FURTHER NOTES ON THE SALMON EXPERIMENT.

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The Fellows of the Society may remember that since the capture of the female grilse at Bridgewater in December, 1873, and which fish I shall in this paper refer to as "the first grilse," a male specimen of nearly the same size and weight, and which I shall refer to as "the second grilse," was caught in the lower Derwent. The second grilse was, in January last, forwarded to Dr. Günther, of the British Museum, for examination, and in reference to it I received by last mail from Dr. Günther the following remarks :—

"The most important specimen is that described in your letter as a migratory salmon, weighing three pounds, taken in the salt water of the Derwent estuary.

"This fish has a short, broad tail, with a perfectly truncated caudal fin, fourteen scales in a transverse line between the adipose fin and lateral line; numerous x shaped spots on the body; 54 pyloric appendages, characters which leave no doubt whatever in my mind that it is a *salmo trutta*, as which it has been recognised by other men well versed in the distinctions of salmonoids.

"It had in its stomach eight anchovies, a diet which will account for the rapid growth of salmonoids in your waters, but which will not improve the flavour of their flesh.

"I have placed this specimen into our public galleries, as evidence of the remarkable success which has attended the efforts of the colony to introduce salmonoids."

Before referring to the above remarks in detail, I desire to express my sense of the obligation we are under to Dr. Günther for the prompt courtesy with which he has at all times examined and reported upon the salmonoids sent from the colony, and my conviction is that any light thrown upon the obscure life history of migratory salmon by the experiment in this colony will always be hailed by him as a scientific gain, even though such light may change somewhat his own preconceived opinions.

In determining the species of any individual belonging to the genus *salmo* in this colony, as we have not the advantage of undoubted fresh specimens for comparison, we have to rely on the written descriptions of recognised authorities on the subject, aided by what we may gather of the life history of the particular individual, so that when dealing with the first grilse, its determination rested on a careful detailed comparison with the descriptions contained in Dr. Günther's admirable "Catalogue of Fishes in the British Museum," published in 1866, coupled with the knowledge that out of nearly 10,000 fish turned into the Derwent, barely 300 were

salmon trout, and the remainder salmon; and that the 300 salmon trout had been liberated in 1867, while 3,000 of the salmon had been liberated in 1865, and the remainder with the salmon trout in 1867. I now propose to deal *seriatim* with Dr. Günther's reasons for concluding that the second grilse is a salmon trout, and first the "short broad tail, with a perfectly truncated caudal fin." Though Dr. Günther, in the catalogue, gives, as one test, "the form of the caudal fin in specimens of a given size, age, and sexual condition," there is no statement which implies that this is an infallible test in immature fish, and as an actual matter of fact, the caudal fin of the first grilse is decidedly emarginate or forked, which was one argument used by me for deciding that it was a true salmon, because salmon trout of even less size almost invariably have this fin truncated, or even rounded. (See Proceedings Royal Society, Tasmania, 1874, p 15). Again, it is remarkable that every salmonoid (except the second grilse) caught in the Derwent estuary last year, and of which four had reached the size at which the caudal fins of salmon trout usually become truncated had the caudal fin more or less distinctly forked. Two of those fish are now before you, and speak for themselves, especially when compared with the male smolt sent to the salmon commissioners from England, and in which the caudal fin is but slightly more forked than in its larger companions. In spite of this discrepancy I wish it to be distinctly understood that I regard the second grilse as identical in species with all these salmonoids, and am disposed to place little reliance on this test where the fish are approaching the adult stage.

An enormous diversity will be found in the form of the caudal fin in specimens of *salmo fario* or common trout, many of which have it truncate when the fish are but 5 or 6 inches in length, while others show emargination when 17 or 18 inches long.

There appears to be, as hinted by Dr. Günther, some subtle connection between the state of sexual development and the form of the caudal fin, and as we know that a percentage of the male salmon parr at only 6 inches in length do arrive at actual sexual maturity, and are capable of impregnating the ova of the full grown female salmon, is it not quite possible that these rapidly developed male fish may exhibit the truncate fin at an earlier stage than their sexually immature brethren?

The second reason assigned is "14 scales in a transverse line between the adipose fin and lateral line." Here again a marvellous discrepancy exists amongst the salmonoids taken in the estuary of the Derwent, for out of some 30 specimens

examined the numbers have ranged from 11 to 14, but in no instance in fish taken below Bridgewater has the number exceeded 14.

In the detailed descriptions of various specimens of *salmo salar* in the British Museum the number of these scales is unfortunately omitted, but in four instances the number in the transverse series descending obliquely backwards from the origin of the dorsal fin to the lateral line is given as well as the number of the longitudinal series of scales between the lateral line and the base of the ventral. In one adult the numbers are $\frac{2}{2}\frac{5}{0}$; in another adult $\frac{2}{2}\frac{6}{2}$; in the third in the grilse stage $\frac{2}{1}\frac{5}{0}$; and in the fourth a parr $\frac{2}{2}\frac{2}{0}$.

Next let us turn to Dr. Günther's descriptions of the salmon trout in the Museum, and we find that the number of scales between the adipose fin and the lateral line varies even in the adult fish from 13 to 15, the latter number never having yet been found in any of our salmonoids taken in salt water.

The male smolt from England already mentioned contains only one scale less in this series (viz., 13) than the second grilse, while the salmon parr preserved in our Museum, which was hatched from an English ovum, has 14 on one side and 13 on the other.

Now, finding this discrepancy coupled with the great variation in the numbers exhibited by our own salmonoids, are we not justified in concluding that, however constant within certain limits, this test may be in mature fish, that as applied to immature specimens, it is all but valueless ?

Dr. Günther's next reason—" numerous x shaped spots on the body "—requires very few words. When fresh from the water the second grilse was perfectly free from spots below the lateral line, and had but few above that line ; shortly after the immersion in spirit, however, several more spots became apparent, and the same thing took place with the first grilse. On turning to Dr. Günther's descriptions, I find details of only one specimen of true salmon, which approximates in size to the second grilse. This is a male, 22 inches long, in reference to which Dr. Günther writes :—" Upper parts greenish, which colour gradually passes into the silvery hue of the belly. There are some scattered x shaped black spots on the side of the back above the lateral line."

It is curious that the above description occurs only in the solitary instance in which the size and sex agrees with the second grilse, because no test is so variable as the fleeting one of colour, which in the *salmonidæ* (as in most fish) is perpetually liable to change rapidly from causes as yet unexplained.

As to the last reason, "54 pyloric appendages," as I had not dissected the fish I was, of course, unaware of the number, which I now find, is three or four less than in the first grilse- and 13 or 14 less than in some others of the Derwent salmonoids. Nevertheless I should have regarded the number 54 (having no other light than Dr. Günther's own descriptions), as a proof of the fish being a true salmon, because the Dr. gives as his own formula for salmo salar, "Cœc. pylor., 53 to 77," and also mentions a mature male from the River Tamar in which the Pyloric appendages were only 51. Again Dr. Günther's formula for salmon trout is "49 to 61, rarely less," but in the descriptions of salmon trout in the British Museum, out of 20 specimens seven contain the minimum number 49 or less; six more contain less than the number found in the second grilse; while the average number in the remaining seven only slightly exceeds 54. On the strength of this test, therefore, we should be justified in regarding the second grilse as a true salmon.

Dr. Günther speaks of the rapid growth of salmonoids in our waters, and attributes it to the presence of the anchovies, but it is at least doubtful whether the fish would thrive better here on anchovies than in Britain on whitebait, sprats, herrings, or others of the schoolfish abounding on the coast. If the first and second grilse could be regarded as true salmon, nothing extraordinary could be found in their size, as it is about the average of grilse taken in spring on their first journey from sea. But the case is very different if they are salmon trout,—because the majority of salmon trout on the first return from sea do not weigh more on an average than from one pound to one pound and a half. That the first and second grilse were on their first journey from sea is all but certain from the presence of several of the deciduous teeth still left on the vomer, and the fact that they should both so much exceed the average weight of a large majority of the salmon trout of a similar age from the best British rivers, is difficult to explain if they are salmon trout.

Had Dr. Günther been able to examine the first smolt sent from this colony in 1869 by the light which the further conduct of the experiment has since thrown on the subject, we should never have been told that that smolt was a stunted salmon trout, because the statement that it was stunted was due to an erroneous conviction that no migratory salmon could return from the sea to a Tasmanian river, and that as we had only received one lot of ova of salmon trout in 1865, the smolt must have been three years and-a-half old. The determination of the species of the second grilse proves that the first smolt was no stunted individual; but that it was what

it appeared, a healthy well-fed fish which had travelled more than 30 miles seaward in obedience to the migratory instinct, and it also proves to my mind that inasmuch as it could not be one of the fish originally hatched from an English salmon trout egg, and there had not been sufficient time for the salmon trout to have bred and produced a smolt of that age; that, therefore, that first smolt could only have been a true salmon—the whole difficulty in the determination of its species having arisen from the fact that, however valuable the tests applied may have been for the elucidation of the species of adult specimens, those tests are valueless when applied to immature fish. So with the determination of the second grilse. If we are to regard it as adult,—that is to say, if it has arrived at such a stage that there would be no further change in the anatomical details of the fish on its next journey seawards, beyond mere increase of size,—then the tests applied by Dr. Günther would doubtless be sufficient to warrant the conclusion that it is a salmon trout (*Salmo trutta*); but if, on the other hand, any further change might take place in those details, its species cannot with absolute certainty be determined till the sum of that change has been recorded; and, therefore, nothing but the capture of a full-grown specimen will ever satisfactorily set the whole question at rest.