



C. Bergeau lith.

M & N Hanhart, imp.



(thirdly) a small canine, (fourthly) a very large canine fitting into a groove of the upper jaw, (fifthly) at some distance from the preceding a smaller canine corresponding to the upper posterior canine, and followed (sixthly) by a series of closely set small teeth\*. The upper jaw overlaps the lower slightly, the maxillary extending far behind the eye, which is rather small, placed in the middle of the depth of the head, nearer to the snout than to the gill-opening. Suborbital slightly and irregularly striated. Origin of the dorsal fin nearer to the end of the snout than to the root of the caudal, its last ray being opposite to the origin of the anal fin. Pectoral extending beyond the root of the ventral, ventral scarcely reaching the vent. Operculum very narrow; a naked space between the suborbital and lower limb of the opercle. Coloration uniform; a black spot on the end of the lateral line.

Two examples, 10 inches long, were collected by Mr. Bartlett at Xeberos.

**TETRAGONOPTERUS MELANURUS, Bl.**

Specimens from Surinam have the caudal fin whitish, with a broad black median band.

**MYLETES DURIVENTRIS, Cuv.**

D. 15-16. A. 33-34. Abdominal spines 39-48. Xeberos.

**CYNODON PECTORALIS, Gthr.**

D. 45-48. Xeberos.

**XIPHORHAMPHUS FALCIROSTRIS, Cuv.**

A. 22-27. Young, with a blackish longitudinal band. Xeberos, Pebas.

6. On the Supposed Arrest of Development of the Salmon when retained in Fresh water. By JAMES MURIE, M.D., F.L.S., F.G.S., Prosector to the Society.

(Plate XXIII.)

*Introductory Remarks.*—Lately there was brought to me a small fish of which the life-history is somewhat peculiar. So interesting, indeed, does it seem to me that I have not hesitated in bringing the facts of the case before the notice of this Society. I do so the more readily because it appears to me that, if it could be shown with certainty that the said fish is an undoubted *Salmo salar*, Linn., a physiological law of wide import would necessarily follow.

\* I have given this detailed description of the dentition because the other species referred to *Cynopotamus* have another series of small teeth within the outer. This is another proof that *Cynopotamus* is not a distinct genus.

A number of writers affirm, and instances shall by and by be quoted where facts are adduced in proof, that Salmon-fry can be retained in fresh water alone in a healthy condition for a number of years consecutively. In these cases, so to speak, the growth has been arrested, and the fish have remained in the parr or smolt condition.

Some have even gone so far as to believe that such fishes, were they permitted to migrate to large freshwater lakes, where abundance of nourishing food could be obtained, would return to their native streams as large and full-developed Salmon.

Other scientific naturalists, on the contrary, entirely ignore the facts of such alleged cases, or at least doubt the accuracy of the observations.

The specific identification of a single specimen in the flesh, and upon which a main argument in the present paper would be satisfactorily established, is not, as some might suppose, an easy matter. When such a competent authority as Dr. Albert Günther, in his Preface to the Catalogue of the Fishes in the British Museum (vol. vi. 1866), states of the *Salmonidæ* that "sometimes forms are met with so peculiarly and so constantly characterized, that no ichthyologist who has seen them will deny them specific rank; but in numerous other cases one is tempted to ask whether we have not to deal with a family which, being one of the most recent creation\*, is composed of forms not yet specifically differentiated," there is surely some ground for giving a decisive judgment with caution.

Such divergence of individual opinion and the consequent difficulty of defining specifically the varied forms of the family increase the value of faithfully recorded instances bearing upon the mooted questions.

The case presently to be related is one, it may be, involving contradiction.

*History.*—I am indebted to the Keeper of our Fish-house, Tennent, for the subjoined information (taken from his Note-book) regarding the receipt and subsequent hatching of Fish-ova. Our Superintendent, Mr. Bartlett, has substantiated his statement.

1. "Ova of Rhine Salmon, presented to the Gardens by Frank Buckland, Esq., on the 8th of January, 1863. These ova began to be hatched on the 20th of the month following (February)."

2. "Ova of Great-Lake Trout, received February 18th, 1863; began to hatch on the 1st of March."

3. "Another batch of Great-Lake Trout came on the 28th of February, and began to hatch on the 12th of March, 1863."

4. "Mr. Gurney presented some ova of the Common Trout upon February 20th, and these began to hatch on the 6th of April, 1863."

5. "In the same year there also was received (21st of February) some ova of Galway Salmon, which commenced hatching on the 1st of March."

6. "Furthermore, upon the 28th of February, 1863, some ova

\* "No fossil true *Salmo* is known at present; the nearest fossil approaching to it is a *Mallotus*" (footnote, *ibid.*).

of Charr and of Salmon-trout arrived. The Salmon-trout began to be hatched on the 11th of March following, and the Charr commenced hatching on the 14th of March."

I am particular in noting these details, so that all possibility of error or mistake may be fully made known.

On Mr. Bartlett's and Tennent's authority I may state that each of these batches of ova, on their arrival and during the subsequent processes of hatching and of rearing, were scrupulously kept separate from each other. The different dates of arrival and of evolution from the egg further prevented confusion.

Concerning the Rhine Salmon and the Great-Lake Trout, Mr. Frank Buckland himself received these from the Fish-rearing Establishment at Huningue, near Basle. If it cannot be authenticated, it is presumed the ova were such as represented. The precise Swiss lake which the Trout were inhabitants of I have not learned.

In 1864, ova of Salmon, Great-Lake Trout, Common Trout, and hybrids between Salmon and Trout were duly added to the Society's collection. Some of these, chiefly the hybrids, never reached maturity, but were addled. What did come forth were sufficiently different in size.

During the four succeeding seasons ova have been hatched in the Gardens, but in limited quantities.

Great care, however, has always been taken that the ova both of the different species, seasons, &c. should be kept separate. In fact, as the whole has been considered in the light of scientific experiments, and with the watchful eye of Mr. Bartlett over them, besides numerous observers well versed in ichthyology constantly visiting the fish-house and overlooking the experiments, there is little room left for doubt as regards the data occurring during the earlier periods of their development in our establishment.

Some of the aforesaid ova of the Rhine Salmon, successfully hatched in the Gardens in February 1863, have lived in *fresh water alone* up to the present date. Regarding these (two in number) I shall say more presently.

From a dozen to twenty in number, according to Mr. Tennent, lived between two and three years in the above condition (viz. in a small tank with a running stream of fresh water), and in apparent health.

After they were a year old, at the usual period of migration of true Salmon, these, then well-marked Parr, showed no uneasy disposition or tendency to escape from their tank.

In the second year some of them had slightly altered in colour, the Parr markings becoming somewhat indistinct; and a tendency to a silvery-scaled appearance ensued. But this change did not occur to all. About a third of the total number, my informant assures me, did not appear to have changed in the slightest.

About the beginning of May of that year (1865), at the season of Salmon-migration, those which had assumed a silvery dress grew restless, and endeavoured to escape by leaping over the tank they were confined in; indeed a few did spring entirely out, and died in



consequence. A net was then put over the tank to prevent a further loss of life.

The same phenomena as regards alteration in colour, and restless disposition at the annual migratory period, occurred the year following (1866).

It was further observed that those which had assumed the silvery dress in the beginning of the year again lost it in the autumn, and became distinctly Parr-marked.

During the latter part of 1866 a good many specimens died—some of those that had assumed the smolt dress, and also others that had not changed.

In 1867 the few that remained exhibited change of dress, restlessness, and leaping-propensity in the spring, as they had done in previous years.

As to their growth, this can only be spoken of approximately; for no exact measurements were taken of those that died previously to the specimen which I exhibit to the Meeting.

During the first and second years the young fish seemed to grow, and did attain a size corresponding to the young of Salmon—that is, from 3 to 6 inches long. It may be observed, however, that at the last period spoken of they particularly varied in size; in other words, some seemed to grow more rapidly or be longer than others, from the same batch of ova.

During the third and fourth years they appeared all to have grown somewhat larger; but the accession of growth was very limited compared with what had taken place the two previous years. They still varied in size, attaining, it might be, 5, 6, and 7 inches respectively.

Only two, as previously mentioned, have lived to their fifth year; these I shall presently describe, but premise this much of them—that, according to Tennent and Mr. Bartlett, they have grown little, if at all, during this last year. The words of these gentlemen are, “they have not perceptibly grown during that period.”

My inquiries as to feeding have been thus answered:—When quite young they received the yolk of egg boiled hard and broken up into small fragments; as they grew older, but in their first year, *Daphne aculeata* and suchlike water-insects, with the common blood-worm were consumed by them in quantities; raw flesh chopped up was also occasionally given them.

In the succeeding years, worms, chopped meat, fish-spawn, and the fry of minute fish have been added. They have always had abundance of fresh food, which at times has been given to them as often as from twelve to twenty times daily.

*Description.*—Having thus dwelt at considerable length on the history of our Salmon-culture in the Society's Gardens, I shall proceed to describe in detail two of the said young Rhine Salmon.

That which I may for convenience' sake call No. 1 (Plate XXIII. fig. 1) I now exhibit, preserved in spirits; the other, No. 2 (Plate XXIII. fig. 2), is at present alive and well in the tank in the Society's Fish-house. Both these were among the brood reared in



February 1863. No. 1 is a male (by examination); of No. 2 the sex cannot be stated.

The coloured figures best display the tints and markings; but for the sake of precision I shall describe each separately. No. 1, it may be observed, has been drawn from the dead specimen, and hence it appears paler than during life; this, however, rather increases its Salmon-like characters. No. 2 has been drawn from life (25th March, 1868). It is very possible it may shortly alter considerably; if it does so, I propose to have it figured in its change of garb\*.

No. 1 (Plate XXIII. fig. 1) may be thus described:—The dorsum, from the head to the tail, is of an olive-brown, deepest in the neighbourhood of the dorsal fin. On the sides this shades into a yellow, which becomes still lighter below the median line, and almost white and silvery towards the abdomen. This is particularly the case between the pectoral and ventral fins. The upper part of the head and the snout are of a sombre hue, approaching to that of the back. Scattered along both above and below the median line are a series of bright red spots; these are absent behind the adipose fin. There are ten transverse bars of a purplish grey, deepest in colour below the median line. The two hinder bars are more or less united; and the same may be said of the anterior one, also indistinctly double and occupying the operculum and suboperculum. The iris is of a golden-yellow colour, the pupil large and black. At the root the dorsal fin is darkest; but the reverse is the case with the pectoral fins. The ventral fins are the lightest-coloured, the anal and caudal intermediate in shade. All these fins are of a neutral yellowish brown. The adipose fin is dark brown.

No. 2 has nearly similar general under-tints to No. 1, but is chiefly distinguished from it by darker markings and spots throughout the body. There are thirteen more or less distinct transverse bars, the opercular one being large and well marked. Between the root of the dorsal fin and the lateral median line a large, broad, and dark-coloured patch exists; this intermingles to a certain extent with the fifth, sixth, and seventh transverse bars. Both along the deep-brown dorsum and below the median lateral line, upon and between the transverse bars, very many small dark spots are freely dispersed. The lesser-sized red spots in this specimen are irregularly placed both upon and above the lateral line. The dorsal fin has a number of deep-coloured interradiial spots, chiefly confined to its root.

The form of the body in both specimens (the dead and the living one) is that of a Salmonoid, but not the clean plump outline of a full-grown Salmon.

\* On June 30th this fish (No. 2) was carefully compared with the drawing made on March 25th; and the coloration then sensibly appeared to have become lighter and yellower. The alteration in shade, however (as Tennent, the keeper, justly pointed out), depended more on the strong sunlight than on any permanent change; for in the mornings and evenings, or when skulking in the shadow of the rockwork, the tone of colour was darker. No silvery-scaled appearance has been assumed this year.



In No. 1, which I shall further describe in detail, the greatest depth of the body is perpendicular to the front of the dorsal fin; it is somewhat less than a fourth of the length of the body (not including the head and tail). The snout is rather blunt and of about equal diameter with the eye. This last occupies one-fourth of the distance between the tip of the snout and the posterior edge of the operculum. A vertical line dropped from the middle of the eye would meet the hinder margin of the maxillary bone; the eye is 0.4 inch in diameter. The angular bend of the hinder margin of the operculum and suboperculum is gently rounded; the præoperculum is still less angular in fact. The interorbital space is slightly convex transversely and antero-posteriorly; it is as broad as the diameter of the eye. The occiput is rather prominent, and between it and the interorbital region laterally there is a slight depression.

There is complete dentition. The vomerine teeth incline to the right and left sides, and are also slightly alternate in position, although apparently only one series. The palatine teeth are more linear in their arrangement, and do not on either side extend so far back as the vomerine.

The dorsal fin has fourteen rays, the anterior two being shorter than the third. The posterior margin of the dorsal fin is nearer the adipose fin than its anterior edge is to the occiput. The adipose fin is dark-coloured, and not red as in the Trout. It is 0.8 of an inch apart from the first caudal ray. The caudal fin is posteriorly incised; the lower fork appears a little larger than the upper. Tail-rays thirty-six in number, the upper and lower or anterior ones being very short. The anal fin possesses twelve rays; its length is greater than its basal attachment; the third, fourth, and fifth rays are the longest. During life the lower corner of this fin is more rounded than our illustration depicts. Each ventral fin is about the same length as the anal (to its furthestmost point); but the ventral is considerably shorter than the pectoral. Its attached root is rather in advance of a vertical line from the posterior end of the base of the dorsal fin; its rays number nine. The pectorals are attached to the thoracic walls immediately beneath the opercular angle; they have thirteen rays apiece.

With respect to the number of scales, taken in linear series longitudinally and transversely to the axis of the body, to which some ichthyologists attach considerable value as a specific test among the Salmonoids, I regret that circumstances prevented me from counting them with such rigid accuracy as could have been desired. Eager to get as correct a sketch of the natural colours as possible, I left over their numeration until the artist had finished, and found that in consequence the body had got somewhat rubbed. It is merely an approximation to the truth, then, when I state there are 120 or 122 scales along, but above, the median lateral line. An oblique series from the lateral line up to the dorsal fin numbered nineteen.

No measurements of No. 2 have yet been taken; the subjoined are those of the male, No. 1. The better to compare this fish with well-authenticated specimens of young Salmon and of hybrids of



nearly equal size, I have placed alongside the dimensions of two specimens in the British-Museum collection.

Unfortunately for perfect exactness of corresponding measurements, mine have been taken in tenths of an inch, while Dr. Günther's are sixteenths, eighths, and quarters of an inch. Notwithstanding this difference in fractions, the eye is able to follow the lines of resemblance, or otherwise.

	No. 1.	Specimens in British Museum.	
		a.	b.
Total length .....	6.5	$6\frac{7}{8}$	$7\frac{1}{2}$
Length of the head .....	1.4	$1\frac{7}{16}$	$1\frac{9}{16}$
Distance between end of snout and eye.....	0.3	$\frac{3}{8}$	$\frac{1}{4}$
Diameter of the eye .....	0.3	..	$\frac{1}{4}$
Length of maxillary bone .....	0.6	$\frac{9}{16}$	$\frac{5}{8}$
Length of base of dorsal .....	0.9	..	..
Greatest height of dorsal .....	1.2	..	..
Length of pectoral .....	1.2	..	..
Distance between root of pectoral and root of ventral .....	1.6	..	..
Length of ventral fin .....	3.1	..	..
Distance between root of ventral and origin of anal fin .....	1.2	..	..
Length of anal fin .....	0.8	..	..

As regards the internal anatomy of the specimen No. 1, of which the bodily measurements are given above, the following points were noted:—The cæcal tubes were from 48 to 50 in number; I state both of these numbers because, although counted several times, there was difficulty, 49 being counted once, 48 a second time, and 50 a third. They were small and not well developed; greatest length of a single one 0.3 inch. The intestine beyond the cæci measured barely 3 inches long. Testes moderately developed,  $2\frac{1}{2}$  inches long, milt flowed freely on being handled. Air-bladder large, long, single, and tapering behind. The vertebræ are 59 in number.

After having described our specimen, it still remains to say whether it is a Salmon or not. If not a true *Salmo salar*, then one would expect it be some other well-known form of the genus *Salmo*.

Now upon this point there is some diversity of opinion. Mr. Buckland and Mr. Bartlett aver it is, and that the whole of the brood which I have referred to as having been hatched in February 1863 are true Salmon. This view I have been myself inclined to adopt; but the opinion of Dr. Günther, than whom I know not a more scientific ichthyologist, has in some respects made me waver respecting a decision. On the other hand, it has strengthened my belief that the arrest of the growth of Salmon when retained in fresh water is a physiological fact, perfectly compatible with what we already know connected with the life-development of the Salmon.

Those who have regarded our specimens as Salmon have done so, first, because of their history; secondly, from their external markings and other outward anatomical resemblances to Salmon;



thirdly, believing in the published statements and experiments of several trustworthy authorities; fourthly, because the fact of an arrest of growth under certain conditions is one consistent with the history of the development of the species.

On the other hand, Dr. Günther expressly affirms:—First, that they are not true Salmon. Secondly, that he cannot venture to give an opinion of what species they may be. Thirdly, he suggests they are hybrids, but is ignorant of the parentage.

Now, as the whole matter is one involving laws of the highest consequence, I have endeavoured to follow out the objections as well as circumstances favourable to the assumed facts.

I trust I have now drawn attention to a question which, negatived by some, upheld by others, still requires careful observations—observations and study different from what heretofore have been given to it, inasmuch as the deductions consequent on the fact of an arrest seem to me to be of high value in elucidating, or, as Dr. Günther says, “finding a way through this vast labyrinth of variation of character in the *Salmonidæ*”<sup>\*</sup>.

The longer I consider the question the wider the generalization of law seems to grow. Imagine some sudden convulsion, and a river is converted into an inland lake. Would the Salmon revert to the Trout?

We can, indeed, conceive such remarkable changes. Is, after all, species dependent on the variation and changes of old mother earth? or is “natural selection” that which circumscribes the limits specifically?

These and many such problems seem wrapped up, or are in some way connected with, such strange physiological anomalies as are found in this Salmon question. To my mind they have a significance in zoological science far beyond that of mere demonstration of points indicating specific difference.

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April 23, 1868.

W. H. Flower, Esq., F.R.S., in the Chair.

Dr. J. Murie read the first part of a memoir on the anatomy of the Sea-Bear (*Otaria*), founded on the animal recently living in the Society's Menagerie.

This paper will be published in the Society's ‘Transactions.’

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Mr. St. George Mivart read the following notes on *Salamandrina perspicillata*, communicated to him by Prof. Lessona of Turin:—

“La *Salamandrina perspicillata* est commune aux environs de

<sup>\*</sup> *Loc. cit.* Preface.