NOTES ON FOUR DEFORMED SPECIMENS OF THE INDIAN CARP, *LABEO ROHITA* (HAMILTON)

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INTRODUCTION

The occurrence of malformations in fishes is not uncommon and when present it is usually apparent even to a casual observer. Gemmill (1912) reviewed work on the abnormalities of bony fishes but information then available on the carp group was very scanty. Only one record of a hump-backed *Catla* has so far been made from India by Hora (1942), which has been subsequently worked out by Law (1944).

This paper deals with four fishes, which in spite of their deformities possess the typical specific characters of *Labeo rohita*. These fishes were collected from the river Jumna and its neighbouring ponds during the months of October to December, 1953, within Delhi State. Specimens are adults and measure 13·7 cm. to 30·8 cm. in standard length. It is of interest to note that all the major external deformities, as noted in the specimens examined, are limited to the dorsal and lateral sides of the body. In two specimens there is coalescence of vertebral centra resulting in bends, while in the other two, bends are without any coalescence of the vertebral centra.

To study deformities, comparison has been made with the normal fish of the same head-length, this being the least affected part in specimens. The deformities have been confirmed with X-ray examinations and dissections of the vertebral columns.

The vertebral column of a normal *L. rohita* has 37 vertebrae, of which the first four unite as in all other physostomous fishes to form a compound vertebra. Of the 37 vertebrae, 21 belong to the trunk region and are provided with 17 pairs of ribs, beginning from the fifth vertebra while the remaining belong to the caudal region and have haemal spines (Sarbahi, 1932).

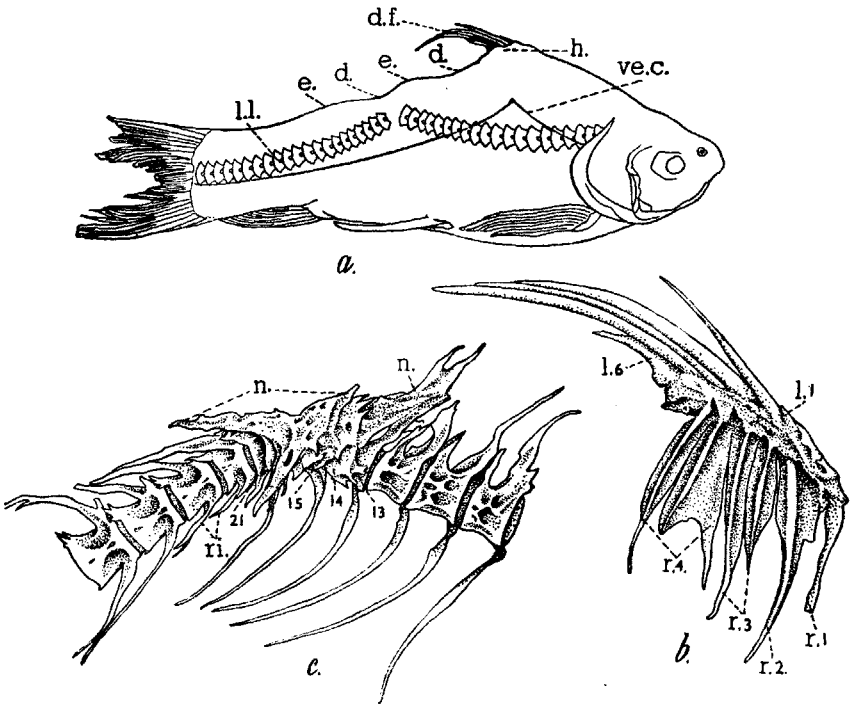
I. COALESCENCE OF VERTEBRAL CENTRA

Specimen No. 1

Deformities (Text-fig. 1. *a.*) are observed externally from the dorsal fin to the beginning of caudal peduncle. A cone-like hump is seen on the dorsal side and the incomplete dorsal fin is present on it. This hump is followed behind by two dorsal depressions and two elevations. Lateral bulgings or swellings are at the level of the first dorsal elevation.

The depth of the body at the hump is greater than that of the normal fish. The dorsal fin which has considerably shifted forward from its normal position is situated above the middle of the pectoral fin and has only six anterior fin rays, the posterior portion being completely absent. There is neither a scar nor any sign of injury at the place of missing dorsal rays and this area is completely covered by the scales. The other fins also show somewhat displaced positions in relation to the other parts of the body and have normal number of fin rays.

Lateral line on both the sides is interrupted, that of the right side is discontinuous after the 19th scale and then continues again from 21st scale; and of the left side shows a break after the 14th scale and then continues from 23rd scale.



TEXT-FIG. 1.

Text-fig. 1. *a*. Specimen No. 1 showing the hump, depressions, elevations, deformed dorsal fin, break in the lateral line and the position of the deformed vertebral column. (Right side × *c.a.* ½).

„ „ *b*. Radials and lepidotrichia of the deformed dorsal fin of specimen No. 1. (× 1).

„ „ *c*. Part of the vertebral column of specimen No. 1 showing the coalescence. (× 1).

In the trunk region (Text-fig. 1. *c.*) the first coalescence of centra is observed in 13th and 14th vertebrae. The two neural spines are fused just above the neural arches while their distal ends are free. Only one pair of pleural ribs is observed in place of two pairs. The second coalescence of centra is noted in 15th to 21st vertebrae and this portion is irregularly contorted laterally. The neural spines of these vertebrae are in form of small irregular projections directed in anterior and posterior directions. A groove on the dorsal side of deformed vertebrae represents their neural canal portion, while small ventral projections indicate the ribs. The neural spines of the trunk vertebrae are directed forward instead of having the usual backward direction. The vertebral column forms an obtuse angle at the hump part.

The dorsal fin (Text-fig. 1. *b.*) has only six lepidotrichia instead of the typical 15 to 16. Four radials are present of which the first one is smaller and more irregular than the remaining three. The first two unbranched lepidotrichia are supported on the second radial, the third and fourth on the third, and the fifth on fourth radials respectively. The sixth lepidotrichia is without any radial support.

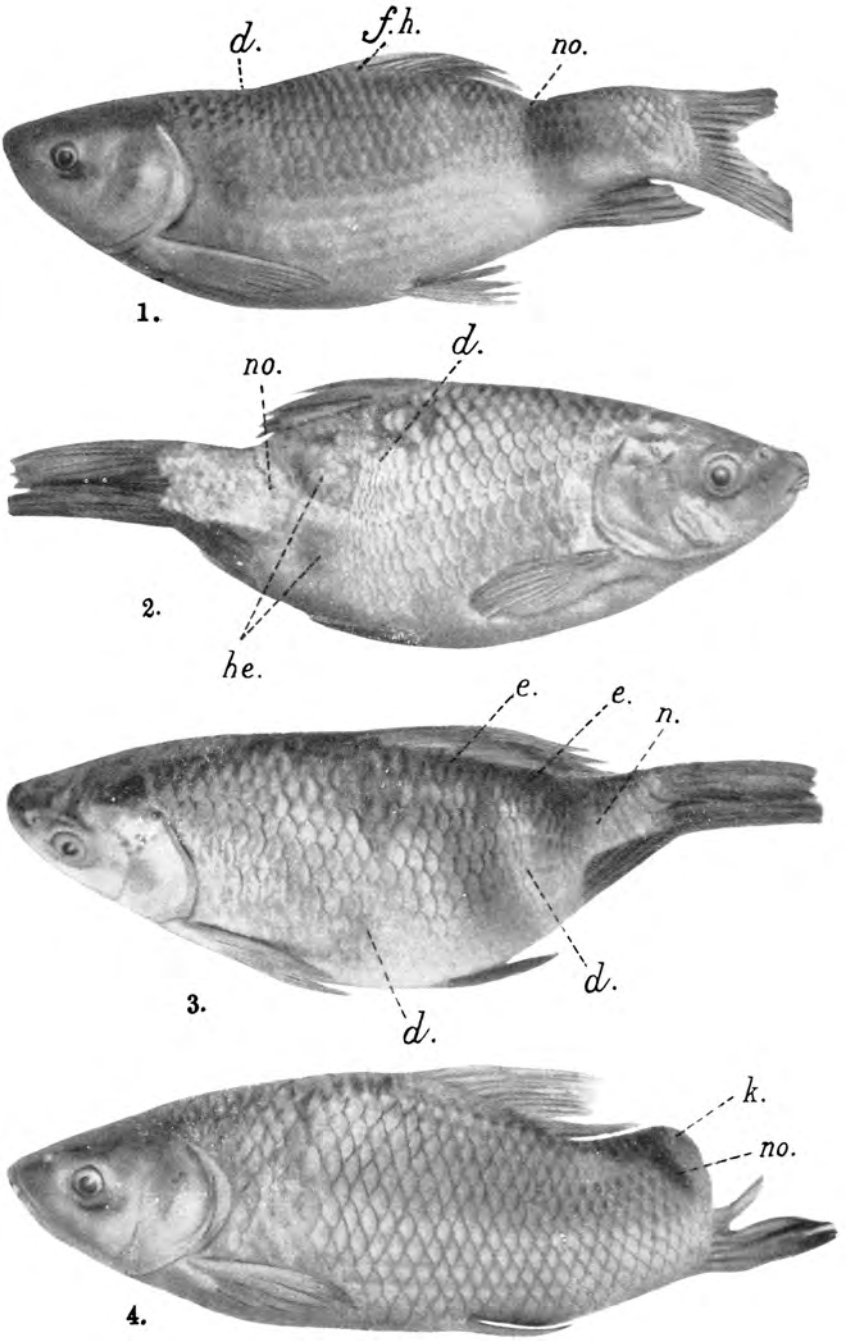


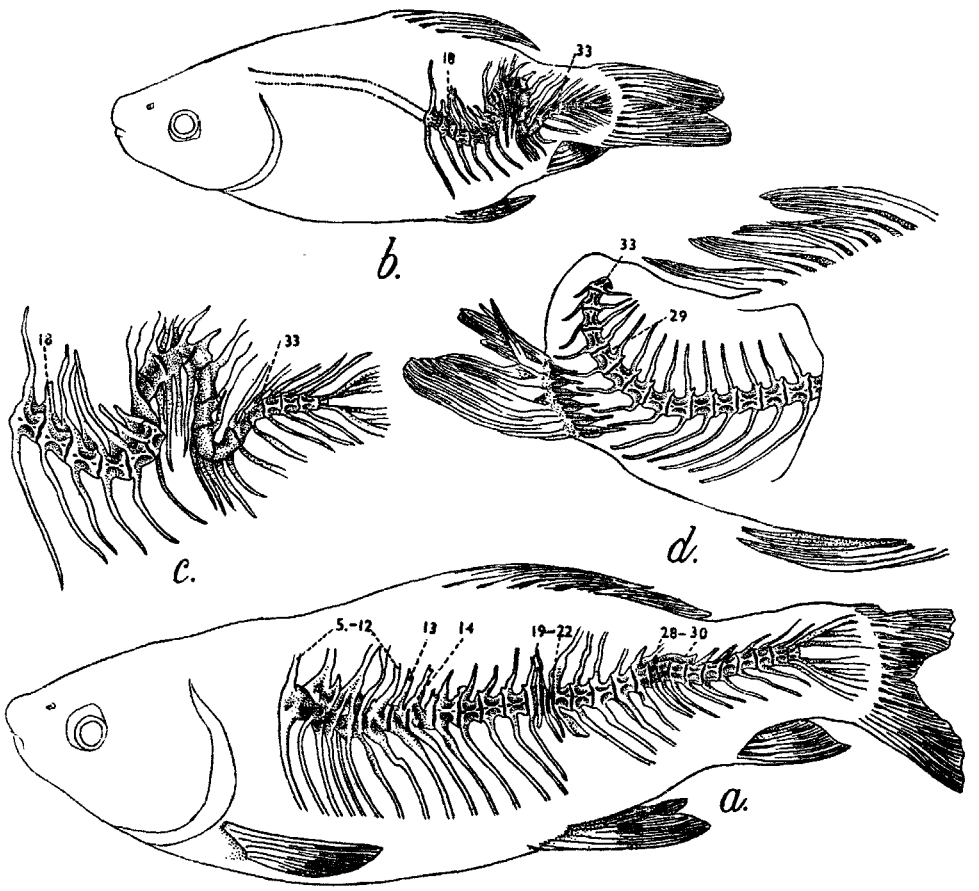
Plate Figs. 1–4.

Photographs of the deformed specimens of *Labeo rohita* (Ham.).

Fig. 1. Specimen No. 2. Left side; Figs. 2, 3. Specimen No. 3. Right and left side respectively; Fig. 4. Specimen No. 4. Left side.

Specimen No. 2

The elevations and depressions in this specimen (Plate XIV, Fig. 1.) are slightly different in position as compared to the first. There is only one shallow depression behind the head region after which is a hump-like flat bulge or elevation. A distinct notch at the beginning of the caudal peduncle on both the sides is present. The entire caudal peduncle, immediately behind the notch, is bent from left to the right side. The position of various fins and the number of rays are normal. The lateral line is, however, interrupted only on the right side with 27 scales in the first part and 11 scales in the second part.



TEXT-FIG. 2.

Text-fig. 2. *a*. Vertebral column of the specimen No. 2 showing the coalesced and the non-coalesced portions. (×½).
b. Non-coalesced portion of the vertebral column with bends in specimen No. 3. (×½).
c. Magnified view of the vertebral column in specimen No. 3.
d. Non-coalesced portion of the vertebral column with upward bend in specimen No. 4. (×½).

The first deformity (Text-fig. 2. *a*.) is from 5th to 14th vertebrae where the centra of 5th to 12th vertebrae are coalesced. The 13th and 14th vertebrae though not

coalesced are deformed because of curvature. The neural spines of 8th to 10th vertebrae are fused. The second deformity is due to coalesced centra of 19th to 22nd vertebrae. The neural spines of 20th and 21st and also of 22nd and 23rd vertebrae are fused while the parapophyses are normal. The third deformity is on account of coalescence of centra of 28th to 30th vertebrae. The neural spines of these vertebrae are fused but the usual number of haemal spines are present. The centra of the vertebrae are more or less compressed and short on the left and ventral sides, while they are broad on the right and dorsal sides and hence the curvature in this portion.

II. No coalescence of vertebral centra

Specimen No. 3

The deformities in this specimen commence (Plate XIV, Figs. 2, 3.) from the beginning of the dorsal fin and extend up to the root of caudal fin. The axis of the fish is sharply bent towards the right side near the caudal peduncle which is short and narrow in comparison with the size of the body.

The depressions and bulgings or elevations are observed on the lateral sides. On the right side there is a single depression and a single bulge with two distinct heads, while the left has two depressions and two elevations. A transverse notch is observed at the beginning of the caudal peduncle on both the sides. The noticeable features are the backward displacement of the dorsal, pectoral and pelvic fins, shortness of the caudal peduncle and increase in the dorso-ventral diameter of the body. Fins have the usual number of rays.

Lateral line on the right side is not distinctly seen throughout and only 18 scales could be counted at different places. On the same side the scales near the depression and notch are all crowded together. On the left side the lateral line has a break after 21st scale and continues in the second part with 14 scales.

The vertebral column (Text-fig. 2. *b* and *c*.) of this fish has short sharp bends from 18th to 33rd vertebrae, where the centra are complete, independent but abnormal. Owing to the bends, associated structures of all deformed vertebrae show change of slope and directions. The bends of the deformed region are towards lateral, upward and downward sides.

Specimen No. 4

This specimen (Plate XIV, Fig. 4.) differs markedly from the other three in having no depressions and elevations, and in the absence of a portion of the caudal peduncle and the caudal fin. The remaining portion of the caudal peduncle forms a blunt truncated stump which is bent upward. On the left side, above the lateral line, an oblique notch is present near the tip of the caudal peduncle. The number of rays in the existing fins is normal. The lateral line on both the sides is continuous and has only 35 scales instead of 40–42 scales.

There are only 33 vertebrae instead of normal 37, posterior four caudal vertebrae being absent (Text-fig. 2. *d*.). The posterior part of the vertebral column is bent upwards and centra of the vertebrae constituting this bend, have shorter dorsal surfaces than the ventral. The last five, 29th to 33rd, caudal vertebrae are slightly bent from the right to the left and have their neural spines curved. The 29th to 32nd vertebrae on the left side have deep depressions on their centra. The last 33rd vertebra has an open groove which marks the position of the arch. The centrum of the last vertebra forms a nodule-like structure.

The differences observed in measurements, scale counts and fin rays in the abnormal specimens as compared to the normal specimens of the same head-lengths, are given in the table.

Differences in measurements (in centimetres), fin rays and scale counts of abnormal and normal specimens of Labeo rohita *of the same head-lengths*

	Specimen No. 1		Specimen No. 2		Specimen No. 3		Specimen No. 4	
	Head-length 9·0 cm.		Head-length 7·2 cm.		Head-length 4·5 cm.		Head-length 6·1 cm.	
	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal
Total length	38·1	42·0	31·8	35·2	17·7	19·9	23·5	28·8
Standard length	30·8	33·8	25·0	28	13·7	15·6	19·0	23·2
Height of the body at the commencement of the dorsal	11·1	11·3			5·9	4·5	7·0	7·2
Height of the body at the middle of the dorsal	13·3	10·3	7·4	7·5	5·3	4·0	6·0	6·3
Height of the body at the end of the dorsal	11·2	7·9	6·5	6·6	4·0	3·4	4·7	5·5
Distance between the tip of the snout and commencement of dorsal	13·9	16·0	12·2	13·5	..	..	..	..
Distance between the tip of the snout and commencement of pelvic	16·0	20·0	14·3	15·8	L 9·0 R 8·7	8·5	..	..
Distance between the tip of the snout and commencement of anal	22·1	28·3	20·4	22·5	L 11·8 R 11·6	12·8	..	..
Distance between the anal and pelvic	6·8	10·2	7·3	9·1	L 3·6 R 3·4	4·5	7·5	6·2
Distance between the pectoral and pelvic	8·6	11·9	7·7	8·5	L 5·0 R 4·0	4·2	..	..
Length of the base of the dorsal	1·9	7·5	5·1	5·7	..	..	..	..
Length of the caudal peduncle	..	..	L 3·8 R 3·0	4·9	1·8	2·4	..	3·7
L. l of left side	33	42	40	42	35	40	36	40
L. l of right side	40	42	38	42	18	40	36	40
L. tr.	6½, 9	7½, 6½	7½, 6	7½, 6½	L 7½, 6½ R 7½, 5½	7½, 6½		

L = Left Side; R = Right Side

Discussion

The deformities observed in fishes in the past and their probable causes have been explained by Gemmill and others. Our observations on malformations in four fishes endorse with and differ from the view of many, but diversity of opinion still exists on the percentage and the cause of such deformations. Synostosis of the vertebral centra and the occurrence of simple bends have been mostly observed by earlier reporters. The feature of synostosis of vertebral centra in two adjacent groups in the first specimen, and in three separate groups in the second specimen, endorses the observations by Gemmill, and Law.

In almost all the deformed specimens the number of neural spines and haemal spines and the pleural ribs are not normal. All the features are different from those recorded by Cobbold (1855), Dyce (1860), Smith (1864–65), Howes (1894), and Ritchie (1908).

The deformities of the vertebral column in the first specimen correspond with the external conical hump, while depressions and elevations have no corresponding vertebral deformities.

The depression in the second specimen corresponds to the first deformed portion of the vertebral column. The portion of the vertebral column corresponding to the elevation with a flat surface does not show any deformity except in the middle region only in a few vertebrae. Deflected region at the beginning of notch corresponds to third group of deformed vertebrae.

The deformities in the first specimen seem to be due to mechanical injury at an early stage caused by some violence followed by irregular calcification. The first and the third deformities in the second specimen are similar to those observed in the first specimen, but the second deformity in the second specimen is due to compression at the time of the formation of vertebral centra as evidenced by their distinct centra which are telescoped into one another. Continuous ossification must have followed the compression resulting in the formation of a compound bone. The congenital factors may be the cause of such a deformity. Law, and Ritchie have observed similar deformity in *Catla* and trout respectively.

Hyrtl's statement (1862) that 'synostosis takes place more frequently in the tail than in the trunk of the fish' is not in conformity with the above observations where synostosis in the vertebral centra has occurred more in the trunk portion than in the tail region. Law, however, found synostosis in the entire vertebral column.

The complex curvatures of the vertebral column in the third specimen corresponds with the latter part of external deformity due to which the whole of the caudal peduncle is considerably shortened.

The curvatures in this may be due to mechanical disturbances or unfavourable influences in the affected part of the body during the period of development. Howes in a sole and Storrow (1909) in a cod fish observed sharp sinuosities which were not confined to a particular part of the vertebral column similar to those described by us.

The upward bend of the vertebral column of the fourth specimen corresponds to the external feature of the body, and this deformity is due to some injury. This is due to the premature calcification in the dorsal portion of all the centra of the caudal vertebrae.

The presence of a short dorsal fin with only a few rays in specimen No. 1 is a consequential change and shows that deformity of the vertebral column took place at an early stage which affected the fin also. The caudal fin in specimen No. 4 seems to have been bitten off by a predatory fish and the bitten portion healed up and regenerated as deformed.

Displaced fins from the normal position, as we have described here, were also recorded by Law. Gemmill and others while discussing the abnormalities of fins made no reference to the external structure of these defective fins. Law has

stated that 'there is considerable derangement in the bones supporting the caudal fin' but the detailed description is wanting. The causes mentioned by Gemmill about the absence and defective growth of fin are also applicable in the present specimens. The first case is due to defective development of fins and the fourth to 'injury or removal followed by healing'.

Law observed that abnormalities in fishes are very rare but McHugh and Barraclough (1951) have mentioned that 'fusions and deformities involving a limited number of vertebrae are not uncommon in natural populations of fishes'. In Atlantic and Pacific herring such anomalies are found in as many as 14 per cent of the individual in a sample (Ford and Bull, 1926; McHugh, 1942). Malformations are seen in many species of teleost fishes as recorded by Wunder (1939), Ninni (1942), O'Donnell (1945), Oselladore (1949-50), and they have reviewed the earlier work of this nature. Law states that it is too premature to make any comment whether environment plays any part or not. Kirpichnikov (1945) states that 'the body form and rate of growth of the carp are known to be extremely sensitive to the effects of environment'. But as the present specimens are collected from different sources of water, the nature of which is not known to us, we cannot comment much on this view.

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Summary

The record on malformation in fishes is not rare and this communication deals with four deformed specimens of *Labeo rohita* (Hamilton). External features, vertebral column and elements of the fins are studied in these carps.

The deformities of vertebral column are grouped into two categories: (i) no coalescence of vertebral centra and (ii) coalescence of vertebral centra. The deformities in the first specimen, as well as the first and the third deformities in the second specimen are probably due to mechanical injury at an early stage caused by some violence followed by irregular calcification. The second deformity in the second specimen is due to compression at the time of formation of vertebral centra and this may be attributed to congenital factors. In the third specimen curvatures in the vertebral column may be due to mechanical disturbances or unfavourable influences during the period of development, and in the fourth, the deformity is clearly due to some injury.

The causes of deformed fins in the specimens are either due to defective development or the injury or removal followed by healing.

The statistical data given by different workers indicate that deformities of vertebral column in fishes are not uncommon in nature. The role played by environment in bringing about such abnormalities is still a controversial issue.

References

Cobbold, T. S. (1855). Description of a malformed trout, with preliminary remarks. *New Phil. Journ.*, **73**, 238–242.

Dyce, R. (1860). On the identity of *Morrhua punctata* and *Morrhua vulgaris*. *Ann. Mag. Nat. His. London*, 366–389.

Ford, E. and Bull, H. O. (1926). Abnormal vertebrae in the herring. *Journ. Mar. Biol. Ass.*, **14**, No. 2, 509–517.

Gemmill, J. F. (1912). The teratology of fishes. Glasgow.

Hora, S. L. (1942). A hump-backed *Catla*. *Year-Book Roy. As. Soc. Bengal for 1941*, **8**, 176.

Howes, G. B. (1894). On synostosis and curvature of the spine in fishes, with special reference to the sole. *Proc. Zool. Soc. London*, 96–100.

Hyrtl, J. (1862). On intervertebral synostoses and suture in fish. *Nat. Hist. Review*, **2**, 103-4.

Kirpichnikov, V. S. (1945). Viability, rate of growth and morphology of carps of different genotypes as affected by rearing conditions. *Comp. Rend. Acad. Sci. Moscow*, **N.S. 47**, No. 7, 503–506.

Law, N. C. (1944). A hump-backed Carp, *Catla catla*. *Proc. Nat. Inst. Sci. India*, **10**, 1, 97–103.

McHugh, J. L. (1942). Variation of vertebral centra in young Pacific herring (*Clupea pallasii*). *Journ. Fish. Res. Bd. Canada*, **5**, No. 4, 347–360.

McHugh, J. L. and Barraclough, W. E. (1951). An abnormal carp, *Cyprinus carpio*, from California waters. *California. Fish and Game*, **37**, No. 4, 391–393.

Ninni, E. (1942). Traumatismi, metacromatismie nuovo caso di arresto della migrazione oculare in pesci dei mari Italiani. *Atti. Soc. Ital. Milano.*, **81**, 9–26.

O'Donnell, D. John (1945). A case of ossification of the spinal column in fishes. *Trans. Amer. Fish. Soc.*, **73**, 41–44.

Oselladore, R. (1949-50). Un esemplare di *Mugil chelo* a colonna vertebrale accorciata. *Atti. dell 'Istituto Veneto di scienze lettere ed arti.*, **108**, 119–121.

Ritchie, J. (1908). A hump-backed trout from Stranraer. *Ann. Scot. Nat. Hist. Edinburgh*, 223–227.

Sarbahi, D. S. (1932). Endoskeleton of *Labeo rohita*. *Journ.* and *Proc. As. Soc. Bengal*, **28**, 1, 296–347.

Smith, J. A. (1864-65). Deformed codfish from Firth of Forth. *Proc. Roy. Phy. Soc. Edinburgh*, 300.

Storrow, B. (1909). A case of spinal curvature in a codling. *Northumberland Sea Fisheries Report for 1909*, 37–39.

Wunder, W. (1939). Die 'Hungerform' und die 'Mastform' des Karpfens (*Cyprinus carpio L.*). *Zeitschr. Wissenschaftliche Biol. Abt. A. Zeitschr. Morph. Okol. Tiere.*, **35**, No. 4, 594–614.

Explanation of Lettering in Text-figures and Plate XIV

d.—depression; *d.f.*—dorsal fin; *e.*—elevation; *f.h.*—flat hump; *h.*—hump; *he.*—head; *k.*—knob; *l.*1.—first lepidotrichia; *l.*6.—sixth lepidotrichia; *l.l.*—lateral line; *n.*—neural spine; *no.*—notch; *r.*1, *r.*2, *r.*3, *r.*4 number of radials; *ri.*—ribs; *ve.c.*—vertebral column. 13, 14, 15, 21, 18, 33, 5–12, 19–22, 28–30, 29 number of vertebrae.

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