

## 160.—SALMON AND TROUT HATCHERIES IN SCOTLAND.

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(1) **HOWIETOUN FISHERY.**—This fishery belongs to the Earl of Lauderdale, Stirling. It was commenced in 1873. From year to year it has been extended and perfected so as to have gained a world-wide reputation as a fish-breeding establishment. Upwards of ten millions of trout ova are now annually incubated at this fishery. Last season no less than 90,000 yearling trout were delivered from it to all parts of Great Britain and Ireland. Two consignments of trout ova and one of salmon were also forwarded successfully to New Zealand. Loch Leven trout (*Salmo levenensis*) is the specialty of the fishery. American brook-trout (*S. fontinalis*) and common trout (*S. fario*) are also extensively cultivated. All eggs are eyed on glass grills, experience having shown that the strongest embryos and healthiest fry are obtained by this method. The normal period eggs take to hatch is found (with water at 44.1° Fahr.) to be as follows: *S. fario*, 71 days; *S. levenensis*, 72 days; *S. fontinalis*, 73 days; and *S. salar*, 77 days. Every twenty-four hours about one million gallons of water flow through the pond system of the hatchery, which secures thorough aeration. There are no less than thirty-two fish ponds at Howietoun, and one botanical, the latter being in course of completion. There are, besides, four ponds at Craigend; and one of nine acres at Goldenhove, which is used for rearing fish for the fishmonger. Very important experiments in hybridization are being conducted at the fishery. The staff required for the working of the establishment consists of a manager, three men, and four girls; and there are in addition constantly employed four laborers and at least two carpenters. Mr. J. R. Guy is secretary of the Howietoun Fishery.

(2) **SOLWAY FISHERY.**—This was established by its proprietor, Mr. Joseph J. Armistead, in 1881, superseding Troutdale Fishery, near Keswick, Cumberland, which was established in 1868. It is situated near the Solway, in Kirkeudbrightshire. Hatching on glass grills is also pursued at this fishery, the percentage of loss being thus reduced to a minimum. Mr. Armistead breeds at his establishment several kinds of trout, and char, salmon, and sea trout, grayling, and other freshwater fishes. The hatching house is capable of holding several millions of ova, and at present contains apparatus that will hatch about one million. A meat-house, ice-house, filter-house, and other buildings have also been erected; and these, with nineteen ponds in operation, and two in course of construction, occupy about an acre of ground. A museum and laboratory have been commenced to facilitate the study of the various details connected with the fishery. The ova and fry esti-

mated for distribution from the fishery, during the season just commenced, is something short of one million, including British and foreign, the bulk of the latter coming from Norway. Small, as well as large, quantities of ova are supplied from the fishery to enable amateurs to try experiments in fish-culture; and an illustrated catalogue of the apparatus required for conducting such experiments, and containing instructions, may be had on application by post. Mr. Armistead also supplies a list of aquatic plants as a suitable and most important adjunct of fish-culture; likewise proper food for trout, in the form of fresh-water shrimps, mollusks, fish meal for feeding fry, &c. Mr. Armistead's postal address is Solway Fishery, near Dumfries.

(3) STORMONTFIELD PONDS.—These ponds were erected in 1853 by the then proprietors of salmon fisheries on the Tay. They are situated about five miles above Perth, on that river, and occupy, roughly, about two acres of ground. Under Mr. Robert Buist, at that time the superintendent of the Tay fisheries, a long series of experiments was conducted, proving many interesting points in the life history of the salmon. These experiments—well known as the “Stormontfield Experiments”—demonstrated, not only the practicability, but the profitability of rearing salmon artificially. The Stormontfield ponds are now superseded by the Dupplin hatchery (referred to below), but are still used for purposes of breeding and rearing. The breeding boxes number 360, and are placed in thirty parallel rows, in the open air, on a gentle slope. Of these boxes some 200 are being used the present season. They are laid with gravel. The present superintendent of the Tay fisheries, Mr. Alexander H. Lumsden, states that in his experience the percentage of loss is very great as compared with that under the new system followed at Dupplin. The two rearing ponds at Stormontfield have been stocked for this season with about 20,000 fry from the Dupplin hatchery, which are doing well, and are now parr about 2 inches long. The fry, fed on ground liver, are kept for about two years in the ponds before being turned out into the river and tributaries.

(4) DUPPLIN HATCHERY.—This new fish-breeding establishment of the Tay District Board is situated at Newmill, Dupplin castle (the property of Lord Kinnoull), Perthshire, on the river Earn, a principal tributary of the river Tay. It was instituted late in 1882. The hatching house is fed by spring water, at the rate of about 12 gallons per minute, which, however, is increased about a half more after the eggs are hatched. The gross hatching capacity of the boxes is estimated at 300,000. These are placed in four rows, fifteen being fitted up on the glass grill system, and five with the Wilmot tray, the whole at present containing, it is calculated, some thousands over the estimated capacity. It has been found that a much larger proportion of loss in eggs and young fish has marked the boxes with the Wilmot trays. But, on the other hand, about a third more of eggs can be laid in a box fitted with the trays, which is an advantage if ova is plentiful. An attend-

nant in special charge of the hatchery keeps a daily account of loss in eggs and fry during the whole season. The loss for the past season amounted to  $2\frac{1}{3}$  per cent. The number of days in hatching has been 64, on the average, the lowest number being 59; water temperature, 45 degrees. The fry are kept till about 40 days old, and then are distributed in the river Tay and its tributaries.

(5) LOCH LEVEN HATCHERY.—The hatching house in connection with the well-known Loch Leven fishery (Kinross-shire) was erected in 1883 by the Loch Leven Angling Association, Limited, assisted by the proprietor of the lake, Sir Graham Montgomery, Bart. The cost of erection was £229 19s. 2d. [about \$1,115]. It is situated about 800 yards from the loch, beside a small stream. The water supply is got from a spring, about 600 yards from the house. With a temperature about 44 degrees, the period of hatching is from 66 to 72 days. There are 12 boxes—9 fitted up with glass grills, and 3 with Wilmot trays. Last season about 180,000 eggs were laid down. The percentage of failure was exceedingly small. The fry were strong and healthy, and were distributed in the spring months in the several feeders of the loch. This season, about 220,000 eggs have been laid down, under the superintendence of Captain Hall, who intends putting the fry into the loch tributaries five or six weeks after hatching. Prior to the erection of a special hatching house for the loch, Lord Lauderdale has, at different times since 1874, stocked it with Loch Leven fry and trout, bred at his own fishery.

(6) LINLITHGOW PALACE LOCH FISHERY.—This fishery was opened in May, 1884. It belongs to Mr. A. G. Anderson, fish merchant, Edinburgh, who has leased the loch for angling purposes from the Crown. A hatching house has been erected close by the loch on a small stream. Two ponds are attached—one for adult trout, and the other for rearing fry. A third and larger pond made of concrete is in course of construction, for stock purposes. The entire hatchery and ponds occupy about 2 acres. The hatching capacity is estimated at 600,000. For hatching, glazed terra-cotta troughs or tanks, and boxes covered with pitch, are used. The former do not give the same amount of space as the latter, in which are placed layers of perforated zinc trays—three or four to each box—thus providing a holding capacity of from 16,000 to 20,000 per box. Over 200,000 ova are already laid down for the season; but a large number of trout have still to be stripped. Last month 300,000 young trout, all strong and healthy, and measuring from  $3\frac{1}{2}$  to  $5\frac{1}{2}$  inches in length, were put into the loch. Mr. Anderson finds the eggs hatch out in about 62 days, at a temperature of about 45 degrees. Last season the loss in hatching was about 3 per cent. So successful has Mr. Anderson's hatchery been that he has erected another house—made of wood (50 feet long and 7 broad), covered with felt—with an estimated hatching capacity of 300,000. Young salmon hatched from the ova, taken from a dead fish killed by the salmon disease, have thrived remarkably well. There is also a tank of ova in the hatchery taken

from a female trout that had been twenty-four hours dead, and impregnated with the milt of a male fully four days dead. These eggs have now been in the tank for about three weeks, and are looking healthy—the loss at present being only  $1\frac{1}{2}$  per cent. A large arrival of Schoodic or landlocked salmon ova is expected at the hatchery from Washington, United States, and also a consignment of "Great Lake" trout ova from the Seewiese fishery, Wurtzburg, Germany.

(7) MARQUIS OF AILSA'S HATCHERY.—This private hatchery is situated at Culzean, in Ayrshire. It was commenced in 1876. In that year a few boxes only were erected outside the vineries in the gardens at Culzean castle, and put under the charge of the gardener. These boxes held about 85,000 salmon ova, which did pretty well; also 2,000 char; 2,000 *S. fontinalis*, and a quantity of common yellow trout. When the wind was high, however, it was found difficult to attend properly to the boxes outside owing to the rippling of the water—any bad eggs being, from this cause, not easily seen. In the following year, therefore, the boxes were fitted up anew in the peach house on a much larger scale. They are now capable of hatching out 250,000 salmon ova yearly. The ova is got from the Doon, Stinchar, and Minnock—the fish being artificially spawned when netted—and the fertilized ova thereafter conveyed in cans to the hatchery, a distance of 25 or 30 miles. For the last six years there have also been annually hatched 10,000 Rhine salmon. In addition, char, *S. fontinalis*, and Loch Leven trout, have been hatched annually, and introduced into the hill lochs on the property. The eggs are hatched on gravel, with a constant supply of pure water flowing through the boxes; and very satisfactory results have been obtained. The fry are turned out into the river Doon immediately on absorption of the umbilical sac, being conveyed in cans a distance of 10 miles from the hatchery, and put into the river about 8 miles from the sea. In two seasons, when ova was plentiful, over 300,000 ova were hatched. There are ponds in which the fry were at first kept till they were a year old, but these have been abandoned, as it has been found that the present practice of putting the fry out when the sac is absorbed is equally satisfactory. Mr. Young, the inspector of Scotch salmon fisheries, says in his second report, in which the Ayrshire salmon rivers are described: "Thanks to the enlightened liberality of the Marquis of Ailsa, the number of fish in the river Doon has been greatly increased by means of artificial stocking."

(8) BENMORE HATCHERY, KILMUN, ARGYLLSHIRE.—This hatchery was constructed by Mr. James Duncan, of Benmore and Kilmun, in 1874, after the plan of Stormontfield, for the purpose of stocking the river Echaig with a larger class of salmon. The results were very marked, not only in the greater number, but in the increased weight of the fish caught. Prior to the introduction of the hatching boxes, the grilse caught weighed about  $3\frac{1}{2}$  pounds—rarely exceeding 5 pounds, while salmon weighed about 7 pounds. After the introduction of the boxes,

grilse were seldom got under 5½ pounds, while the heaviest salmon caught in the river in 1882 weighed 18 pounds. In Loch Eck, out of which the Echaig flows, fish weighing nearly 30 pounds have been taken with the net. The capacity of the hatchery is 100,000 ova. In the season of 1882, 80,000 young salmon from Tay and Tweed ova, after the absorption of the umbilical sac, were turned into the river and tributaries. The boxes are filled to within a few inches of the top with coarse gravel, a layer of finer gravel above forming the bed for the ova. The loss has not exceeded 5 per cent. The hatchery has been idle for two seasons, it being questionable if any permanent benefit can be had in the attempt to stock small rivers on the west coast at present.

(9) LOCHBUY FISHERY, ISLE OF MULL.—This fishery was established in 1878. It is the property of Maclaine of Lochbuy. Upwards of 50,000 ova of salmon, sea and other varieties of trout (*Salmo fontinalis*, &c.), are annually hatched. The proprietor every year imports eggs from Norway, Germany, Austria, and America. There are large ponds for the reception of fry and for keeping breeding stock. The specialty of the establishment is the breeding and rearing of salmon and sea trout (spawned from the wild fish caught in the rivers on the property), for the restocking of the rivers and lakes on Lochbuy estate for sporting purposes. Large sheets of water on the estate, which were utterly untenanted by fish, now teem with splendid varieties, and afford magnificent sport to the angler. The proprietor not only stocks his own waters, but also sells ova, fry, or grown fish.

(10) ABERDEEN HATCHERY.—This hatchery was established in the end of 1863 by the district boards of the rivers Dee and Don, and has been under the experienced management of Mr. Alexander Adam, manager of the Aberdeen Salmon Company. It is erected in the fish house of the salmon company, where a quantity of ice is always kept. The average time of hatching is 107 days. There are 13 boxes made of slate laid in with gravel. From 15,000 to 20,000 are hatched out every year. The fry are distributed in the rivers Dee and Don as soon as the umbilical sac is absorbed. The average loss in hatching has been found to be about 7½ per cent. The fry are taken up the rivers from 10 to 20 miles, sometimes as far as 40 miles, in pails, and, by using a little ice on the way, the temperature of the water is kept down.

(11) THE MORISTON HATCHERY, INVERNESS-SHIRE.—This hatchery was erected in 1878 on the property of J. R. J. M. Grant, esq., of Glenmoriston, for the purpose of stocking the river Moriston with salmon. The Moriston was not accessible to salmon until a pass was formed, a few years ago, at the falls, near Loch Ness. The hatchery is situated 3 miles above the falls on a tributary of the river. There are 40 boxes laid with gravel, each large enough to receive 1,000 salmon ova. Neither the glass grill system nor the Wilmot tray has yet been tried. An average of about 30,000 fry were turned out in each of five

years; the fry from the hatching of the spring of 1883 only being turned into a temporary pond, where they were kept until they were a year old. A few salmon are seen every year ascending the pass into the river, which is strictly preserved, it being thought desirable not to disturb the water yet, either by rod or by net, for the purpose of sport or of collecting ova. Mr. Grant is anxious to make the Moriston an early fishing river, and, with this view, takes ova only from other early rivers. Some of the proprietors of these rivers in the neighborhood are averse to disturbing their waters for the collection of ova, and the fishery boards, in the absence of unanimity on the question, do not see their way to give authority to take ova, as they doubt whether they have the power to do so under the present law; consequently, the hatchery has not been filled during the last two spawning seasons.

It appears that the Duke of Sutherland's hatchery at Loch Brora, Sutherlandshire, and the Duke of Buccleuch's ponds at Drumlaurig, Dumfriesshire—the latter so celebrated in connection with the experiments and observations conducted there by Mr. Shaw, bearing on the life history of the salmon in its early stages—are not at present in operation. Information has been sought, but not obtained, regarding the artificial ponds which were at one time kept on the river Thurso; so that it is not known whether these ponds are still used. The same remark applies to the ponds which were, at one time, kept at Inyershin, Sutherlandshire, by Mr. Andrew Young, whose name ranks with those of Shaw and Buist as a close observer of the early life history and migrations of the salmon. The hatchery formerly kept at Rossdhu, Loch Lomond, has, it is understood, fallen into disrepair, not having been used for a good many years. The two ponds, however, still remain, and, as boxes could be erected without much expense, this little establishment might, with very little trouble, be resuscitated. At Ravenscraig Castle, on the river Ugie, Aberdeenshire, a set of hatching boxes at one time was maintained. It was considered, latterly, that the Ugie fishing was not much benefited by the operations conducted. A hatching establishment existed at Tongueland, on the river Dee, Kirkcudbrightshire, for some eight or nine years prior to 1871, but, after the death of the then tenant of the fishings, Mr. John Gillone, it appears to have been allowed to drop. His sons, however, it is understood, contemplate its revival. The district board of the South Esk (Forfarshire) placed a few breeding boxes on a tributary of that river a good many years ago, but these apparently did not succeed and do not now exist.

It is not pretended, however, that this reference to hatcheries and ponds that have once been in operation, by any means includes all that have existed in modern years in Scotland; as it is believed that many private individuals have, at different times, made experiments in fish-culture on a larger or smaller scale.

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