

The slaughter that came under my notice last year was so large, that I fear, when the country is more opened up the poor Huia will become extinct, a fate I shall much deplore, as any one who has once seen this most graceful bird alive can only regret that he has not oftener a chance of doing so.

I am glad to say, one inducement to its destruction is wanting, as it is reported by all who have cooked it, to be a tough morsel. I ascertained that over 600 skins were procured last year, from the back ranges of the East Coast of the Wellington Province, by the natives. I may mention, that, part of the ranges had been *tapu* by the natives, for the last seven years, so as to protect the Huia from being killed off.

I exhibit a specimen, obtained with some difficulty, from one of the brothers mentioned in the beginning of this paper.

ART. XXVI.—*Notes on the Introduction and Acclimatization of the Salmon.*

By JAMES STEWART, C.E.

[Read before the Auckland Institute, 6th December, 1875.]

THE recent importation into Auckland of healthy Salmon Ova, and successful distribution of them by Mr. Firth in the upland tributaries of the Waikato and Thames, has drawn renewed attention to the subject of the introduction of this splendid fish into New Zealand. Happening to be on my way to Waikato on the morning on which Mr. Firth left with his charge, I can bear testimony to the completeness of his arrangements; and the care and forethought brought to bear on the most minute details of the enterprise, which, favoured by very unseasonable weather, but, on that account, all the more favourable to success, enabled him to distribute the living ova in waters over a wide area of country, and, so far as possible, with the present venture, secure many chances of success.

The subject and discussions naturally arising from it on that journey, awakened, in my mind, memories of almost forgotten scenes and experiences in pisciculture in the old country. At intervals, during my absence of a week in the Waikato, I was enabled to recall my early observations, and study the matter in the light of present requirements, and as a small contribution to the cause, I have now the honour to lay before this Institute, and my fellow-colonists these notes, in the hope that the work will not be allowed to rest with the present venture, but will be prosecuted anew, and with the certainty of the same success attending it as has been achieved in the introduction of the Trout.

By way of explanation of what may be deemed interference with the work to which many able minds and hands are devoted, I must premise that I have had the honour of being early and much connected with the artificial propagation of salmon. I believe all who have ever felt interest enough to enquire into the natural history of this fish, and keep in mind the facts now admitted as the singular points of its development and growth, have heard of the great salmon-breeding establishment at Stormontfield on the Tay, and many are, no doubt, quite familiar with the plans and details of it. The Stormontfield Salmon Works were designed in the latter end of 1853, by Mr. P. D. Brown, M. Inst. C.E., of whom I was then a pupil. I was honoured with a large share in the arrangement and design, and was entrusted with the whole of the details and supervision of the contracts. These works have been often described, and their results debated. Savants from many countries have visited them, conversed with the careful and intelligent Superintendent, Mr. Peter Marshall, widely known as "Peter of the Pools," and the results of these observations have been given to the world of science year by year. But to one who had the interests and anxiety inseparable from the execution and working of so novel an undertaking, the opinions, deductions, and criticism of naturalists had an interest different from that with which the public in general could receive them; and now, on reviewing the doings in the way of introduction and acclimatization in the Australian and New Zealand Colonies, carried on during the past twelve years; with as yet but partial success, I am led to the conviction that the subject is by no means a very difficult one, and that, if a truly Colonial attempt is made, with proper arrangements, the result will be thoroughly successful.

An important point, bearing on the transit of the ova, was observed during the first winter's incubation at Stormontfield; and is, I find, not generally known. This is, the possibility of freezing the ova solid with the water for considerable periods without destruction to their vitality; and another well-known fact, on which I am sure the whole success of the acclimatization depends; has, in the recent venture in the Waikato and Thames—from the unexpected nature of the case—necessarily been dispensed with, I refer to the necessity of keeping the young fish for one or two years safely in streams and ponds. Regarding the first point above mentioned, I wish to guard against holding it as absolutely proved, beyond the extent to which my own observation went; and I am not aware of having observed any public notice of the facts, which are these:—In the design of the works it was foreseen that the shallow water in the hatching-boxes, would be, if unprotected, frozen solid in winter; and it was assumed that such an event would destroy all chances of incubation. With this in view preparations

were made for the use of a fine stream of spring water, rising in the woods to the eastward, and on the opposite side of the lade, or canal, from which the works draw their water. The pipes from this spring were not, however, laid when that season's stock of ova was deposited in the boxes, filling, I think, 276 of them and leaving twenty-four empty. The frost set in with severity before the spring-water—which had a constant winter temperature of about 45° Fah.—could be turned into the filtering-pond, and the boxes began to freeze. Immediate steps were taken to cover them with hurdles and straw, and with the rough woollen blankets used by the fish-merchants in despatching their salmon packed in ice to the London market. Before this was accomplished, however, two lines of boxes were frozen to the gravel, and were soon shapeless masses of ice. The frost lasted one month, and, in the thaw, the ice in these two lines of frozen boxes was broken up into lumps, in which the ova were seen retaining their natural appearance. Such an opportunity for experiment was not to be overlooked. The lumps of ice and imprisoned ova were deposited in the water of the boxes which had not been stocked. From the protected boxes, 252 in all, much ice, containing more frozen ova, was gathered and put with the rest, all of which quickly thawed, and the eggs were found in the gravel presenting a perfectly healthy appearance. The result was, the ova, which had been frozen during one month, was one month longer in the incubation, and, so far as I remember, produced just the same proportion of fish as the others which were kept above the freezing point. It was then remarked that, if the ova would keep safely in solid ice during one month, they would most likely do so for three or four, and so solve the problem of transit through the tropics. Although I am not aware of this circumstance having been remarked by writers on the subject, I notice that, in one instance, it is taken for granted that the freezing of the ova for a few days, or at most for a few weeks, is certain destruction to its vitality. It will most likely be found to depend on the period at which they are frozen. In the case mentioned the weather had been freezing from the date of spawning; but not with severity sufficient to freeze running water, so that, practically, the process of incubation had not commenced.

The possibility of, by this means, transporting healthy ova to the antipodes, became so familiar to my mind, and I judged it to be so well known, that when the (I believe) first attempt was made to effect it in the ship "Beautiful Star" in 1862, and failed, from the length and generally unfavourable voyage causing the ice to give out, I attributed it to the method of solid freezing having been ignored.

It is sufficiently proved, however, that the method of packing in moss and ice, and stowing in an ice-house, is capable of preserving the ova in

vitality sufficiently long to land them here in safety, so far as incubation is concerned. But I am convinced that it is a most important point to cause the period of incubation after deposit in the boxes on the breeding-grounds to be as long as possible, or at all events as near to the natural average period as can be attained. I believe the average at Stormontfield is 120 days, and nothing quite so long can be looked for; but it seems natural to suppose that ova landed here, with the certainty of being hatched in a few days, perhaps hours, will not have the same chance of producing healthy fish as those which experience the acclimatizing influence of two months in a cool southern stream during incubation. It may be admitted, however, that, by the exercise of very great care in the non-freezing method, the temperature may be kept so low as will effect the above end. But, if the solid method could, with certainty, be resorted to at the time of spawning, the trouble, bulk of stowage, and anxiety on arrival in the Colony would be reduced to a mere nothing.

The management after incubation, and the nursing, is the most important point, and is a subject fraught with some difficulties. If it is an essential part of the Stormontfield scheme—where the young fish or par, are in their natural waters—that they should be carefully tended for one and two years, how much more so is it important that they should so cared for here, when, acclimatization has in addition to be effected. Remembering the helpless state the young fish are in for nearly six weeks, with the ovum adhering as an umbilical sac, the numerous enemies in the eels and crayfish, of which they have to run the gauntlet, and above all, that for one and two years they must remain in a helpless condition, before migrating to the sea, it is not probable that, of the ten thousand ova which have now been distributed in the Waikato and Thames waters, there is a reasonable good chance of one returning from the sea as a grilse. Very helpless indeed, the young par are, as they are to be seen in the lower canal at Stormontfield, in thousands, during May and June, ready to pass into the nursing pond, and such, in unprotected waters must suffer fearfully. This points to the true cause of the Stormontfield success. It is not so, because it is a breeding place merely. Its nominal capacity is for 300,000, its utmost power of production under half a million, the produce of perhaps fifty fish, from one spawning bed out of a hundred or two beds equally good. Millions of fish are, no doubt, hatched naturally in the Tay each year, and that the comparatively small number bred at Stormontfield, told favourably on the river, can only be explained on the supposition that of the numbers of *smolts* reared in the river and artificially, the latter bears to the former a high ratio. In the ponds, the mortality is small, and loss from enemies nil. The *smolts* when sent to the river, remain there only so

long as enables them leisurely to reach the sea, where in their natural feeding grounds they rapidly attain size, and return to their rivers again as grilse.

Although par are exceedingly difficult to transport with safety, it has been accomplished; and to considerable distances. But it would be better to prepare nursing streams and ponds, even at every river-basin whose waters it is intended to stock. It is well known that the salmon do not, as a rule, return to any stream, but that from which they proceeded to the sea. These ponds and streams need be of a very simple design, the requirements being, plenty of cool, clear, and well aerated water, with good current over basaltic shingle. And of course, protection from floods and the entrance of eels. In this manner a colonial scheme ought to be entered into and carried out. But the details of the scheme are by no means few, and would necessitate careful study. The introduction should not be confined to one year, but a second, or even a third lot of ova would be desirable. The scheme could be capable of sending to sea each time, through every river selected as suitable in the colony, not less than ten thousand smolts, and perhaps 200,000 in all each year. And if some doubt attaches to the suitability of such rivers as the Waikato and Waipa, none can be expressed in regard to the magnificent shingle beds of the rivers of Canterbury and Otago, and other Southern Provinces. I can see no reason against these grand counterparts of the Tay, Dee, and Spey, becoming waters teeming with salmon, descended from progenitors which have not their equals for combined size and quality in the world, Salmon of 71 lbs. and 64 lbs. have been taken in the Tay. Fish like these are worthy to be the ancestors of future denizens of the Clutha and Waitaki, and let us hope, if only hope, of the Waikato also.

ART. XXVII.—*Contributions to the Ichthyology of New Zealand.*

By Captain F. W. HUTTON, C.M.Z.S.

[Read before the Otago Institute, October 26, 1875.]

THERAPON (♀) **RUBIGINOSUS**. sp. nov.

D. $\frac{11}{12}$, A. $\frac{3}{10}$, L. Lat. 80, L. Trans. 12/23.

Length three times the height of the body, or four times the length of the head. The diameter of the eye goes three and a half times into the length of the head. Scales ctenoid. Body compressed, the greatest height under the third dorsal spine. Mouth small, nearly vertical. A series of very minute teeth in each jaw; palate, apparently toothless. Præopercu-