CHANGES IN THE INTERNAL STRUCTURE OF THE AIR-BLADDER OF *SILONIA SILONDIA* (HAM.) DURING GROWTH.

By K. KRISHNAN NAIR, *B.A., Officiating Gallery Assistant, Zoological Survey of India, Calcutta.*

The earlier accounts of the structure of the air-bladder of *Silonia silondia* (Ham.) by Taylor[1], Day[2] and Bridge and Haddon[3] differ greatly from one another, and as in the case of *Pangasius pangasius* (Ham.)[4], Dr. S. L. Hora[5] was of the opinion that the differences were due to the relative sizes of the specimens examined by the respective workers. He accordingly suggested to me to make a detailed study of the air-bladder of *S. silondia* for elucidating the changes in its structure during growth. In order to enable me to carry out the proposed investigation, Dr. Hora very kindly placed the valuable material in the Indian Museum at my disposal and helped me in procuring further specimens. Thus it has been possible to dissect specimens ranging from 45 mm. to 1,250 mm. in total length.

I take this opportunity to record my grateful thanks to Dr. Baini Prashad, Director, Zoological Survey of India for affording me the necessary facilities for work. The work has been carried out under the supervision and guidance of Dr. S. L. Hora to whom I am greatly indebted for the material, valuable suggestions and constant encouragement.

DESCRIPTION OF THE MATERIAL.

1. *Size of the specimen : 45 mm. in total length* (text-fig. 1, *a.* & *b*).

The air-bladder of a specimen 45 mm. in total length is somewhat reniform, with its anterior wall concave and its posterior wall slightly convex. The bladder is broader towards the posterior end and its long axis is disposed transversely. The inside cavity is divided into a short but somewhat broad anterior chamber (*ac.*), and two lateral chambers (*lc.*) by the primary transverse (*ts.*) and longitudinal (*ls.*) septa. The transverse septum is very thick and short; dorsally it is closely applied to the ventral and lateral surfaces of the bony elements of the vertebral column. The longitudinal septum is continuous in the ventral half (text-fig. 1, *b.*) of the bladder, but in the dorsal half it does not quite reach the posterior wall. There is, however, an outgrowth from the posterior wall of the bladder towards this incomplete longitudinal septum. A small space in between the posterior wall and the incomplete longitudinal septum is thickened by root-like fibrous growths (*rf.*) from the wall of the bladder. A pneumatic duct[6] connecting the air-bladder

---

[1] Taylor, *Edinburgh Journ. Science,* (N. S.), V, p. 33, (1831).

[2] Day, *Proc. Zool. Soc. London,* p. 703, (1871).

[3] Bridge and Haddon, *Trans. Roy. Soc. London* (B) CLXXXIV, pp. 221-223, (1894).

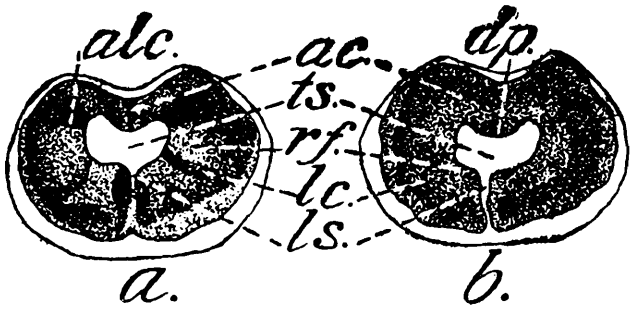
[4] Nair K. K., *Rec. Ind. Mus.,* XXXIX, pp. 117-124, (1937).

[5] Dr. Hora very kindly allowed me to consult his manucsript on the revision of the Schilbeidae which is to be published in the *Records of Indian Museum.*

[6] Though Bridge and Haddon could detect no trace of a pneumatic duct, Dr. Hora had already observed one in the course of his taxonomic studies referred to above.

with the oesophagus is present; it opens into the bladder on its ventral wall (*dp.*) in the middle and just in front of the transverse septum.

In the dorsal half (text-fig. 1, *a.*) of the bladder there are two deep cavities (*alc.*) at the sides of the antero-lateral portions of the transverse septum. These cavities inwardly correspond with the two bulging pockets on the dorsal surface of the air-bladder which approximate



TEXT-FIG. 1. Air-bladder of a specimen of *Silonia silondia* (Ham.) 45 mm. in total length. × 6.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *alc.* the deep cavities at the sides of the antero-lateral portions of the transverse septum; *dp.* opening of the pneumatic duct into the bladder; *lc.* lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths; *ts.* transverse septum.

upwards, but there is no connection between the two. The antero-lateral portions of the bladder are well protected by the deflected anterior divisions of the modified transverse processes, and the wall in this region is very thin, while that of the remaining parts of the bladder is very thick. The cavities of the lateral chambers are broken up by the root-like fibrous thickening which arise from the septa and the walls of the bladder.

The bladder is relatively very small and its walls do not come in contact with those of the body cavity. The cavity of the bladder is filled with some sort of loose tissue. It may here be noted that the condition of some of the internal structures may sometimes be found, similar to that described above even in larger specimens (*vide* text-fig. 3).

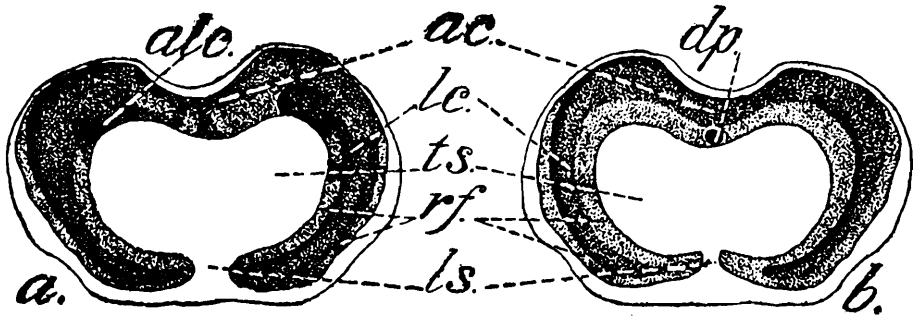
2. *Size of specimen: 127 mm. in total length.*

The air-bladder of a specimen 127 mm. in total length is similar in shape to the one described above. Internally, the transverse septum is better developed and the longitudinal septum meets both the dorsal and the ventral walls. The number of the root-like fibrous structures is considerably greater.

3. *Size of specimen: 153 mm. in total length* (text-fig. 2, *a.* & *b*).

The transverse septum (*ts.*) of the air-bladder of a specimen 153 mm. in total length is very thick and broad, and in consequence, the longitudinal septum (*ls.*) is considerably shortened: it is equally well developed. The transverse septum is so voluminous that it forms a broad central pillar. The comparatively much narrower longitudinal septum connects the pillar with the posterior wall of the bladder and thus divides an otherwise circular cavity of the bladder into two lateral portions. The anterior chamber (*ac.*) is less deep along the median line than at the sides, where the cavities, especially in the dorsal half, are very deep (text-fig. 2, *a.*). The lateral chambers (*lc.*) are considerably filled up by the fibrous thickenings (*rf.*) which arise from the septa

and the postero-lateral walls. There is a pneumatic duct (*dp.*) connecting the air-bladder with the oesophagus, though it ends blindly into



TEXT-FIG. 2. Air-bladder of a specimen of *Silonia silondia* (Ham.) 153 mm. in total length. × 4½.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *alc.* the deep cavities at the sides of the antero-lateral portions of the transverse septum; *dp.* opening of the pneumatic duct into the bladder; *lc.* lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths; *ts.* transverse septum.

the oesophagus. The walls of the antero-lateral portions are thin while those of the other parts are thick. The posterior edge of the bladder is almost straight and not convex as in the earlier stages.

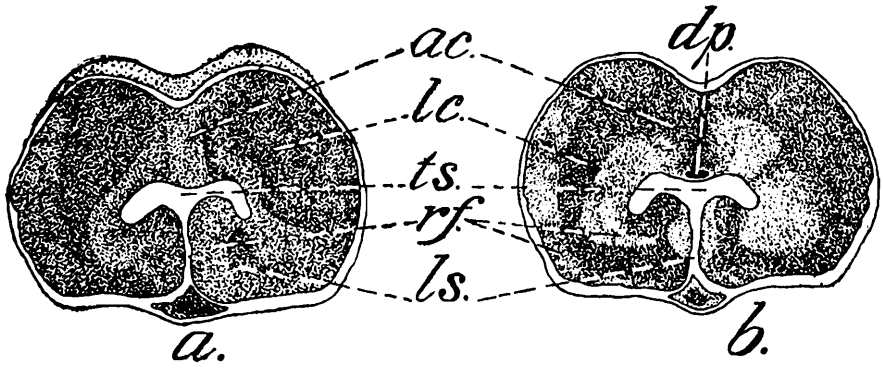
Bridge and Haddon[1] described the air-bladder of a specimen of about seven inches long which is a size intermediate between the one described above and the next one. My observations of the internal structure of the air-bladder of a specimen of about the same size do not agree with those of Bridge and Haddon. They state that the actual cavity of the bladder is reduced to the condition of a comparatively narrow circular canal surrounding the central pillar which extends vertically between the dorsal and ventral walls, while in my dissections the longitudinal septum was found to divide the cavity into two lateral portions.

4. *Size of specimen : 274 mm. in total length.*

The shape of the air-bladder of a specimen 274 mm. in total length is almost the same as the one described above. Here the transverse and longitudinal septa are very thin as shown in the next stage (text-fig. 3). The cavity of the bladder is spacious and the walls are rather thin.

5. *Size of specimen : 336 mm. in total length* (text-fig. 3, *a.* & *b*).

The internal structure of the air-bladder of a specimen 336 mm. in



TEXT-FIG. 3. Air-bladder of a specimen of *Silonia silondia* (Ham.) 336 mm. in total length. × 1¾.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *dp.* opening of the pneumatic duct into the bladder; *lc.* lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths; *ts.* transverse septum.

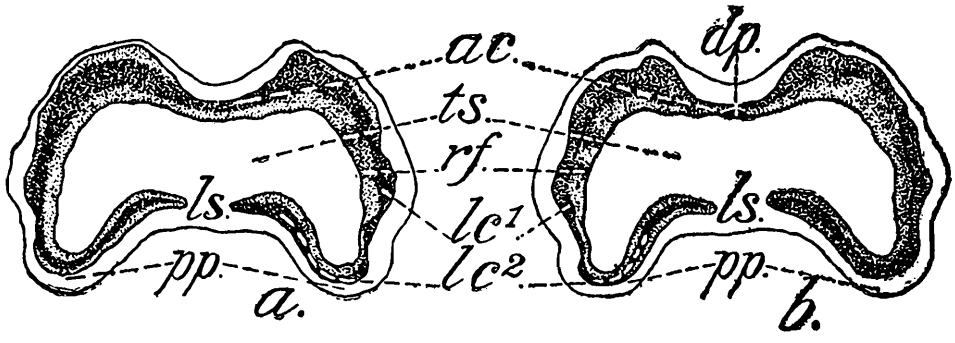
[1] Bridge and Haddon, *Trans. Roy. Soc. London* (B) CLXXXIV, pp. 221-223, (1894).

total length is rather different from those described above. There are the primary transverse (*ts.*) and longitudinal (*ls.*) septa which are not very thick. These septa divide the cavity into one big anterior chamber (*ac.*) and two lateral chambers (*lc.*) one on either side of the longitudinal septum. The extremities of the transverse septum are deflected backwards into the lateral chambers. The longitudinal septum forks at its posterior end and these branches join the posterior wall of the bladder, thus subtending a small cavity roughly in the shape of a triangle in between them. There is a pneumatic duct with a definite opening (*dp.*) into the bladder. The anterior chamber is spacious, especially in the dorsal half (text-fig. 3, *a.*). No separate cavities, as found in the previous bladders in the anterior chamber of the dorsal half could be seen here. The root-like fibres (*rf.*) of the transverse septum encroach upon the cavity of the anterior chamber. The cavities of the lateral chambers are also invaded by fibrous growths from the transverse and longitudinal septa.

The bladder is comparatively more hollow, and the walls more thin. The ventral surface of the bladder was covered by a thick layer of fat and was not in contact with the walls of the body cavity. The relatively simple condition of the bladder in the above specimen may be due to a retardation of the normal process of growth.

6. *Size of specimen : 527 mm. in total length* (text-fig. 4, *a.* and *b*).

The air-bladder of a specimen 527 mm. in total length is different in shape from those described above. The posterior contour of the bladder



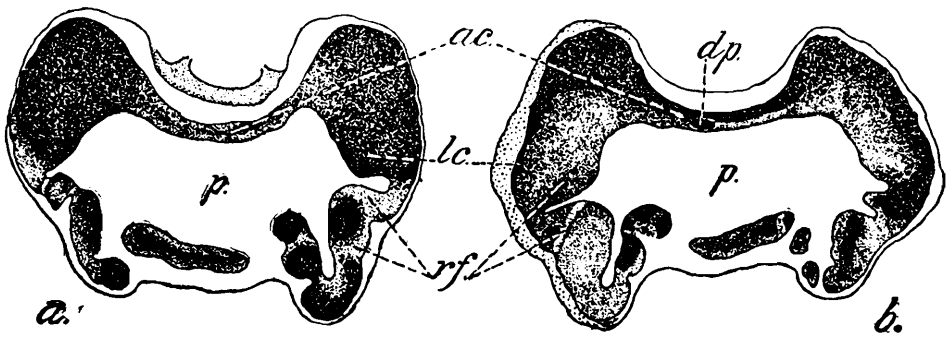
TEXT-FIG. 4. Air-bladder of a specimen of *Silonia silondia* (Ham.) 527 mm. in total length. × 1¾.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber ; *dp.* opening of the pneumatic duct into the bladder ; lc^1. first part of the original lateral chamber ; lc^2. second part of the original lateral chamber ; *ls.* longitudinal septum ; *pp.* postero-lateral pouches ; *rf.* root-like fibrous growths ; *ts.* transverse septum.

is concave and constricted in the median portion so that there are two postero-lateral pouches (*pp.*) pointing backwards. The transverse septum (*ts.*) has extended much and its deflected lateral extremities grow into the postero-lateral pouches, thus dividing the lateral chambers into two portions ($lc.^1$ and $lc.^2$). The two posterior divisions ($lc.^2$) of the lateral chambers are not continuous since there is the stout longitudinal septum (*ls.*) extending between them. The anterior chamber (*ac.*) of the bladder is very narrow in the median portion, though it is slightly dialated towards the sides. The whole cavity of the bladder is filled by the transverse septum and the fibrous growths (*rf.*) which arise from all parts of the walls. There is still a pneumatic duct (*dp.*) opening into the anterior chamber. The walls of the bladder are thickened and very tough.

7. *Size of specimen : 851 mm. in total length* (text-fig. 5, *a.* and *b*).

The antero-lateral portions of the air-bladder of a specimen 851 mm. in total length bulge upwards and are accomodated in the bony recesses



TEXT-FIG. 5. Air-bladder of a specimen of *Silonia silondia* (Ham.) 851 mm. in total length. × 1⅓.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber ; *dp.* opening of the pneumatic duct into the bladder ; *lc.* lateral chambers ; *p.* the thick pillar formed by the growth of the transverse and longitudinal septa into each other ; *rf.* root-like fibrous growths.

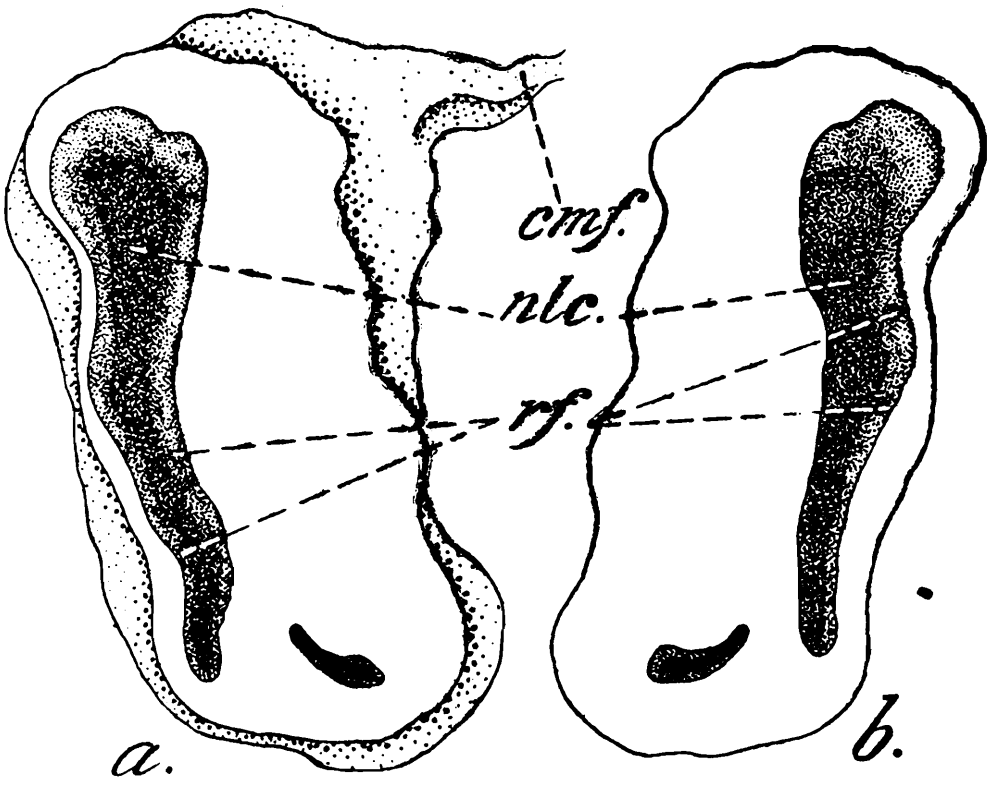
of the modified transverse processes. The whole dorsal surface is closely applied to the ventral and lateral surfaces of the bony elements immediately above. Internally, there is no differentiation of a longitudinal septum from a transverse septum. They have grown into each other and have formed a thick pillar (*p.*). The lateral deflected extremities of this pillar, which were found to be entire in an earlier stage of the bladder described above (*vide* p. 8), are divided into numerous branches which grow away from it to terminate laterally before reaching the outer walls of the bladder. They break up the cavities of the lateral chambers and subtend small spaces between them. The whole of the cavity of the bladder becomes very shallow on account of the growth of root-like fibrous tissues (*rf.*) from the walls of the bladder as well as from the pillar-like structure. In the dorsal half of the bladder (text-fig. 5, *a.*) the antero-lateral pockets are deep, but in the ventral half all the portions are invaded by the thick root-like fibres of the pillar. The growth of the fibrous tissues is greater in the ventral half (text-fig. 5, *b.*) than in the dorsal one. There is still a pneumatic duct (*dp.*) which opens into the bladder.

8. *Size of specimen : 1,250 mm. in total length* (text-fig. 6, *a.* and *b*).

The shape of the air-bladder of a specimen 1,250 mm. in total length is different from those described above. It consists of two oblong portions placed laterally, one on each side of the anterior portion of the vertebral column. These two portions are connected together anteriorly by a cylindrical, transverse mass of some tough fibrous tissue (*cmf.*).

In the oblong portion (text-fig. 6.) there is a narrow longitudinal cavity (*nlc.*) Internally it does not communicate with the corresponding one on the other side, since the only connection between the two portions is a solid cylindrical mass of fibres noted above. There is another very small cavity towards the posterior end. The narrow longitudinal cavity with root-like fibrous growths (*rf.*) represents the lateral chamber which, in the earlier stages was noticed being filled in by the growth of the transverse septum and its branches. The small cavity seems to have originated from one of the many small spaces subtended by the branched lateral

extremities of the pillar described above (text-fig. 5). The transverse fibrous connection between the two parts of the bladder was probably formed by the obliteration of the original anterior chamber.



TEXT-FIG. 6. Air-bladder of a specimen of *Silonia silondia* (Ham.) 1,250 mm. in total length. $\times 3\frac{1}{3}$.

a. Dorsal half. *b*. Ventral half. *cmf*. the cylindrical mass of tough fibre which connects the two oblong portions of the air-bladder which are placed laterally on either side of the vertebral column; *nlc*. the narrow longitudinal cavity of the air-bladder; *rf*. root-like fibrous growths.

Day's[1] description of the air-bladder appears to correspond to a great extent with the above description. Taylor[2] might have had a specimen intermediate in size between the last two stages described above.

CONCLUSION.

Taking all the growth stages described above into consideration it seems probable that the air-bladder of *Silonia silondia* (Ham.), even at a very early stage of its growth is a considerably modified structure. Its small size and laterally oval form show a considerable deviation from the normal siluroid type of air-bladder. During growth the central part of the bladder, normally occupied by a thin transverse septum and a thin longitudinal septum, assumes a solid appearance through the hypertrophy of the fibrous tissue of the septa. This central mass restricts the cavity of the bladder to the sides and in consequence becomes surrounded by a narrow and almost circular canal. With growth this canal becomes sub-divided towards the posterior end. In the largest specimen examined, about 50 inches in total length, the bladder is divided into two, tough-walled, lateral portions which are connected entirely by fibrous tissue.

---

[1] Day, *Proc. Zool. Soc. London*, p. 703, (1871).
[2] Taylor, *Edinburgh Journ. Science* (N. S.) V, p. 33, (1831).

In his article on the " Correlation Between the Disposition of the Liver and Kidney and the Form of the Air-bladder in Certain Siluroid Fishes of India ", Hora[1] has already explained the probable reasons for the reduction of the bladder in Schilbeid fishes, and they appear to me substantially correct. There can hardly be any doubt that in these fishes the bladder is being sacrificed to provide enough space for the liver and the kidney in the considerably reduced body cavity.

[1] Hora, *Proc. Nat. Inst. Sci. India*, III, pp. 31-43, (1937).