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Plecospondylic spinal column in the eel *Anguilla anguilla**)

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1. INTRODUCTION

Several cases of deformities in the spinal column were described in fishes, viz. lordosis in the bitterling (*Rhodeus amarus*) by ROTH (1922), in the minnow (*Phoxinus phoxinus*) by ROTH (1922), in the pike (*Esox lucius*) by ROTH (1922) and PLEHN (1924); kyphosis in the toothcarps (*Cyprinodontidae*) by ROTH (1922); scoliosis in the carp (*Cyprinus carpio*) by HOFER (1904), ROTH (1922) and PLEHN (1924); kyphoscoliosis in the toothcarps by ROTH (1922); kypholordosis in the highly arched Aischgründer race of the carp by SPICZAKOW (1935) and in the carp by SCHÄPERCLAUS (1941, 1954); plecospondylic spinal column in the eel (*Anguilla anguilla*) by SCHÄPERCLAUS (1941, 1954) and in the guppy or millionfish (*Lebistes reticulatus*) by STOLK (1955 a). SCHRÄDER (1930) described curvatures of the spinal column in fishes of about 55 species and families.

In this paper we briefly describe a case of plecospondylic spinal column, observed in an adult eel (*Anguilla anguilla*) (fig. 1). The fish was fixed in formalin and embedded in paraffin. The sections (4—6 μ) were cut frontally and transversally and stained with hematoxylin and eosin, hematoxylin and phloxin as also according to the VAN GIESON method and the azan method.

2. DESCRIPTION

The eel with the plecospondylic spinal column was an adult male, measuring 27.6 cm. In consequence of the many curvatures, mainly in lateral direction, the spinal column was extremely shortened (fig. 1). The number of the curvatures amounted to 6.

Microscopical investigation showed several vertebrae to have lost their normal position and to be displaced the one in regard to the other, often to a considerable extent (figs. 2 and 3), however, always forming a very regular curvature. The periost consisted of a thin layer of connective tissue made up of flattened cells with fusiform nuclei. This periost showed no abnormal peculiarities.

*) Received May 16, 1955.

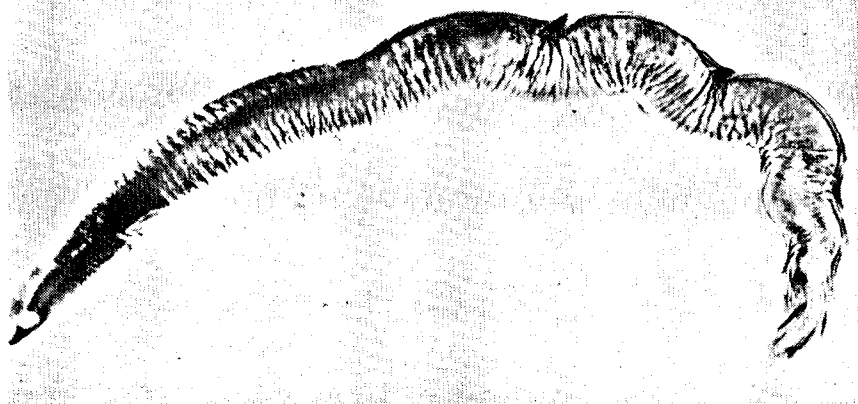


FIGURE 1. Plecospondylic spinal column in the eel *Anguilla anguilla*. Dorsal side. The body shows several consecutive wavelike curvatures.

On section, the displaced vertebrae seemed to consist of a densely structured compacta and a looser spongiosa (fig. 3). This corresponds very well with the structure of the normal vertebra.

In some vertebrae the normal, regular form is lost. These vertebrae showed some deformation, being transformed into irregular pieces of bone, sometimes growing together, thus forming a bone stick. Lacunae with osteoclasts were not observed on the surface of the vertebrae.

An increase in size, a decrease in size and disappearance of the vertebrae as found in the plecospondylic spinal column of *Lebistes* (STOLK, 1955 a), were not found. Inflammatory cells, such as polynuclear leucocytes and lymphocytes were not present in the plecospondylic spinal column of this *Anguilla*, nor did we find the cells with club-shaped inclusions, the so-called coarse granulocytes in the discharging state, often observed in inflammations and in tumours of fishes.

DUTHIE (1939) and CATTON (1951) in certain teleost fishes; — ARONOWITZ NIGRELLI and GORDON (1951) in a spontaneous epithelioma of the platyfish *Xiphophorus (Platypoecilus) variatus*; — STOLK (1950, 1954a) in the inflammation of gills in the guppy or millionfish *Lebistes reticulatus*; STOLK (1950, 1954 b) in the thyroid tis of the guppy or millionfish *Lebistes reticulatus*; — STOLK (1954 c) in the mesenchymal tumour of the skin in the platyfish *Xiphophorus maculatus* (red variety); — STOLK (1954 d) in the polycystic kidneys of the guppy or millionfish *Lebistes reticulatus*, of the swordtail *Xiphophorus helleri* and of the swordtail-platyfish hybrids *Xiphophorus helleri* x *maculatus*; — STOLK (1955 b) in the polycystic kidneys of the minor *Hyphessobrycon callistus callistus*; — STOLK (1955 c) in the polycystic kidneys of the veiltail *Carassius auratus* var. *japonicus bicaudatus*; — STOLK (1955 d) in the congenital teratoma of the skin in the guppy or millionfish *Lebistes reticulatus*; — STOLK (1956 a) in the hypophysitis of *Acanthophthalmus kuhli*; — STOLK (1956 b) in the epithelioma of the oral mucosa in the cat shark *Scylliorhinus catulus*; — STOLK (1956 c) in the inactive thyroid gland of the goldfish *Carassius auratus* with acromegaly; — STOLK (1956 d) in the fibroma of the skin in *Malapterurus electricus*; — STOLK (1956 e) in the loose,

wide-meshed connective tissue of the mouth bottom, the upper jaw and the kidneys of the Cichlid *Pterophyllum scalare*. — See for particulars of these coarse granulocytes in the discharging stage: the publications of STOLK.

No deformites have been found in the skeleton of the head and of the extremities, either in the musculature or in the skin.

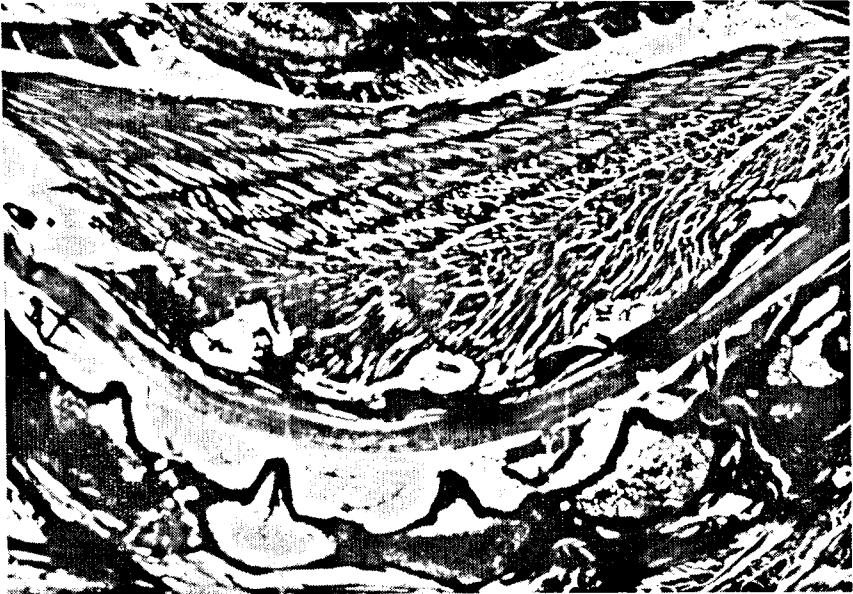


FIGURE 2. Plecospondylic spinal column in the eel *Anguilla anguilla*. Frontal section, small magnification. Scoliosis, arisen by displacement of the vertebrae (below, black). The spinal cord is visible (gray), showing also a curvature. At the top of the figure musculature. The myomeres and myosepta are clearly visible.

3. DISCUSSION

The plecospondylic spinal column of this *Anguilla anguilla* bears a good resemblance to the corresponding deformity described by SCHÄPERCLAUS (1941, 1954) in the same species. His specimen measured 33 cm and the röntgenogram showed apart from the alternating lordotic and kyphotic curvatures, also a number of scolioses.

Some remarks as to the cause of this plecospondylic spinal column in *Anguilla* may be given. At the autopsy no indications were found with regard to the etiology. Since inflammatory cells were lacking in the plecospondylic spinal column, local inflammation did not occur. Deformity combined with an inflammatory process viz. a lordosis, was found by ROTH (1922) in the pike (*Esox lucius*).

It is most likely, that the plecospondylic spinal column of our *Anguilla* has arisen from a preceding process of osteomalacia, as in the corresponding deformity of *Lebistes* (STOLK, 1955 a). The osteomalacia affects the entire skeleton and thus the several curvatures of the spinal column can properly be explained. WUNDER (1934) observed in the carp (*Cyprinus carpio*) after a primary osteomalacia a secondary curvature of the spinal column.

The plecospondylic spinal column repeatedly occurred in pox disease ("Pockenkrankheit") and rachitis. This also points to the osteomalacia as a cause of the plecospondylic spinal column, as these diseases are accompanied by osteomalacia.

Our conclusion must be, that in the plecospondylic spinal column of our *Anguilla* osteomalacia probably was the primary disease. It is indeterminate how far the osteomalacia is a result of hereditary factors.



FIGURE 3. Plecospondylic spinal column in the eel *Anguilla anguilla*. Frontal section, more magnified than figure 2. Scoliosis arisen by displacement of the vertebrae (below and at the top of the figure, black). The vertebrae consist of a densely structured compacta and a looser spongiosa. The spinal cord is visible (gray), showing also a curvature.

4. SUMMARY

Description of a case of plecospondylic spinal column in an adult eel (*Anguilla anguilla*). The deformity showed the following symptoms: displacement and deformation of the vertebrae. Increase in size, decrease in size and disappearance of the vertebrae, as found in the plecospondylic spinal column of *Lebistes* (STOLK, 1955a), were not observed.

No deformities were found in the skeleton of the head, the extremities, the musculature or the skin.

Inflammatory cells such as polynuclear granulocytes, lymphocytes and cells with club-shaped inclusions, the so-called coarse granulocytes in the discharging stage were not found. Therefore inflammatory processes cannot have played an important part in the origin of the plecospondylic spinal column of our *Anguilla*. It is probable that osteomalacia was the primary disease.

REFERENCES :

- ARONOWITZ, O., NIGRELLI, R. F. and GORDON, M.
1951 A spontaneous epithelioma in the platyfish, *Xiphophorus (Platypoecilus) variatus*. — *Zoologica, Scientific Contributions of the New York Zoological Society*, 36 : 239.
- CATTON, W. T.
1951 Blood cell formation in certain teleost fishes. *Blood*. — *J. Hematol.*, 6 : 39.
- DUTHIE, E. S.
1939 The origin, development and function of the blood cells in certain marine teleosts. Part 1, Morphology. — *J. Anat.*, 73 : 396.
- HOFER, B.
1904 *Handbuch der Fischkrankheiten*. — Schweizerbart, Stuttgart.
- KOCK,
1912 Über ein gehäuftes Vorkommen von Wirbelsäulenverkrümmung bei Fischen. — *Berl. Klin. Wochenschrift*.
- PLEHN, M.
1924 *Praktikum der Fischkrankheiten*. — E. Schweizerbartsche Verlagshandlung, Stuttgart.
- ROTH, W.
1922 *Handbücher für die praktische naturwissenschaftliche Arbeit XI. Die Krankheiten der Aquarienfische und ihre Bekämpfung. Geschäftssteile des Mikrokosmos*. — Francksche Verlagshandlung, Stuttgart.
- SCHRÄDER, Th.
1930 Über die Missbildungen der Wirbelsäule bei Fische insbesondere über die Wellenkrümmung (Plekospodylie) beim Aal (*Anguilla vulgaris*). — *Z. f. Fischerei*, 28 : 495—543.
- SCHÄPERCLAUS, W.
1941 *Fischkrankheiten*, 2. Auflage. — Gustav Wenzel und Sohn, Braunschweig.
1954 *Fischkrankheiten*, 3. Auflage. — Akademie-Verlag, Berlin.
- SPICZAKOW, T.
1935 Zum Problem der Rasse und des Exterieurs beim Karpfen. — *Z. f. Fischerei*, 33 : 409—472.
- STOLK, A.
1950 Enige gevallen van gezwollen en ontstekingen bij poikilotherme Vertebraten, een bijdrage tot de Vergelijkende Pathologie. (With an English summary). — Thesis, Utrecht. G. W. v. d. Wiel & Co., Arnhem.
1954a Cell with club-shaped inclusions in the inflammation of gills in the viviparous Cyprinodont *Lebistes reticulatus* (PETERS). — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 57 : 46—49.
1954b Thyroiditis in the viviparous Cyprinodont *Lebistes reticulatus* (PETERS). — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 57 : 50—56.
1954c Tumours of fishes, VI. — Mesenchymal tumour of the skin in the viviparous Cyprinodont *Xiphophorus maculatus* GÜNTHER (red variety). — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 57 : 652—658.
1954d Polycystic kidneys in the viviparous Cyprinodonts *Lebistes reticulatus* (PETERS), *Xiphophorus helleri* HECKEL and the hybrid *Xiphophorus helleri* HECKEL x *Xiphophorus maculatus* GÜNTHER. — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 57 : 659—665.
1955a Plecospondylic spinal column in the viviparous Cyprinodont *Lebistes reticulatus* (PETERS). — *Beaufortia, Series of miscellaneous publications, Zoological Museum, Amsterdam* 1 (5) : 1—9.
1955b Polycystic kidneys in the Characid *Hypheobrycon callistus callistus* (BOULENGER). — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 58 : 63—69.
1955c Polycystic kidneys in the veiltail *Carassius auratus* var. *japonicus bicaudatus* ZERNECKE. — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 58 : 70—73.
1955d Tumours of fishes. VII. Congenital teratoma of the skin in the viviparous Cyprinodont *Lebistes reticulatus* (PETERS). — *Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam*, C 58 : 190—194.

- 1956a Hypophysitis in the Cobitid *Acanthopthalmus kuhli* (VALENCIENNES). — Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam, C 59 : 377—386.
- 1956b Tumours of fishes. IX. Epithelioma of the oral mucosa in the Scylliid *Scylliorhinus catulus* (L.). — Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam, C 59 : 196—210.
- 1956c Thyroid and pituitary gland in a goldfish (*Carassius auratus*) with acromegaly. — Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam, C 59 : in press.
- 1956d Tumours of fishes. XIII. Multiple fibromas of the skin in the Malapterurid *Malapterurus electricus*. Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam C 50 : in press.
- 1956e Oval cells with club-shaped inclusions in the connective tissue of the Cichlid *Pterophyllum scalare* CUVIER. — Proc. Kon. Nederl. Akad. v. Wetensch., Amsterdam C 59 : in press.
- WUNDER, W.
- 1934 Beobachtungen über Knochenerweichung und nachfolgende Wirbelsäulenverkrümmung beim Karpfen (*Cyprinus carpio* L.). — Z. f. Fischerei, 32 : 37—67.