	600	0	2	1	1	2	0.00	0.33	0.17	0.17	0.33
265, 266, 267	72	3	600	2	1	0	0	0	0.33	0.17	0.00	0.00	0.00
268, 269, 270	75	3	600	1	1	2	0	0	0.17	0.17	0.33	0.00	0.00
271, 272, 273	78	3	600	1	1	1	0	0	0.17	0.17	0.17	0.00	0.00
274, 275, 276	81	3	600	0	1	1	1	0	0.00	0.17	0.17	0.17	0.00
277, 278, 279	84	3	600	2	0	1	1	1	0.33	0.00	0.17	0.17	0.17
280, 281, 282	87	3	600	1	1	0	0	0	0.17	0.17	0.00	0.00	0.00
283, 284, 285	90	3	600	1	2	1	0	0	0.17	0.33	0.17	0.00	0.00
286, 287, 288	93	3	600	1	1	1	0	0	0.17	0.17	0.17	0.00	0.00

TABLE 9. Number of mitoses in the thyroid gland, the lobus anterior, the lobus intermedius, the lobus posterior and the lobus tuberalis of the pituitary gland during the development of the gonopodium in *Xiphophorus maculatus*. Of each stage three animals were used, of which 600 nuclei of one cell type were investigated, consequently 200 nuclei per animal. The duration of the experiments is given as well.

Investigations		d/n	D/n	c_h	c_s	Publications
Species	Particulars					
Tanichthys albonubes	Thyroidal tumour (STOLK, 1956*b*)			0.77	0.89	STOLK (1956*a*)
——	Normal			0.27 to 0.43	0.35 to 0.49	STOLK (1956*a*)
Barbus tetrazona	*Ichthyophonus* disease			0.74 to 0.86	0.79 to 0.88	STOLK (1956*d*)
——	Normal			0.29 to 0.43	0.36 to 0.48	STOLK (1956*d*)
Trichogaster trichopterus	*Ichthyophonus* disease			0.76 to 0.90	0.81 to 0.94	STOLK (1956*d*)
——	Normal			0.24 to 0.36	0.33 to 0.40	STOLK (1956*d*)
Cichlasoma biocellatum	Thyroidal tumour			0.84	0.87	STOLK (1956*e*)
——	Normal			0.23 to 0.38	0.28 to 0.42	STOLK (1956*e*)
Anoptichthys jordani	Overlapping of the eyes by skin-folds	2.600 to 3.780	2.820 to 3.980	0.158 to 0.296	0.184 to 0.314	STOLK (1958*b*)
Lebistes reticulatus	Development of the gonopodium	0.933 to 2.100	1.300 to 2.400	0.327 to 0.500	0.360 to 0.523	STOLK (this publication)
Xiphophorus helleri	Development of the gonopodium	0.933 to 2.233	1.333 to 2.533	0.317 to 0.500	0.350 to 0.520	STOLK (this publication)
Xiphophorus maculatus	Development of the gonopodium	1.000 to 2.467	1.300 to 2.800	0.300 to 0.490	0.330 to 0.517	STOLK (this publication)

TABLE 10. Values of the quotients d/n, D/n, c_h and c_s obtained in some investigations (STOLK, 1950 *b*, 1951 *a*, 1951 *c*, 1954, 1955 *a*, 1956 *a*, 1956 *c*, 1956 *d*, 1956 *e*, 1956 *g*, 1957 *a*, 1957 *b*, 1958 *a*, 1958 *b* and this publication).

Investigations		d/n	D/n	c_h	c_s	Publications
Species	Particulars					
Lebistes reticulatus	Gestation period	0.9 to 2.7				STOLK (1950*b* and 1951*a*)
—	Embryo	1.1 to 1.4	2.0 to 2.5	0.62 to 0.67	0.68 to 0.80	STOLK (1951*c* and 1954)
—	Treated for 54 to 183 days with 0.05% thiouracil solutions			0.61 to 0.76	0.74 to 0.92	STOLK (1955*a*)
—	Untreated			0.29 to 0.44	0.35 to 0.51	STOLK (1955*a*)
—	Treated for 54 to 183 days with nitrofurazone solutions (concentration: 69 mg per 5000 ml tap water)			0.68 to 0.75	0.75 to 0.87	STOLK (1956*c*)
—	Untreated			0.22 to 0.39	0.30 to 0.49	STOLK (1956*c*)
Xiphophorus helleri	Treated for 45 tot 114 days with 0.05% thiouracil solutions			0.59 to 0.79	0.68 to 0.90	STOLK (1955*a*)
—	Untreated			0.20 to 0.55	0.28 to 0.49	STOLK (1955*a*)
—	Treated for 45 to 114 days with nitrofurazone solutions (concentration: 69 mg per 5000 ml tap water			0.61 to 0.77	0.65 to 0.89	STOLK (1956*c*)
—	Untreated			0.24 to 0.45	0.32 to 0.48	STOLK (1956*c*)
Dermogenys pusillus	Gestation period	1.1 to 2.5	1.5 to 2.8	0.28 to 0.58	0.32 to 0.59	STOLK (1956*g* and 1957*a*)
—	Embryo	1.0 to 1.6	1.5 to 2.0	0.56 to 0.65	0.60 to 0.68	STOLK (1957*b* and 1958*a*)

TABLE 10. Values of the quotients d/n, D/n, c_h and c_s obtained in some investigations (STOLK, 1950 *b*, 1951 *a*, 1951 *c*, 1954, 1955 *a*, 1956 *a*, 1956 *c* 1956 *d*, 1956 *e*, 1956 *g*, 1957 *a*, 1957 *d*, 1958 *b* ann this publication.

Abb. 1. Die Bruchstelle, wie sie sich dem Betrachter an der lebenden Schlange bot. Man erkennt die unnormale Häutung. *Aufnahme:* H.-G. PETZOLD.

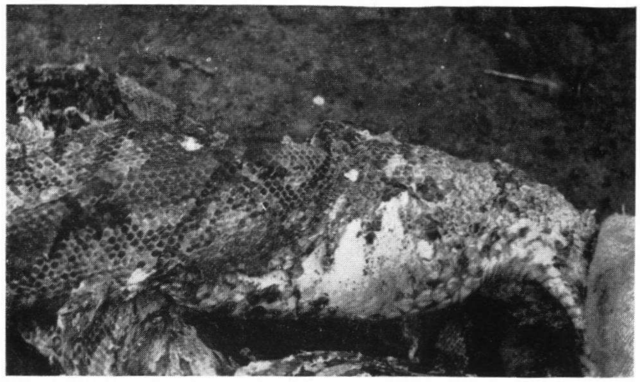

Abb. 2. Der angeschwollene Leib der Netzschlange. Deutlich ist zu sehen, dass vom After ab der Schwanz nicht geschwollen ist. Auch hier wird die unnormale Häutung deutlich. *Aufnahme:* H.-G. PETZOLD.

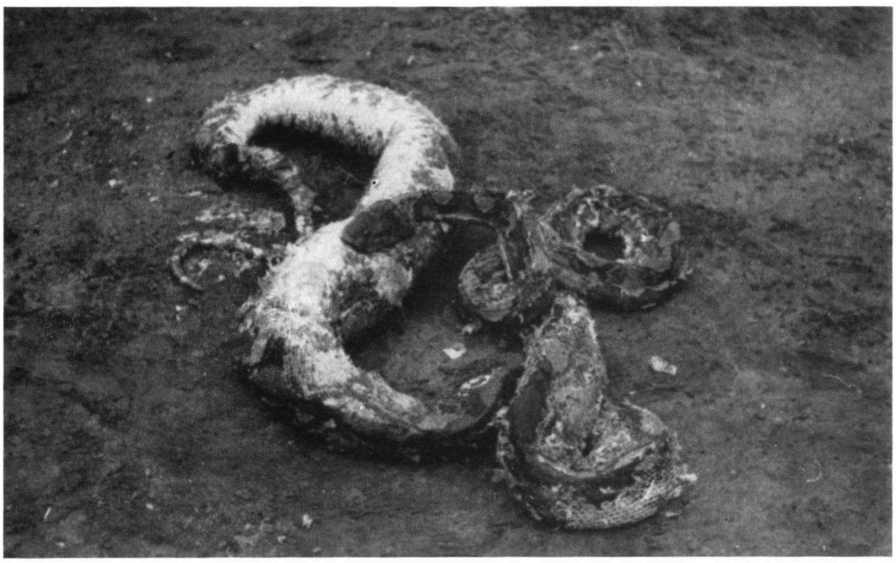

Abb. 3. Die Netzschlange unmittelbar nach ihrem Tode. *Aufnahme:* H.-G. PETZOLD.

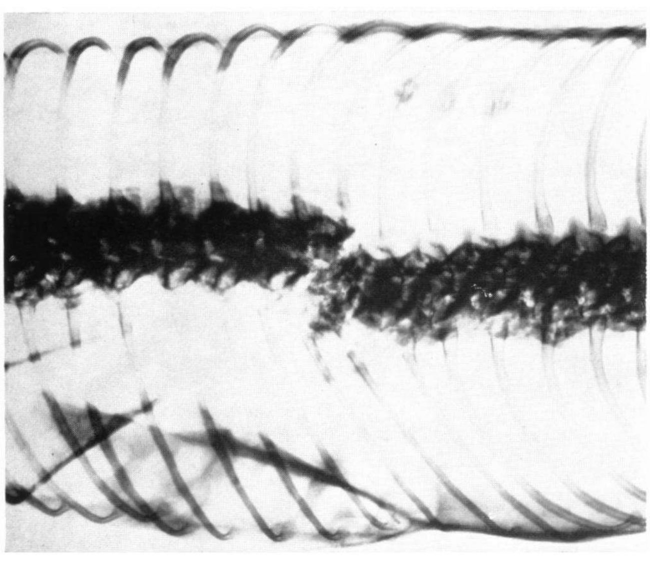

Abb. 4. Röntgenbild der Bruchstelle von dorsal. Neben der seitlichen Verschiebung sind die Rippenbrüche gut erkennbar. *Aufnahme:* Dr. G. BEUTEL.

Abb. 5. Seitenbild des Wirbelsäulenbruches, wobei man die Verschiebung des Rückgrates in dorsoventraler Richtung erkennt. *Aufnahme:* Dr. G. BEUTEL.