

ART. XXIV.—*On the Brown Trout introduced into Otago.* By W. ARTHUR, C.E.

[Read before the Otago Institute, 9th July, 1878.]

## Plate XIII.

THE principal object of this paper is to put on record those facts which have been ascertained, connected with the acclimatization of trout in Otago. The present time is in many respects peculiarly suitable for observing how exotic plants and animals adapt themselves to the conditions of life in New Zealand, into which they have been recently introduced. It is equally true, and has been advocated before now, that observations constant and careful should be undertaken by all the friends of science, on the effects of colonization upon the native flora and fauna; because the existing circumstances under which these are placed are in a state of progression and change, while the old conditions will soon be things of the past. So also with our trout, for in twenty years hence the banks of many streams, which at present in a state of nature supply certain food, will be cultivated and probably yield a totally different description of food, while the trout themselves will be much more numerous and, I am afraid, of a smaller average weight. The opportunity can only occur once, of observing the immediate results of stocking any stream with trout. Therefore it seems to me a reasonable precaution to publish periodically an account of the progress of our knowledge, and as a contribution towards this object I have selected the special subject of this paper, being one in which I have always taken much interest.

1. *Distribution and Growth of Trout in Otago.*

The first successful hatching of trout (*Salmo fario*) in Otago was in October, 1868. This was achieved by Mr. Clifford, then Curator to our Acclimatization Society, who went to Tasmania, and got from the natural spawning-beds at the breeding-ponds of the Plenty, 800 ova, whereof 720 were hatched out as above at our Opoho breeding-ponds. Part of this lot was sent to Lake Wakatipu, but all the young fish died on the road. The remainder seem to have been sent to Mr. Young, at Palmerston, and were turned out in the mill-race on that gentleman's property. A year afterwards one of these fish was caught, and found to be seven inches in length. In October, 1869, the second shipment of 1,000 trout ova was brought from Tasmania by Mr. Clifford, and placed in the breeding-boxes at Opoho, the water having a temperature of 44° Fah. The fish from these two lots of trout ova form the original stock, which were liberated in our streams in November, 1869, and from these and their descendants the ova for stocking the rivers in Otago have been obtained. I append a table published by our Acclimatization Society, showing the rivers into which young trout

have been put, their number, and the years in which this was done. Altogether, 64,810 young trout have been liberated in 134 rivers and streams in Otago up to December, 1877.

As showing how soon and easily confusion may arise for want of a few precautions, I may here mention that beyond the general fact that our breed of trout is believed to be from a Thames tributary, we really do not know much about them. It is true that the trout in Tasmania, whence ours were brought here as their ova, were got from England, but what particular stream to trace them to seems from all I can learn to be now impossible. From notes kindly given me by Mr. Howard, of the Wallacetown salmon-ponds, it appears that three lots were sent to Tasmania, which turned out more or less successful. Of these, Mr. Francis Francis sent one from the Weycombe, Bucks, and another from the Wey at Alton, Hants, and Mr. Buckland sent one lot from Alresford, on the Itchen, Hants. If I am not able to say, therefore, to which place the descent of our trout is to be traced, or if each of the places named has not a joint honour in their parentage, I think you will agree that we have got a very handsome and valuable variety of *Salmo fario*.

*Growth of the Trout.*—I will now proceed to lay before you such facts as I have been able to collect, tending to show the probable rate of growth of trout in our rivers, under the conditions of the state of nature which existed when these fish were first turned out and which still hold good for most of our streams, and particularly that no trout are ever known to have previously inhabited these waters. The rivers that I shall refer to are the Shag, Water of Leith, Lee Stream, Deep Stream and Upper Taieri, not because we have not information of the success of trout in other streams, but because such information is as yet rather general and indefinite.

*Shag River.*—In the year 1868, young trout, 75 in number, appear to have been put in Mr. Young's mill-race at Palmerston, as already mentioned, and in 1869 there were 53 liberated in Shag River. The mill-race has communication with the river. After this, the first specimens I am aware of, caught in this river, are those taken in 1874, and which are now preserved in the Otago Museum. The male fish (one of these) was taken in June of that year, and weighed 14½lbs. The female (the other) was taken in July, and weighed 16½lbs. Now, comparing the above dates, we find that the greatest possible age of these fish could not exceed six years. This indicates an average growth for the male fish of 2½lbs. a year, and of 2¾lbs. a year for the female. But I am inclined to believe that for the first year or eighteen months trout do not attain that average in our streams, or at all events in the Shag River. A certain amount of corroboration arises from the fact I have alluded to above, of Mr. Clifford catching one of the 1868

trout in 1869, and finding it measure seven inches, which would represent a weight under half a pound. If we say then that the above two trout attained a weight in the first year of even one pound, then their subsequent average growth must have been  $2\frac{3}{8}$  lbs. and  $\frac{3}{10}$  lbs. respectively, yearly.

*Water of Leith.*—In 1869 the first trout were put in this stream, 75 in number, and additions have from year to year been made to this and other rivers to keep up the stock. In the end of 1874 and beginning of 1875 the Leith was opened for angling, when the largest trout caught weighed 3 lbs. In August, 1875, among a number of spawning fish taken, I saw one which must have weighed 7 lbs. Mr. Deans, the curator of our Acclimatization Society, informs me of a male trout taken in the Leith, in 1877, which weighed  $12\frac{1}{2}$  lbs.; and in February of this year a gentleman caught a female, while fishing with artificial minnow, which weighed 10 lbs. This latter fish I saw; it was a very well-shaped specimen and in excellent condition. It is certainly astonishing that trouts can attain such weights in so small a stream running through a city like Dunedin! The average yearly growth of the largest of these trout—viz., the male fish—is a little over  $1\frac{1}{2}$  lbs.—on the same supposition as I used regarding the Shag River fish—viz., that it was one of the fish put in in 1869. Any other theory will, of course, give a more rapid growth, but I do not consider it safe to err in that direction.

*Lee Stream.*—Trout were, to the number of 98, put into this (which has become the favourite angling stream of Otago) in the year 1869. No other lot of trout has ever been added, yet these 98 young fish have stocked the stream throughout its whole course of some twenty miles from near the Lammerlaw mountains to the Taieri River into which it flows. It was open for angling in 1875. In October of that year a well-known angler killed some very fine fish with fly. The heaviest of these weighed 5 lbs.—this is equal to a yearly growth of  $\frac{5}{6}$  of a lb., or say 1 lb.

*Deep Stream.*—In 1869 there were 100 young trout turned out in this stream. This is the only lot ever put into the Deep Stream, where fish are now plentiful. It was opened for angling in 1875, but no fish over 2 to 4 lbs. was taken till 1876, when one of 8 lbs. was caught with grasshopper. This gives  $1\frac{1}{3}$  lbs. as the known yearly growth, on an average, of the trout in the Deep Stream.

*Upper Taieri.*—In 1870 a few dozen young trout were put into this river at the Styx, and in 1875 there were 425 more turned in. At the beginning of this year it was fished for the first time, when several large trout were taken, weighing from 3 to 6 lbs., the largest which was caught with the fly being 6 lbs. 6 ozs. in weight. This gives the greatest possible yearly growth at 13 ozs., or say 1 lb.

Of other streams we have not so much information; but I may mention that large trout have been seen in the Kakanui, Waitati, Lovell's Creek,

Fulton's Creek, Waipahu River, Mimihau, and some of about 10lbs. in weight in the Wakatipu Lake at Queenstown. In the Kuriwao a trout 6½lbs. was killed in the beginning of this year. Trout were first put in this stream in 1874, but into the Waiwera, into which the Kuriwao runs, in 1873. So that the average yearly growth may be taken at about 1½lbs. As regards the Waikouaiti River, I have had, from two different sources, tolerably reliable evidence that the trout put into it have lived and thrived, but this requires confirmation.

In the above I have, as explained, regarded the average weight on the theory (which is a safe one), that the fish actually caught and weighed, may have been individuals of the first stock put into each stream. Of course there still remains another, but more laborious, method for the future, of determining the rate of growth, viz., marking young fish when caught, and returning them to the river for future observations. Two summers ago I began this plan in the Lee Stream, by removing the posterior half of the adipose fin; but as yet I have not been fortunate enough to recapture any of those so marked. These fish would run from four to seven inches in length, and in number about one dozen. In the Southland rivers young trout were turned out from 1870 to 1877, as shown by a list appended, which Mr. Howard has sent me. As yet, however, I have not been able to get any positive information as to how they have succeeded.

Comparing now the growth of our trout with river trout of England and Scotland, I find that Stoddart, in his *Lochs and Rivers of Scotland*, gives the following as his opinion. The fry are hatched out in April, and by the month of October stop growing for that season, having attained a length of six or seven inches, and weighing a quarter of a pound. There is no perceptible growth till the following spring, when food again becomes plentiful. They then resume growing, and before winter have increased in length by two inches, and in weight up to half a pound, by which time a certain number are in spawning condition. It is four years before these fish reach one pound weight, when many cease growing, but some from favouring conditions of locality and feed reach a greater weight. These latter live almost entirely upon ground and surface food—not minnows. In well sheltered waters and when the feed is particularly good, as in the Leet and Eden, in the course of five or six years trout have reached two pounds weight and upwards.\* Again, Yarrel, in his *British Fishes*, says:—"An acutely observing friend of mine \* \* \* has for years kept trout in a kind of store stream, and having fed them with every kind of food, has had some of them increase

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\* Stoddart says that in South of England an experiment with trout in three tanks fed respectively with worms, minnows, and large water-flies, was tried, when those fed on flies attained twice the weight of the others.

from 1lb. to 10lbs. in four years. I found, says he, that one of the trout I had fed and weighed regularly for the last six years was not improving in size and colour. I therefore killed it. The fish is a female and weighed exactly seven pounds. The accompanying schedule will show its gradual increase:—

Date of weighing	1835	1836	1837	1838	1839	1840
	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
April 1st.	0 12	1 12	3 4	5 4	7 0	7 4
October 1st.	1 4	2 0	5 0	5 12	7 8	7 0

Littlecot, October, 1840." This latter experiment shows, under careful artificial feeding, that trout are capable in England of a growth, according to this gentleman, of  $1\frac{2}{3}$  lbs. yearly to  $2\frac{1}{3}$  lbs. when they have reached their full growth. But trout, in a state of nature, as described by Stoddart, may more properly be compared with the results I have given of our Otago trout. Stoddart's remarks therefore amount to this, that under the most favourable circumstances at home, river trout will attain up to maturity, a yearly average increase in weight of  $\frac{1}{3}$  lb., while our experience here shows they have reached an average yearly increase of from 1lb to  $2\frac{1}{3}$  lbs! In no river of Otago have these fish grown so rapidly, are so fat, or have become so heavy as in the Shag, some individuals having been seen in Mr. Rich's property supposed to be 20lbs in weight. They abound from the estuary to the "second gorge," a distance I should think of 15 miles by the river. The banks of the Shag are partly cultivated and partly covered with native grass and flax. Surface food cannot therefore be plentiful, but at all seasons there are in the pools and shallows numbers of *Galaxias* or native minnows, bullheads, and during summer immense shoals of smelts and silverfish.\* On one occasion I killed a trout below Palmerston,  $6\frac{1}{2}$  lbs. weight, in the stomach of which I found about three dozen smelts. It is rather against the trout, that during summer the Shag River runs low and clear, so low as to be easily crossed in the fords with watertight boots without the feet getting wet. The growth of trout in the Leith may also be attributed chiefly to the great numbers of smelt which frequent its lower waters. But it is different with the Lee, Deep Stream, and Upper Taieri rivers, where the great staple of food is made up of flies, gnats, grasshoppers, cadis-bait, fresh-water shell-fish, beetles and cray-fish—the small kinds of native fish are not very numerous in these streams. Before leaving this part of my subject, I may mention a curious circumstance regarding the Lee Stream which anglers have discovered. Painfully lean trout have been caught there, which took the fly or grasshopper greedily

\* This fish is called Silverfish by Mr. Powell, but Smelt (*Retropinna richardsoni*) by Dr. Hector; it is a true salmonoid, which the fish I have called a smelt is not, but is also known as whitebait.

and were apparently in good enough health. In December, 1875, I killed one of these which, though about 24 inches in length, only weighed 4 lbs. It ought if in good condition to have been about 7 lbs. Several other similar or worse-conditioned trout have since then been taken. But the worst specimen I have seen was caught at the beginning of this year, in a feeder of the Lee, the Broad Creek, which surpassed all others in its poverty. It was about twenty inches long and weighed only 1 lb. or thereby. There was really no substance on its body, it was literally a skeleton. It is difficult to account for such a phenomenon, particularly when equally large trout have been killed in the Lee, which were in excellent condition.

## 2. Habits of the Trout.

In dealing with this part of my subject, I propose to offer a few remarks under the heads of Spawning Season, Differences of External Appearance, and the Habits of our Trout as observed during the open season.

*Spawning Season.*—From actual observations, trout are known to have spawned in the several streams named as follows:—

Shag River	..	..	..	from June 20th	to July 31st
Water of Leith	..	..	..	„ June 30th	„ Aug. 4th
Lee Stream	..	..	..	„ June 15th	„ July 25th
Lovell's Creek	..	..	..	„ June 6th	„ July 31st
Fulton's Creek	..	..	..	..	during July, &c.

In Silverstream, a man of Mr. McGregor's saw trout engaged, as he thought, spawning from June 20th to July 20th.\* As regards Southland, propagation of trout has been carried on there solely with fish kept constantly confined to small ponds at Wallacetown by or under charge of Mr. Howard. This gentleman's experience of this method has proved it to be a mistake. Spawning is late and prolonged and the breeding fish do not thrive. He found that they lived well enough throughout the year, but were liable to attacks of fungus, which killed them in fourteen days. This fungus he cured repeatedly by washing or dipping the fish in salt water; but it invariably returned, and eventually the trout succumbed. With us, Mr. Deans has followed a more natural plan, that of catching the fish when ripe, stripping the females of their ova, and impregnating these with the milt of the male. The milt of young or mature males does equally well, and one male is sufficient to fructify the ova of several females. The trout in the Leith will average 800 ova to the lb. weight of the fish itself. A female  $\frac{1}{2}$  lb. weight has yielded about 400, and one of the largest caught, being a healthy fish of about 7 lbs., gave close on 6000 ova. In our breeding boxes at Opoho, we have found the time the ova take to hatch to be 78 days; but this is modified to some

\* This period is later than the corresponding time at home, which is in October and November, by about six weeks.

extent by the temperature of the water. During the winter months the temperature of the water averages about 42°F.; and during the period of hatching it ranges from 42° to 52°. The strongest and healthiest fish are those which are hatched out in water at 48°. After birth the young trout are ready for turning out in from 30 to 50 days, but will carry best whenever they begin to feed, which is at an age of 25 to 28 days. When the young fish are about 6 weeks old and well fed, they average, in our ponds, 1½ inches in length, and at 100 days measure 3 inches, being distinguished by dark bands like the fry of the salmon. In transporting the trout fry from the ponds to the rivers in which they are liberated, it has been most successfully done with fish about 1 inch to 1½ inches long. The can of water having a sufficient quantity of watercress put into it carefully to prevent the consequences of shaking in transit. In this manner Mr. Deans has conveyed many supplies to our streams without losing a single trout. It has been observed with us, that in spawning, when the female has selected her male companion, she proceeds to a suitable gravel bed, where she prepares the ridd with her tail, the action of the stream assisting. She frequently rolls on her side and lashes the water with her tail, the ova being passed and impregnated from time to time, until the whole operation is completed. When confined they have been seen to take 8 to 10 days, or more in spawning; but as yet I have not ascertained how long they naturally take in our rivers; probably, however, not more than a week.

*Differences in External Appearance.*—The differences in the external appearance of our trout are corroborative of all previous experience of these fish in home waters. Here, as there, these are due to various causes, such as age, sex, abundance or scarcity and also quality of food, range and colour of water, geological character of formation over which the river flows, and the season of the year. My own observations here, enable me to say that our trout are finest in appearances at the height of summer. By autumn they begin to get darker, some even I have caught were black-looking and lean, though all originally from the same stock. Already the various streams have stamped the trout with local peculiarities of some interest. Thus for example, in summer, trout which I have seen taken out of *Shag River* were remarkable for plumpness and good condition almost to deformity. They were all very bright silvery on the sides running into pure white on the belly, the back being grey or very light olive. Spots sometimes numerous and mostly of large size and black in colour, red spots are wanting or rare. The heads are small, even in the males, those of the females being beautifully shaped. The extreme fatness of form and bright silvery colour, I have no doubt are due to the river bottom being fine sand and gravel, the water clear, and the great bulk of the food being the small

fish already mentioned. This agrees with the opinion expressed by Sir Humphrey Davy, as mentioned in Dr. Hamilton's *British Fishes*, which is, that when trout "feed much on hard substances, such as larvæ and their cases, and the ova of other fish, they have more red spots and redder fins, and that when they feed most on small fish and on flies, they have more tendency to be spotted with small black spots and are generally more silvery."

In the *Water of Leith*, when first opened for fishing, the trout were of a fine appearance, colours being bright and the red spots large, but there is a falling off in this respect, at least as regards average-sized fish, and during spawning they all assume a darker or greyish hue. This water flows through bush, and its bed is one mass of trap rock, boulders, and small stones. No doubt a large amount of the feed is in flies, caterpillars, and slugs, and also, in the lower pools, smelts.

The trout in the *Lee Stream* also, when it was opened for fishing in 1875, were, as a rule, of a handsomer shape and colour than they now are. The females, of 2 lbs. and upwards, were silvery on their sides, very fat, and had small well-formed heads, a few red spots also along the sides. The males were dark olive brown on the back, golden yellow on the sides, and pure white on the belly. They had, and still have, numerous black spots, and large red or crimson spots on the sides and below the lateral line. The adipose fin in these and the trout in the other rivers is tinged with red, and is distinguished by two or three dark brown spots. The tail also has a few dark spots, generally confined to the upper margin. The males in this stream, when in good condition, are very handsome fish, the head though large is not unusually so. The bed of this river is mostly rocky, but in the upper water it is more gravelly than below the Accommodation House. Some of the pools towards the end of summer get very much overgrown with water plants. The feed consists of the native life from the tussock-covered banks, flies, beetles, spiders, and numerous grasshoppers, while the bed of the stream contains small shell-fish, larvæ, and crayfish. The native minnows and small fish are not plentiful. The Lee rises near the Lammerlaws, at a height of about 1,500 feet above the sea, and joins the Taieri River at about 40 feet.

The *Deep Stream* trout have a tendency to be more silvery in colour than those of the Lee. Still, the males are very much alike, with numerous large black spots, the usual number of large red ones, and a rich golden tinge over their sides. In February of this year I saw three very fine trout caught by Mr. Pillans in the Deep Stream, with minnow. In weight they were from 2½ lbs. to 2¾ lbs.; they were females. Two of them were olive brown on back, silvery on sides and belly, the spots large and dark, but not



numerous, and a few red ones as usual. The third fish differed in a marked degree from these, though all three were fat and in good condition. Its back was olive colour like the others, but its sides were of that rich golden hue, so pleasing in an angler's eyes, while the black spots were exceedingly numerous, only about an eighth of an inch apart. I have not in New Zealand seen another case of such a difference in external colour and markings in trout of the same sex taken under such exactly similar conditions. In waters I have fished in Scotland, however, I must admit I have seen more remarkable differences, and where least to be expected. The character of the bed of this stream is generally rocky, but it has many more gravel-beds than the Lee, particularly for two miles above and below Walsh's Accommodation House, where anglers usually put up. The banks of the stream, like those of the Lee, are all in a state of nature—all native tussocks and rushes, with a few veronicas in places—the feed also is the same. In its course from the Lammerlaws to the Taieri, it will cover a distance of 30 or 40 miles, and, being snow-fed in early summer, is rather later as an angling stream than the Lee.

As regards the *Upper Taieri*, the fish, so far as I have seen them, are similar to those of the two last streams described; but my acquaintance is as yet too limited with the trout there, to warrant me saying more about them as to appearance. The capabilities of this river for producing large well-conditioned trout, consist in the immense ranges of water, or reaches, free from any obstructions which characterise it, and a considerable supply of bottom feed, abundance of insect life, and rich loamy banks. The course of the stream is also marked by abundance of gravel, suited for spawning beds.

In no stream here have I as yet seen trout of mature size, marked with distinct bands of dark colour transversely to the length of their bodies. This is a common mark in British streams, but the colour is evanescent, and will disappear in a short time if a trout goes under a stone or bank. When fishing clear reaches of water at home, I have frequently noticed this peculiarity. These bands are only assumed by the fish when the river is clear. I have never seen them when the water was discoloured, nor in lake fish. It is well known at the same time that trout can alter their colour to suit that of the water for the time being; they are much lighter when the water is clear than during floods.

### 3. *Habits of the Trout, as observed by Anglers.*

Undoubtedly the trout here are more bold, when feeding, than at home, possibly because as yet our streams are not so much fished.\* The time

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\* They always feed with their heads up stream, seize their prey by the head, and bolt it or suck it into the gullet.

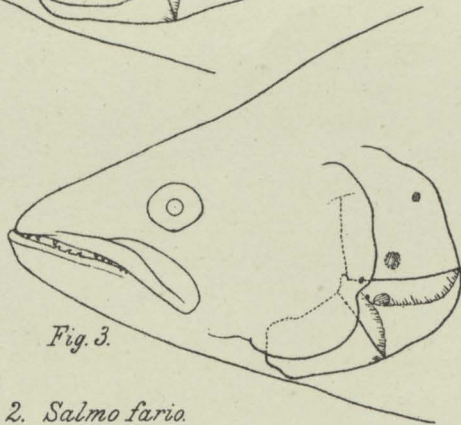
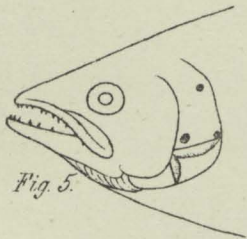
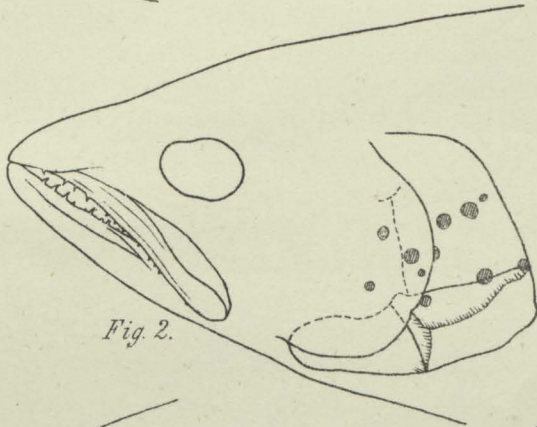
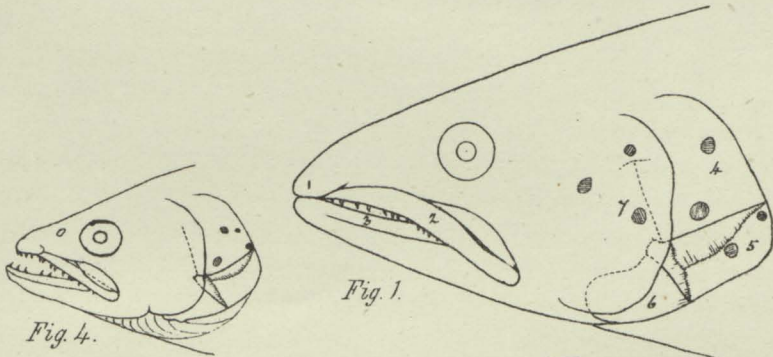
of day also when they appear to feed most, differs in some of our waters fished by me from all previous experience. Thus in the Lee and Deep Streams, every angler has remarked that they are more on the feed during the middle of the day, from spring to autumn, than either in the morning or evening;\* while in the Shag River and Leith they are found to feed when the water is low and clear, almost entirely at night. In the Shag River, there can be no doubt, this is owing to the fineness and transparency of the water. There, during the day, a few fish only are seen; but from dusk, all through the night until dawn, they are more or less on the move, while at times the water seems alive with large fish, which throw themselves out of the water, tumble along the surface, or pursue the whitebait and minnows right into the shallows. Then is the time when the fish are nearly all caught, that being done by the use of natural or artificial minnows. A fresh in this river operates similarly to nightfall, and large takes have been often made on such an occasion. In the Leith good fishings have been got in the morning, but the best at night.†

In all these streams of Otago the meteorological conditions of the atmosphere seem to have a marked effect on the movements of the trout. Thus, with a falling barometer and the approach of rain, particularly if the air is at the same time getting colder, I have noticed that the trout invariably cease feeding. It is only rarely I have caught trout, and never more than a solitary one, under these circumstances. Electricity also, when approaching in the form of thunder clouds or otherwise, has the same effect. But when the storm actually bursts over the stream, as a rule I have found the fish begin to take once more. I have seen the very same thing occur on Scotch waters. As a rule here, it is found far more trout are caught when an east wind blows than when it comes from any other direction; the temperature of this favourable wind has a good deal to do with this result. Although no experiments as yet have been made here to test the theory, yet I believe that, as regards temperature, trout will take surface food as long as the air is warmer than the water, and at times when colder, but only within certain limits. Not only do my own observations lead to this conclusion, but I may mention here a corroborative fact which came to my knowledge some years ago. Then being in Scotland, I had the good fortune to be permitted the perusal of a register of the temperature of the air and water at Loch Tay, which was shown me by a gentleman who had been residing there as factor to the Earl of Breadalbane, to whom the fishings belong. By comparing the readings of the thermometers for air

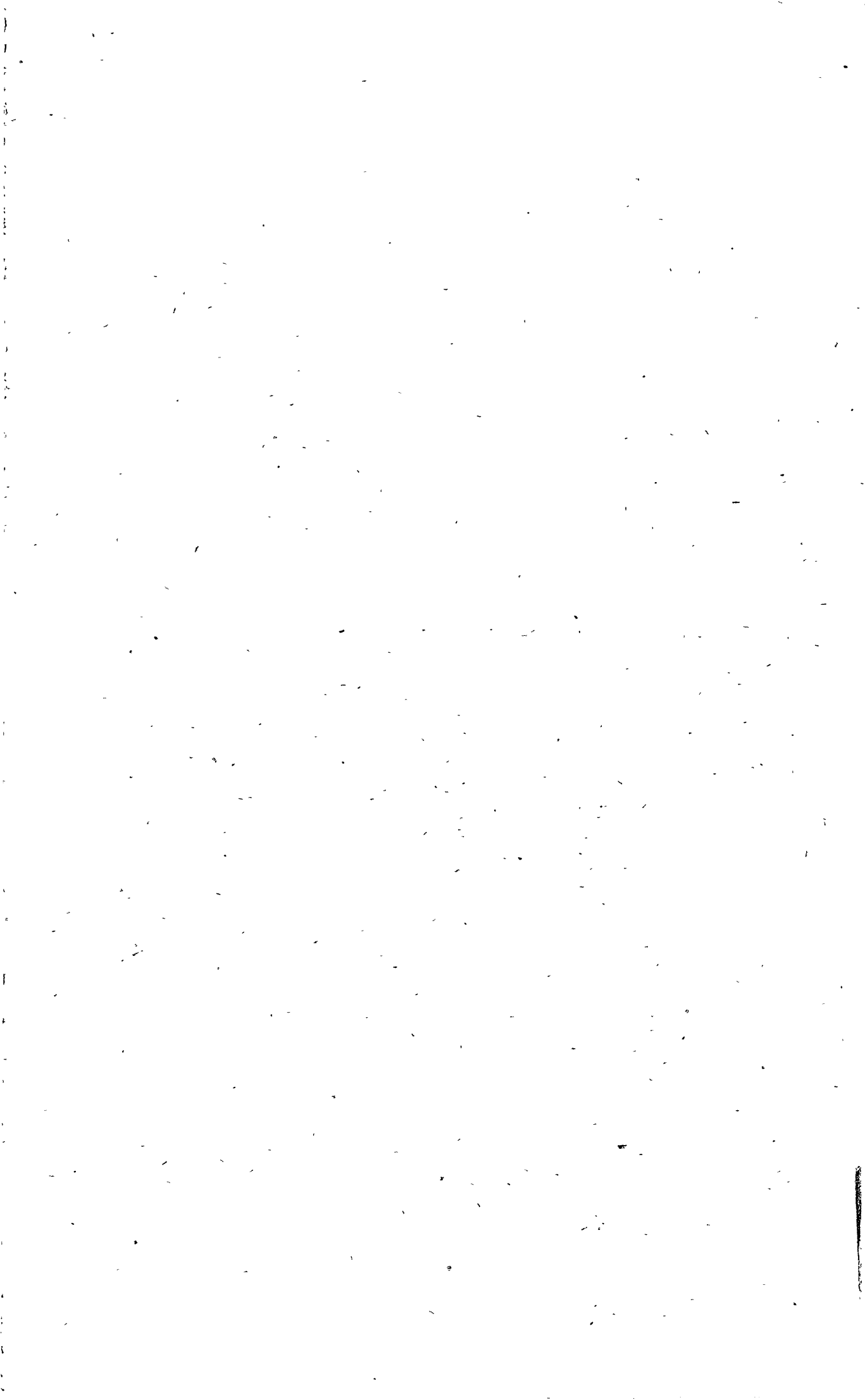
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\* I have killed good fish in the morning on one or two occasions, but rarely any fish at all at night, and never large ones.

† In British rivers, under ordinary weather, evening and night are the times when trout feed most, unless in spring, when this is confined to the middle of the day.



1. 2. *Salmo fario*  
3. 4. 5. *Salmo trutta*.



and water during each day of the fishing season, it was found that most salmon were killed with the rod on Loch Tay when the difference in temperature did not exceed 2° Fah.; but when it became as much as 5°, the fish ceased to take altogether. Although fish are cold-blooded animals, this would appear to indicate a certain degree of sensitiveness to variations in temperature. It is not so easy to account for trout and other species of the Salmonidæ being aware (to use a common expression) when the barometer is falling before rain, as I have stated already. But one thing I am convinced of is that they do feel when the atmospheric pressure on the water alters to an appreciable extent. They get sluggish, and will not move to feed when the air becomes rarefied. But when the weather begins to change and clear up they soon move about again and resume feeding. I explain this on the supposition that, in the first instance, the fish feel their bodies sensibly heavier, so as to indispose them to move; but when the atmosphere regains its normal pressure, they are relieved from the sensation of weight, and their ordinary lively habits are resumed. Other animals—human beings included—are affected by the very same cause. This is, no doubt, rather a speculative part of my subject, and I could easily enlarge my remarks on it, but probably I have said enough for the present.

#### 4. *Distinguishing Marks of Trout.*

This brings me to the concluding and more technical portion of my paper, but before going into that I think it will be better to record my examinations of a number of specimens of *S. fario*, which were caught in some of those rivers which I have already frequently referred to. From various causes my notes are not so complete as they should be, but still I give them just as they are. They may be useful for comparison and reference.

#### *Specimens of Salmo fario examined in Otago.*

a.—1877, Nov. 30th.—Male trout caught in Lee Stream—the gorge water—with grasshopper, the river being very low. Condition thin, head long, and lower jaw hooked; colour, brown on back, golden on sides, numerous black spots and large red ones, a few being beneath the lateral line.

*Dimensions*: Weight, 5lbs.; length, 25 in.; depth, 6 in.; head, 6½ in.; maxillary bone projecting ½ in. behind the vertical from posterior margin of orbit; sixteen round black spots on gill-cover, one side. Teeth, vomer three firm five loose, palatines each well armed with teeth, tongue also, and with two small teeth loose near the tip.

*Fin Rays*: P.14 on each fin; C.21 (doubtful). *Scales*: 16 in transverse row from adipose fin backwards to lateral line. *Pyl. cæca*: 54. *Contents of stomach*: crayfish, 2 in. long, and remains of larger one; three legs of a grasshopper and part of a black beetle.

b.—Dec. 7th.—Male trout, taken at night in Shag River with natural minnow, water very low; colour silvery white, back light olive, spots black and numerous; condition very fat; head ordinary size, lower jaw hooked, maxillary projecting  $\frac{1}{4}$  in. behind posterior margin of orbit; body of vomer, 5 teeth firm, 2 wanting; palatine left, 13 firm, 3 gone; right palatine, 10 firm, 4 gone.

*Dimensions*: Weight, 5 lbs. 2 oz.; length, 23 in.; depth,  $5\frac{1}{2}$  in.; girth,  $13\frac{1}{2}$  in.; head,  $5\frac{1}{2}$  in.

*Fin Rays*: P.13 on each. *Scales*: 15 on one side, 16 on other, in transverse rows from dead fin backwards to lateral line. *Pyl. cæca*: 43. *Contents of stomach*: remains of one or two small minnows.

c.—Dec. 19th.—Male trout, taken in Shag River at night with natural minnow; water low; colour, silvery sides, back, light olive; spots black and numerous, some on upper margin of tail, lower margin gone, probably bitten off by a shag; condition fat; head ordinary size, lower jaw hooked, maxillary projecting  $\frac{1}{2}$  in. behind the posterior margin of orbit; head of vomer, 3 teeth; palatine a row each. *Dimensions*: Weight, 5 lbs. 5 oz.; length,  $23\frac{1}{2}$  in.; depth, 6 in.; girth,  $13\frac{1}{2}$  in.; head, 6 in.

*Fin Rays*: D.13, P. $14\frac{3}{4}$  <sup>one side,</sup> <sub>other side,</sub> V.9, A.12, C.22. *Scales*: 14 in transverse row from adipose fin backwards to lateral line. *Pyl. cæca*: (not taken). *Contents of stomach*: part of one small minnow.

d.—1878, Jan. 19th.—Female trout taken with grasshopper in Lee Stream in the Ledge pool; colour, back brown, sides olive colour, belly white, black spots plentiful, red ones very large; tail slightly forked; head small, maxillary within vertical from posterior margin of orbit; head of vomer, 2 teeth and 2 gone; body of vomer, double row; palatines, one row of teeth on each.

*Dimensions*: Weight, 2 lbs.; length, 16 in.; depth,  $3\frac{1}{2}$  in.; girth,  $8\frac{1}{2}$  in.; head,  $3\frac{1}{2}$  in.

*Fin Rays*: D.13, P.14, V.9, A.11, C.19. *Scales*: 15 in transverse row from adipose fin backwards to lateral line. *Pyl. cæca*: 54. *Contents of stomach*: shell-fish and cadis-bait numerous, leg of crayfish, two small stones.

e.—Feb. 8th.—Male trout caught in Deep Stream with grasshopper; water low and clear; colour, back brown, sides and belly, golden tinge, black spots very numerous and large, red spots large, a few black spots on adipose fin and upper margin of tail; head ordinary size, maxillary projecting  $\frac{1}{2}$  in. behind vertical from posterior margin of orbit; head of vomer, 3 teeth and 1 gone; body of vomer, double row, some missing; palatines, 1 row on each.

*Dimensions*: Weight,  $3\frac{1}{2}$  lbs.; length, 19 in.; depth, 5 in.; girth,  $11\frac{1}{2}$  in.; head,  $4\frac{1}{2}$  in.

*Fin Rays*: D.11, P.12, V.9, A.10. *Scales*: 15 in transverse row, from adipose fin backwards to lateral line. *Pyl. cæca*: 46. *Contents of stomach*: crayfish, beetles, flies.

*f.*—Feb. 8th.—Female trout taken in Deep Stream, with grasshopper. Colour, back olive brown, silvery towards belly, black spots ordinary number and large, red ones not very distinct, on gill-cover six distinct large black spots; head small; maxillary projecting  $\frac{1}{8}$  in. behind vertical from posterior margin of orbit; teeth, double row on vomer, some awanting; one row on each palatine bone. This fish was in excellent condition; roe well developed. When cooked was found of first-rate quality; the flesh was very red.

*Dimensions*: Weight, 4 lbs. 10 oz.; length, 22 in.; depth, 5 in.; girth,  $12\frac{1}{4}$  in.; head,  $4\frac{1}{2}$  in.

*Fin Rays*: D.13, P.12, V.9, A.11. *Scales*: 17 in transverse row from adipose fin backwards to lateral line. *Pyl. cæca*: 47. *Contents of stomach*: crayfish, green beetles, and flies.

*g.*—March 2nd.—Female trout, taken in Broad Creek, with grasshopper. Colour, back olive brown, sides and belly silvery, black spots ordinary number, red ditto all large; six black spots on left side of head and five on right; tail large, forked and handsomely shaped; it and adipose without spots; head very small; right maxillary projecting  $\frac{1}{8}$  in. behind vertical from posterior margin of orbit; left maxillary awanting, excepting small portion of posterior end, evidently lost by some accident; fish fat and in good condition.

*Dimensions*: Weight,  $2\frac{1}{2}$  lbs.; length,  $17\frac{3}{4}$  in.; depth,  $4\frac{3}{8}$  in.; girth,  $10\frac{3}{4}$  in.; head,  $3\frac{1}{2}$  in.

*Fin Rays*: D.13, P.13, V.9, A.10, C.19. *Scales*: 16 in row from adipose fin backwards to lateral line. *Pyl. cæca*: 47, surrounded by unusual quantity of fat. *Contents of stomach*: cadis-bait, larvæ, grass, rushes, and one small shell-fish.

*h.*—March 6th.—Male trout taken in Shag River at night with natural minnow. Colour, back light olive, sides and belly silvery, black spots numerous and large, no red ones, black spots on adipose fin but none on tail, tail square; head small, maxillary projecting  $\frac{1}{4}$  in. behind vertical from posterior margin of orbit; fish fat, short and thick, back arched; teeth, two on head and usual rows on body of vomer and on palatine.

*Dimensions*: Weight,  $5\frac{1}{4}$  lbs.; length,  $21\frac{1}{4}$  in.; depth, 6 in.; girth,  $14\frac{1}{4}$  in.; head,  $4\frac{3}{4}$  in.

*Fin Rays*: D.11, P.13, V.10, A.10, C.19. *Scales*: 16 in transverse row from adipose fin back to lateral line. *Pyl. cæca*: 47, doubtful number, some being cut in removing stomach. *Contents of stomach*: not examined.

The following two specimens described are the stuffed ones in the Otago Museum already referred to under the heading Distribution and Growth of Trout, and the natural colours of which cannot now be given.

*i.*—Male trout taken in Shag River, June, 1874. Present colour brown on back and dark grey on sides; head large; mandible terminating in very long hook; tail square; black spots numerous.

*Dimensions*: Weight, 14lbs.; length, 29 $\frac{1}{2}$ in.; depth, 7in.; head, 7in.

*Fin Rays*: D.10, P.13, V.9, A.10, C.19.

*Scales*: 15 in transverse row from adipose fin back to lateral line.

*j.*—Female trout, taken in Shag River, July, 1874. Present colour brown on back and dark grey on sides; head short and blunt; tail square; black spots plentiful but not numerous.

*Dimensions*: Weight, 16 $\frac{1}{2}$ lbs.; length, 29 $\frac{1}{2}$ in.; depth, 6 $\frac{1}{2}$ in.; head, 5 $\frac{1}{2}$ in.;

*Fin Rays*: D.11, P.13, V.9, A.10, C.19. *Scales*: 16 in transverse row from adipose fin backwards to lateral line.

Collecting now the results together of my examination of the various specimens above detailed, I find, that as regards the colour and spots, these vary in the different rivers from which the respective individuals were taken. The Shag River fish are all silvery, and, as a rule, have numerous black spots, red spots wanting or rare. The other trout, furthest removed in appearance from these, are those of the Lee and Deep Streams, which are golden on the sides; in the males black spots numerous; the females are mostly silvery, the spots being less plentiful, and both have red spots, the male most. The fin rays vary more or less; they are in the specimens examined by me dorsal, 10 to 13; pectoral, 12 to 14; V. 9 to 10, A.10 to 12, C.19. Of these, the most constant is the caudal fin, which never seems to vary from 19. In two specimens where I found more than this number, I am inclined to think I must have made a mistake in counting them. Next in invariability are the ventrals; seven individuals I found had each 9 rays in these fins, and only one had 10. The anal fin rays are tolerably constant, but the pectoral and dorsal fins vary a good deal.

The scales I found, reckoning from the adipose fin backwards to the lateral line, to range from 14 to 17, and the pyloric cæca from 43 to 54.\* Now, if we compare these results with the numbers given by three authorities, Günther, Hamilton, and Yarrell, we find they give the following:—D.13 to 14, P.14., V.9., A.11 to 12, C.19, scales 15, and pyloric cæca, 33 to 46. That is, with the exception of the ventral and caudal fins, a higher number of fin rays than I find; scales fewer in a

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\* The head of vomer carries 2 to 4 teeth, and body of vomer teeth all the way. Palatines, tongue, and mandible all armed with teeth.



transverse row, according to Günther, and the pyloric cæca fewer on an average by 9. As yet, I have made no examination of the number of vertebræ, so my comparison in that and one or two other particulars is incomplete.

With regard to the features of the head, as to structure, my remarks will refer to two heads, both of females—one of a fish,  $4\frac{1}{2}$  lbs. in weight, taken in the Lee in October, 1877; and the other of a fish over 6 lbs. in weight, caught in the Upper Taieri River in March, 1878. Fac-similes\* of these are represented on pl. XIII., fig. 1 and fig. 2 (*S. fario*) accompanying this paper. In fig. 1 the posterior end of maxillary is  $2\frac{3}{8}$  inches from the snout, and at its greatest width measures  $\frac{7}{8}$  of an inch. The lower limb is strong and prominent, and the whole bone characteristically coarse and large.† Of the gill-covers, the posterior margin of the operculum forms nearly a right-angle with the junction line of the operculum and suboperculum. This junction or joint of the operculum and suboperculum forms an angle of nearly  $23^\circ$  with the axis of the body of the fish. The suboperculum in shape roughly resembles or approaches a rectangle, the posterior lower margin forming a blunt rounded angle. The average length, or middle length of this bone, is  $1\frac{3}{8}$  inches, and the middle width  $\frac{5}{8}$  of an inch. The interoperculum forms rather less than a right angle at its junction with the suboperculum, this line making with the axis of the body of the fish an angle of  $47^\circ$ . The lower margin is flatly rounded and continuous, nearly in line with lower margin of suboperculum, and the anterior extremity nearly semi-circular. The preoperculum is sinuously rounded in margin, and covers about one half of the surface of the interoperculum.

In the case of fig. 2, the posterior end of maxillary measures  $2\frac{1}{8}$  inches from the snout, and the body of the bone very nearly  $\frac{1}{2}$  an inch at its greatest width. It is approximately similar to the maxillary of fig. 1, the Lee Stream trout, only the posterior extremity is much more rounded, this fish being evidently an older individual. The end projects  $\frac{3}{8}$  in. behind vertical, from posterior margin of orbit. The posterior margin of the operculum forms nearly a right-angle with the junction of the operculum and suboperculum. This line or joint of operculum and suboperculum forms an angle with the axis of the body of the fish of nearly  $26^\circ$ . The suboperculum in shape roughly approaches a four-sided figure, almost a rectangle, the posterior lower margin forming a blunt angle with a sharp curve at the apex. The middle length of this bone is  $1\frac{5}{8}$  inches, and its middle width  $\frac{5}{8}$  inch. The interoperculum forms at its junction with the

\* [Reduced one-half from author's original drawings.]

† It projects  $\frac{5}{8}$  in. behind the vertical, from posterior margin of orbit.

suboperculum rather less than a right-angle, this line of junction making with the axis of the fish an angle of  $50^{\circ}$ . The lower margin is flatly rounded, and is a general continuation of lower margin of suboperculum. The anterior end is semi-circular, or nearly so. The preoperculum has its margin rounded, and not so sinuous as in that of fig. 1; it covers fully the half surface of interoperculum.

The gill-covers, when examined from the outside, appear to be divided as shown by hatched lines on the diagrams, which traverse the body of the suboperculum. These lines, however, are only the margin of an integument or skin, covering a series of spines. They do not represent the true articulation of the bones, which can only be correctly seen by dividing the head in two, and examining the gill-covers from the inside. When this is done there is no difficulty, as the joints are marked by distinct ridges or lines of thickened bone. Dr. Günther lays some stress on the presence or absence of a lower limb to the preoperculum in salmonoids, and says of that of *S. fario*, it "is without or with a very indistinct lower limb." At the same time he makes no reference to the interoperculum, so far as I have been able to find. Now the lower limb referred to is not by any means a very distinct mark, but the interoperculum is a well-defined bone. There is only one general remark I need add here, which is, that the specimens of trout from our Otago stock examined are representatives of only one variety, while those available to the authorities I have named are of many varieties.

As an article of food, when our trout are taken from 2lbs. to 5lbs., in good condition, and at the proper season, they cut up pink or red, and if properly cooked are excellent. Those from the Lee and Deep Stream are the best I have eaten. The Shag River fish are rather earthy in taste, but this flavour almost disappears if they be cut across in thin steaks and fried.

#### *Salmo trutta.*

Having now concluded all I have to communicate for the present of the growth, habits, and characteristics of our brown trout, I should like, before closing this paper, to give you, for comparison, the results of such limited observations as I have been enabled to make on the sea trout (*S. trutta*) introduced into Otago. In 1871, Mr. Young, of Palmerston, put 134 young sea trout into Shag River. In November, 1875, a fish  $10\frac{1}{2}$ lbs. weight was netted near Quarantine Island, Otago Harbour, which was declared on good authority to be a true sea trout. I saw this fish, and have no doubt as to its identity, though I had no opportunity of making an examination. Since then they have been taken in the salt water, in the harbour at Blueskin and at Moeraki, but not as yet in any river. A considerable number of these I saw; they ranged in weight from 1 lb. to 15 lbs., and I believe them to have been sea trout. As this is questioned, however, by some, I have

made diagrams of the heads of three sea trout (being the only ones I can get), two of which are at present in my possession, and one belongs to our Museum. They were caught in Otago harbour.

These are placed beside the diagrams of *S. fario* to facilitate comparison. By this means some characteristic distinctions are at once apparent. In each head the lower jaw is rather longer than the upper. The maxillary does not project beyond a vertical line drawn from the posterior margin of orbit. The lower limb is narrower and the upper broader relatively than in the two heads of *S. fario*, and the whole bone is finer and more delicate. Of the gill-covers, the greatest difference is manifest in the suboperculum, which roughly approaches a sector of a circle in outline, its lower free margin being nearly semi-circular. The outline of integument on surface of this bone has a great similarity in the three specimens, and differs decidedly from that on the same bone on the trout heads. The spots on the gill-covers are from three to four, while in the trout they are from seven to eleven; while of the more general features the heads are short and deep, and fine at the snout, that of the Museum specimen being only one-fifth of the whole length of the fish. This fish measures—length, 16 in.; depth, 3 $\frac{1}{4}$  in.; head, 2 $\frac{1}{4}$  in.; and scales 16 in transverse row from adipose fin backwards. And lastly, these three fish have the distinct coating of bright silvery scales all over their bodies. The description of the head (*S. trutta*), given by Günther and Yarrell, agrees very well with the above three specimens.

#### DESCRIPTION OF PLATE XIII.

[NOTE.—Reduced one-half from the author's original drawings.]

##### *Salmo fario.*

- Fig. 1. Fac-simile head of female trout, taken in Lee Stream, Oct., 1877; weight, 4 $\frac{1}{2}$  lbs.  
 2. Fac-simile of dried head of female trout taken in Upper Taieri, Mar. 1878; weight 6 lbs. 6 ozs.

[NOTE.—The numbers represent the following bones: 1, pre-maxillary or inter-maxillary; 2, maxillary; 3, mandible; 4, operculum; 5, suboperculum; 6, interoperculum; 7, preoperculum.

##### *Salmo trutta.*

3. Fac-simile head of female, 7 lbs, weight, got in harbour, Nov. 6, 1877.  
 4. Do. do. dried specimen, 1 lb. weight, got in Otago Harbour, March, 1878.  
 5. Hand-sketch head of specimen, 1 $\frac{1}{2}$  lbs. weight, in Otago Museum; caught at Otago Heads, April, 1874.

## LIST OF YOUNG TROUT DISTRIBUTED SINCE 1869.

(From the Report of the Otago Acclimatization Society for the Years 1876 and 1877.)

NAME OF RIVER.	1869.	1870.	1871.	1872	1873.	1874.	1875.	1876.	1877.
Abbott's Creek .. ..	..	..	..	..	..	200	..	..	..
Ahuriri (Waitaki) .. ..	..	..	..	..	..	..	300	286	..
Ahuriri (Glenoamaru) .. ..	..	..	..	..	..	..	..	..	255
Akatore Creek .. ..	..	..	..	..	75	150	500	..	..
Awahokoma (Waitaki) .. ..	..	..	..	..	..	..	..	120	..
Awamoka .. ..	..	..	..	..	..	101	..	..	..
Back Creek (Clydevale) .. ..	..	..	..	..	..	..	..	700	..
Beaumont .. ..	..	..	..	..	..	..	100	..	..
Beck's Creek (Manuherikia) .. ..	..	..	..	..	75	..	..	..	..
Benger Burn .. ..	..	..	..	..	75	..	..	..	..
Black Burn .. ..	..	..	..	..	..	..	200	..	..
Boat-harbour Creek .. ..	80	..	..	..	50	..	500	..	520
Branch (Waipahi) .. ..	..	..	..	..	..	..	200	..	..
Boundary Creek (Waihola) .. ..	..	..	..	..	50	..	..	..	256
"  " (Kaitangata) .. ..	..	..	..	..	..	..	54	..	..
"  " (Oamaru) .. ..	..	..	..	..	..	..	..	60	..
Bullock Creek (Wanaka) .. ..	..	..	..	..	..	..	..	50	..
Catlin's River .. ..	..	..	..	..	..	..	..	..	270
Clifton (Kaihiku) .. ..	..	..	..	..	50	..	..	..	..
Clutha (Albertown) .. ..	..	..	..	..	..	..	..	354	..
Clydevale Station Creek .. ..	..	..	..	..	..	..	..	210	..
Crookston Burn .. ..	..	..	..	..	..	50	..	..	..
Creek at Gore .. ..	..	..	..	..	..	..	..	51	..
Deep Stream .. ..	100	..	..	..	..	..	..	..	..
Earnsclough .. ..	..	..	..	..	..	..	..	800	*400
Fall's Creek (Kaitangata) .. ..	..	..	..	..	..	..	152	..	..
Fern Burn .. ..	..	..	..	..	..	..	..	51	..
Flagstaff Creek .. ..	..	..	..	..	..	60	100	..	..
Flag Swamp Creek .. ..	..	..	..	..	200	..	..	..	..
Flodden .. ..	..	..	..	..	40	..	..	..	..
Fraser's Creek .. ..	..	..	..	..	..	300	500	..	..
Fruid .. ..	..	..	..	..	..	225	80	..	..
Fulton's Creek (West Taieri) .. ..	76	..	..	..	..	..	..	..	..
Glenoamaru .. ..	..	..	..	..	..	..	500	140	..
Hakateramea .. ..	..	..	..	..	..	..	..	450	..
Halfway Creek (Rock and Pillar) .. ..	..	..	..	..	..	..	50	..	..
Hawea River .. ..	..	..	..	..	..	..	..	453	..
Hawke Bay .. ..	..	..	..	..	109	..	..	..	..
Hillend (F. S. Pillans) .. ..	..	..	..	..	..	..	300	..	..
Island Stream .. ..	48	..	..	..	..	..	..	..	..
Jack Hall's Creek (Wanaka) .. ..	..	..	..	..	..	..	..	105	..
Kakanui .. ..	53	..	..	..	..	..	..	..	..
Kaihiku .. ..	..	..	..	..	150	250	500	50	..
Kaikorai .. ..	..	..	..	..	..	200	100	..	..
Kaiwera .. ..	..	..	..	..	..	100	..	..	..
Kaitangata Creek .. ..	..	..	..	..	..	..	304	..	..
Kilmog Creek, or Waihemo .. ..	51	..	..	..	..	..	..	..	..
Kuriwao .. ..	..	..	..	..	..	204	620	..	100
Kurow .. ..	..	..	..	..	..	..	..	305	..
Lake Ohou .. ..	..	..	..	..	..	..	222	300	..
Lauder .. ..	..	..	..	..	605	..	..	..	..
Lees Canal .. ..	..	..	..	..	100	..	200	..	..
Lee Stream .. ..	98	..	..	..	..	..	..	..	..
Lindis River .. ..	..	..	..	..	..	..	..	..	†520
Linn Burn .. ..	..	..	..	..	..	..	30	..	..
Leithan .. ..	..	..	..	..	..	100	..	..	..
<i>Carried forward</i> .. ..	506	..	..	..	1,579	1,940	5,512	4,485	2,321

\* All died on journey.

† All died on journey but 50.

LIST OF YOUNG TROUT—continued.

NAME OF RIVER.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.
<i>Brought forward</i> .. ..	506	..	..	..	1,579	1,940	5,512	4,485	2,321
Lovell's Creek .. ..	..	..	..	..	42	300	500	..	..
Luggat Burn .. ..	..	..	..	..	..	..	150	250	..
Manor Burn .. ..	..	..	..	..	..	..	..	..	..
Manuherikia (Upper) .. ..	..	..	..	..	242	..	..	..	..
Marshall's Creek (Clinton) .. ..	..	..	..	..	..	..	210	..	..
Matatapu .. ..	..	..	..	..	..	..	..	144	..
M'Pherson's Creek (Waipori Lake) .. ..	..	..	..	..	50	..	..	122	..
Matukituki .. ..	..	..	..	..	..	..	50	..	..
Mataura .. ..	..	..	..	..	..	..	..	..	390
Meggat Burn (Waiholā) .. ..	..	..	..	..	..	..	50	..	..
Merton Creek .. ..	..	..	..	..	..	..	300	..	..
Mimihou .. ..	..	..	..	..	..	..	75	..	..
Oamaru Creek .. ..	..	..	..	..	..	..	..	200	..
Okapua (Mataura) .. ..	..	..	..	..	..	..	200	200	..
Oamarama (Waitaki) .. ..	..	..	..	..	..	122	165	950	..
Otakaike .. ..	..	..	..	..	..	..	..	200	..
Otama (Mataura) .. ..	..	..	..	..	..	..	600	..	..
Otaria .. ..	..	..	..	..	..	..	..	536	..
Otamaite .. ..	..	..	..	..	..	..	..	320	..
Otematata (Waitaki) .. ..	..	..	..	..	..	..	..	..	..
Otepopo River .. ..	101	..	..	..	..	..	..	290	800
Owake (Upper) .. ..	..	..	..	..	..	..	..	600	..
(Lower) .. ..	..	..	..	..	..	..	..	..	..
Owiho (N. E. Valley) .. ..	..	..	..	..	50	..	100	..	..
Peat Bog Creek (Pomahaka) .. ..	..	..	..	..	..	50	..	..	..
Pleasant River .. ..	..	..	..	..	400	..	..	..	..
Pomahaka .. ..	..	..	..	..	125	200	1,720	1,250	2,000
Pomahi .. ..	..	..	..	..	..	100	..	..	..
Puerua .. ..	..	..	..	..	100	300	1,000	1,162	700
Pukerau .. ..	..	..	..	..	..	..	..	250	..
Quail Burn (Waitaki) .. ..	..	..	..	..	..	..	100	100	..
Quartz Creek (Wanaka) .. ..	..	..	..	..	..	..	..	252	..
Rankle Burn .. ..	..	..	..	..	..	..	500	..	..
Ronald's Creek (Pomahaka) .. ..	..	..	..	..	..	50	..	..	..
Rumbling Burn (Wanaka) .. ..	..	..	..	..	..	..	..	202	..
Sawyer's Bay Creek .. ..	..	..	..	..	..	100	..	..	..
Silver Stream .. ..	55	..	..	..	100	200	652	..	620
Sheepwash Creek .. ..	..	..	..	..	..	..	..	40	..
Shag Creek (Akatore) .. ..	..	..	..	..	..	100	..	..	..
Shag River .. ..	53	..	..	..	..	..	..	..	..
Young's Ponds .. ..	75	..	..	..	..	..	..	..	..
Station Creek (Benmore) .. ..	..	..	..	..	..	..	170	110	..
Stoney Creek .. ..	..	..	..	..	..	..	50	..	..
Swift Creek .. ..	..	..	..	..	..	50	..	..	..
Swinburn .. ..	..	..	..	..	250	..	..	..	..
St. Leonards .. ..	..	..	..	..	..	60	..	..	..
Taieri (Upper) .. ..	..	25	..	..	..	..	425	..	..
Talla .. ..	..	..	..	..	..	225	120	..	..
Tautuku (Upper) .. ..	..	..	..	..	..	..	..	..	220
Teviot .. ..	..	..	..	..	157	..	..	..	..
Tokomairiro .. ..	62	..	..	..	..	..	500	..	600
Trotter's Ck. & Hampden Str'ms. .. ..	..	..	..	..	1,000	..	..	..	..
Trumble's Creek .. ..	..	..	..	..	..	..	100	..	..
Tuapeka .. ..	..	..	..	..	..	..	400	..	..
Waikoikoi .. ..	..	..	..	..	..	150	..	..	..
Waikouaiti River .. ..	61	..	..	..	..	..	..	..	..
<i>Carried forward</i> .. ..	913	25	..	..	4,095	3,947	13,649	11,663	7,651

## LIST OF YOUNG TROUT—continued.

NAME OF RIVER.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.
<i>Brought forward</i> .. ..	913	..	..	..	4,095	3,947	13,649	11,663	7,651
Waitapeka .. ..	..	..	..	..	..	100	..	..	..
Waihemo, or Kilmog .. ..	..	..	..	..	..	..	500	..	..
Wairuna .. ..	..	..	..	..	..	125	500	..	..
Waitahuna .. ..	..	..	..	..	..	..	500	..	800
Waireka .. ..	..	..	..	..	..	..	500	..	..
Waitati (Upper) .. ..	..	..	..	..	100	..	..	..	..
„ (Lower) .. ..	57	..	..	..	..	250	500	..	820
Water of Leith .. ..	75	..	..	..	..	450	..	..	650
Waterworks Reservoir .. ..	40	..	..	..	..	..	..	..	..
Waikaka .. ..	..	..	..	..	..	..	..	563	..
Waikouaiti .. ..	..	..	..	..	..	80	350	..	..
Waimea .. ..	..	..	..	..	..	..	..	300	..
Waipahi { Top waters .. ..	..	..	..	..	..	..	..	..	1,000
„ { Trumble's .. ..	..	..	..	..	..	300	1,100	..	1,300
„ { (Lower .. ..	..	..	..	..	76	401	700	..	..
Waiwera .. ..	..	..	..	..	150	450	900	..	1,000
„ (top) .. ..	..	..	..	..	..	..	..	..	600
Wyndham .. ..	..	..	..	..	..	..	500	..	410
Washpool and other Creeks .. ..	..	..	..	..	70	..	..	..	..
Mr. Clark (Wairuna) .. ..	..	..	..	..	..	..	100	..	..
„ Larnach (Peninsula) .. ..	..	..	..	..	150	..	..	150	..
„ Reid (Elderslie) .. ..	..	..	..	..	200	..	..	1,000	..
„ Menlove (Windsor Park) .. ..	..	..	..	..	..	..	..	150	..
„ McGregor, C. E. .. ..	..	..	..	..	..	125	..	500	..
„ C. R. Howden .. ..	..	..	..	..	..	..	..	500	..
„ Wheatley (Kakanui) .. ..	..	..	..	..	..	..	..	800	..
<i>Totals</i> .. ..	1,085	1,000	2,000	..	4,841	6,228	19,799	15,626	14,231

## LIST OF YOUNG TROUT DISTRIBUTED FROM THE WALLACETOWN SALMON PONDS, SOUTHLAND BY MR. HOWARD.

NAME OF RIVER.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.
Benmore Creek .. ..	..	..	..	310	..	..	..	..
Centre Creek .. ..	50	..	..	..	..	..	..	..
Clutha River .. ..	..	..	210	..	..	..	..	..
Eyre Creek .. ..	50	..	..	..	..	..	..	..
Makarewa (Upper) .. ..	350	..	..	..	..	..	..	..
„ (Lower) .. ..	..	82	..	220 <sup>a</sup>	500	125	41 <sup>a</sup> , 32 <sup>b</sup>	25 <sup>a</sup> , 11 <sup>b</sup>
Mataura (Upper) .. ..	..	..	..	160	..	..	500	..
Mimihou River .. ..	..	..	..	..	500	800	..	..
Morley Creek .. ..	..	..	..	..	..	..	..	..
Omut .. ..	..	60	50	..	..	..	..	..
Orawia .. ..	..	..	..	..	500	..	..	..
Oreti River .. ..	..	..	..	..	450	1,000	1,500	75
Otamaiti Creek .. ..	..	100	..	..	..	..	..	..
Otipiri (Upper Makarewa) .. ..	..	..	..	..	..	1,500	..	..
Puni Creek .. ..	..	..	100	..	..	..	..	..
Titiroa .. ..	..	..	..	..	..	..	250	..
Waiou River .. ..	47	..	..	..	500	..	..	..
Wakatipu Lake .. ..	100	..	..	..	..	..	..	..
Waikaka River .. ..	..	..	..	..	..	..	350	..
Waikivi .. ..	117	..	100	..	..	..	..	..
Waihopai .. ..	100	..	..	..	..	..	..	..
Waimatuku River .. ..	..	..	..	147	..	500	..	..
Winton Creek .. ..	..	..	..	205	..	..	..	..
Wyndham River .. ..	..	..	..	..	..	..	1,000	..

<sup>a</sup>, yearlings; <sup>b</sup>, old fish, some 10lbs. weight.