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FISH-CULTURE:

A PRACTICAL GUIDE

TO THE

MODERN SYSTEM OF BREEDING AND REARING FISH.

BY

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OF GREAT BRITAIN.

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P R E F A C E.

THE practice of Pisciculture has become a matter of such public interest and importance, that I am induced to put forth this little treatise, not because no works on the subject have been published before, but because there are many points which are extremely interesting in the science, and which, in all probability, will become the most popular part of it, which have been hitherto almost overlooked.

My design is not only to show my readers how they may hatch the eggs of fish, but how they can best bestow their energies, and direct their studies and experiments, as a means towards increasing the supply of wholesome fish

food ; to review the various fresh-water fish found in Great Britain, and point out those which are most valuable to us, and how they may best be distributed, cultivated, and increased ; and, further, to consider the merits of such fish as it may be advisable to acclimatize, but which are not at present included in our Fauna. Comprehensively considered, my plan is to indicate how water may be made most productive, and what should be done with those vast aqueous deserts of lake and stream which are now comparatively valueless, but which would be mines of wealth to us were it not for the ignorance which generally pertains to everything vitally connected with this subject.

I believe water—neglected, ill-used water—if properly tilled, to be much more valuable than land, through its greater productive powers¹

¹ What edible animal is there that exists on land which possesses the capability of reproducing 9,000 of its own size in a period little exceeding eighteen months? This can, however, be performed by a grilse of eight or nine pounds' weight. A grilse of this size will deposit, say, 9,000 ova ; in about fifteen or sixteen months the fry from this ova go down to the sea, and in two or three months more they have been known to come back to the river as grilse of from five to ten pounds' weight.

—powers which are greater because we have a combination of two elements, both land and water, helping and encouraging each other in the work of reproduction—and where the best species of fish, as salmon and trout, can be cultivated, it is capable of yielding a revenue very far exceeding that of land alone.

Water requires few or none of those expenses demanded on land. Left to itself, it produces and reproduces to a degree which, computing by acreage, very far transcends the land. What would our rivers and streams be worth if brought back *only* to a state of nature, if man had not (instead of cultivating them) almost destroyed them? But ought we to be satisfied to restore our streams to their natural state, and content to leave them so? Is water-culture so difficult a study, so recondite in its secrets, so partial and uncertain in its results, that it should not vie, by the means of study and experiment, with agriculture? Surely the results already obtained do not tell us so; much rather do they encourage us to pursue our inquiries, that we may win from Nature her secrets and profit thereby. We know something of the

science, but how many valuable secrets remain to be explored !

The mere artificial hatching of fish is by no means a difficult operation if a plentiful supply of clear and cool water can be obtained. But the points chiefly to be considered are, how are fish to be fed and fattened when they are hatched ; what suits them, and what does not ? There is no difficulty in producing any number of fish, but the rearing them until fit for food is another matter. We often hear of the fish in certain waters dying off without being able to discover the cause. Some weed, or insect, or other matter which is very prejudicial to fish, may have become mixed with the water ; and we ought to be able to detect the cause at once, and with certainty. We ought to know how such things are to be prevented, and what the diseases of fish spring from. But we do not.

The agriculturist knows to a head or two what amount of stock his farm will carry. He knows what kinds of roots are best suited, not only for stock to feed on, but for his various fields to grow. The cold land suits

one thing, the dry land another. This land will grow swedes and that corn, this rye-grass, and the other some other crop. He knows what species of food, and what variety of it, will fatten his stock the quickest. He knows what roots and cereals are the most productive and pay best, and in what order they should be planted. He knows what breeds of stock suit his farm, and where to put them, and when it is most profitable to him to get rid of them. As a breeder and feeder, he knows how to cross-breed and feed his stock, so as even to change the very frames and carcasses of his cattle into the shape most favourable to his interests; and how has he arrived at all this, but by study and experiment?

Contrast our knowledge of water-culture with that of agriculture, and the result is simply degrading. We should know what kind of food suits our various fish best, and what conditions best produce that food, and how those conditions are best to be cultivated, *so that such food may be self-producing*. Hence it will be seen that the habits of all the insects and plants found in water, and their correlative agreements and

dependence upon each other, must be studied. Going lower still, the conditions that suit these conditions, even to their chemical and microscopical analysis, peep out, and a grand scheme of a new science, a new phase of creation, is, as I have said, dimly foreshadowed, in which the food of man is the dependent consideration.

Were we to study to understand the position in creation which every insect fills, the great secret would not be to us the jumble which it is, and we should begin to appreciate the beauty and harmony of the works of the Creator, and to see the wickedness and absurdity of interfering to disarrange them. The aquarium has hitherto been an interesting scientific trifle; henceforth it should be a link in this great chain of observation. It will be seen, by the few remarks I have made, that this science requires to be, and is capable of being, widely popularized. I shall touch further on these matters in the body of my work as I find occasion.

It may be urged that, in the succeeding pages, I have taken somewhat too wide a range of subjects into the study of Pisciculture. I do not

think so, however, if this science is to become as popular among us and as beneficial to us as it should be. The mere hatching and rearing of small fish appears to me to be but an integral part of Pisciculture; and it will not be denied that considerations as to the best kinds of fish to encourage, and how to encourage them, with the best methods of producing suitable food for them, are necessarily points of as much importance as that of bringing them into the world.

I have now only to add, that since the publication of the First Edition of this work, the practice of fish culture in this country has received considerable impetus, and many events have taken place which rendered a wide revision of the book necessary; and I have therefore thought fit not only to revise and re-write many of the chapters, but to add others, and to make many additions to the stock of information they originally afforded.

Not the least important, perhaps, of these events, is the formation of a public Piscicultural establishment, under the auspices of the Acclimatisation Society of Great Britain, which esta-

blishment has been placed under my management; and thus I have enjoyed peculiar advantages for bringing my account of the knowledge and practice of the art down to the very latest period. This additional information, I cannot doubt, will be most useful and acceptable to my readers.

FRANCIS FRANCIS.

THE FIRS,
TWICKENHAM.

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FISH CULTURE.

INTRODUCTORY CHAPTER.

THE ORIGIN AND PROGRESS OF PISCICULTURE.

PISCICULTURE is said to have been originally discovered by the Chinese, those barbarians to whom civilization owes so large a debt, even for its silk and its tea, and many most ingenious and useful inventions. The art was practised by the Chinese from time immemorial, and the scale upon which they have employed it is far larger, and more comprehensive, than has been since adopted. Planting in suitable places in their rivers large posts, to which a framework was attached, they placed thereon faggots and hurdles for the fish to spawn on. That operation completed, they removed the hurdles, &c., collected the eggs, and either hatched them under their own immediate supervision, or stocked other

streams with them. By this simple but effective process, the rivers of China have come to abound with fish, to such an extent, that it forms the staple of food amongst the lower classes.

The Romans followed the Chinese in their practice of pisciculture. During the republic, the art was employed to supply the wants of the nation; under the empire it was extended and improved by the luxurious nobles, until it became a hobby upon which the ambitious gourmand lavished his treasure to an extent which, even in the present age, would be regarded with wonder. Speaking of the achievements of Lucullus, M. Jourdier (one of the French pisciculturists, who has written an interesting work upon the culture of fish, leeches, &c. &c.), quoting M. Guezon Duval, says that, "at his house at Tusculum, on the borders of the Gulf of Naples, he dug large trenches, or canals, running from his fishponds to the sea. Into these canals the fresh-water streams were conducted, and a pure running water thus kept up. Many of the sea-fish, which spawn in fresh water, entered these canals and stocked the ponds with their fry, and, on their return to the sea, flood-gates were placed at the entrance of the canals, closing the passage, and while their posterity was growing, the fish themselves furnished the market."

These proceedings on the part of Lucullus were imitated by the Roman patricians, at their villas, on the borders of the Gulfs of Baïæ and Naples; and at a later date, we have almost fabulous stories of the cultivation of lampreys, and the prices realized by red mullet of large size, and other fish. M. Jourdier further adds a note, to the effect that this process is carried on at the present time, in much the same manner, on the rivers of the Basin of Arcachon, "MM. Javal, Borsnere, and several large river proprietors, having there immense reservoirs, whence they and their farmers draw very large revenues." This may have been very ingenious on the part of Lucullus, and is no doubt profitable to MM. Javal and Borsnere, but if they only supplied the market with the spent fish, which are on their descent to the sea, I do not respect the taste of the purchasers.

Continuing his remarks upon the pisciculture of the ancients, M. Jourdier speaks of the oysters of Lake Lucrin, their cultivation having been originated by Sergius Orata, in the time of Crassus. These oysters were brought from Brindisi, and Sergius Orata led the public to believe that the flavour of the oysters was greatly improved by their residence in Lake Lucrin. Hence they became shortly so popular, that he covered Lake Lucrin with contrivances

destined for the breeding of oysters. The Lake of Fusaro, a salt lake between the ruins of Cumæ and the promontory of Misenum (the Avernus of the ancients ; the Acheron of Virgil) and of which I may speak hereafter, furnishes another proof of the skill which the ancient Romans brought to bear upon this favoured art. As regards the practice of pisciculture later on and during the middle ages, we have abundant evidences of the high estimation in which it was held by the monks. Indeed, it became a matter of serious importance to them, from the supposed requirements of their religion, and the natural difficulties which often presented themselves to the providing of a supply of fish at all adequate to the wants imposed by the fasts they observed. M. Jourdier attributes to Dom Pinchon, a monk of the Abbey of Réome, who lived in the fourteenth century, the discovery of the method of breeding and rearing fish by means of wooden boxes. The ends of these boxes were of wicker-work, and in the bottom of them sand was deposited ; excavations were made in the sand, and the eggs of the fish deposited therein, a gentle stream of water being then turned on, and run through the boxes. As far as I can understand this method, which seems very simple, there is little difference between it and the plan at present adopted.

Subsequently to this, but more than a century ago, we find another discoverer who appears to have practised the artificial hatching of fish, and in a very complete and simple manner. This was Lieutenant Jacobi, a German gentleman. His mode of proceeding is detailed in a series of papers published in the *Hanover Magazine*, in 1763—4 and 5. This gentleman appears to have experimented upon various kinds of fresh-water fish, and to have been successful with all of them. The plan he adopted for hatching salmon and trout was to construct a long oaken box, with fine gratings at the top and ends; to fill it partially with gravel, and, having procured the ripe spawn from a female fish, and fecundated it by mixing it with the milt of the male, to deposit it in the gravel in the box; and having then placed the box in a clear running stream of a suitable depth, he left the task of incubation to nature. Sir Humphrey Davy, in his “*Salmonia*,” gives a full account of Jacobi’s plan and proceedings. And this plan, with little alteration, is in use at the present day. But the art, from some cause, for a long series of years, fell into disuse, and was well-nigh forgotten, when Mr. Shaw, of Drumlanrig, being anxious to decide the “parr question,” carried out a series of experiments, which extended over many

years, viz. from 1833 to 1839. In 1833 and the following years, he took young parr from the river, and experimented with them. In 1836 he collected spawn from the natural beds deposited by the salmon themselves, and hatched it by artificial incubation. In January, 1837, having prepared suitable beds and basins for hatching and rearing the fish, he caught a male and female salmon in the Nith, expressed the roe and milt in the manner at present employed, and placed it in the beds prepared,¹ hatched and reared the fish, and kept them until they reached the smolt state. So that in this country Mr. Shaw must be deemed, if not the discoverer, the first person who has of later years practised the art, and given the results to the public; and as far as actual results are concerned, it has all the merit of a discovery. In France, Messrs. Gehin and Remy, two French fishermen of Bresse, in the department of Vosges, may be said to have re-discovered the art, as far as their own country is concerned. They were poor, and to an extent ignorant fishermen, who clearly had nothing but observation to trust to. Certainly, their discovery led to more immediate and

¹ Whether Mr. Shaw took the idea or no from "*Salmonia*," I cannot say, but he would in all probability have read that work.

active results than ours did; probably this may have been from the fact that the art was really more requisite for the re-stocking of the exhausted rivers. However this may be, Gehin and Remy having carefully noted the whole process of depositing the spawn, it occurred to them that this process might be carried out artificially, and, thereby, vast quantities of ova, then yearly sacrificed (the fish being taken in the spawning season), having been properly fecundated, and planted in the river, might be saved, and little comparative damage would be done to the fisheries by the practices unfortunately so much in vogue.

Having by experiments found that their plan was perfectly feasible, they commenced their operations in 1842, although it was not until 1848 that their claims to public consideration were acknowledged. From that time, however, they successfully carried on their process in various streams, both in France and in Germany. About this time M. Coste, Professor of Embryogenie in the College of France, took up the subject, having been attracted to it by his experiments on the embryos of fish; and hearing of what Gehin and Remy were doing, he represented the matter to the Minister of Agriculture and Commerce. The attention of the Government was arrested. The

subject was considered, and finally it was determined that a grant of 30,000 francs (1,250*l.*) should be made, to create the establishment which subsequently arose at Huningue. A brief description of the piscicultural establishment at Huningue may not, perhaps, be altogether out of place here.

This establishment is situated at no great distance from the Rhine, near the Rhine and Rhone Canal, and in the neighbourhood of some large springs, the water from which is used for the partial hatching of the ova—for a comparatively small portion of ova is really hatched at Huningue, the ova being sent away to all parts of France, and even Europe, when it is so far vitalized that the eyes of the embryo within can be discerned. These eggs are then placed in receptacles prepared for them, and the process of incubation is completed.

The space covered by the establishment at Huningue is about thirty-six hectares (about seventy acres), and on this handsome buildings of considerable size are erected, with suitable offices for the manager and the attendants; these buildings being disposed in the form of a square, the middle or chief one containing the offices. This is forty-eight metres long by eleven metres wide. The buildings which stand at right angles to it are two sheds, each sixty

metres long by nine wide;¹ the other side of the square being composed of two guard-houses. In the centre is a court, with shrubs and two small basins or reservoirs. In the principal building, on the ground floor, is a pavilion, in which experiments which require particular care are conducted: over this are the offices. The grounds are laid out and interspersed with fish-ponds, ornamental plants, flowers, &c. These ponds are fed partly by the Rhine water, and partly by the little rivulet of L'Augraben, which traverses the grounds. The spring water is conducted to the buildings in which all the operations are carried on by pipes entering the building in three brick trenches, this water is then raised to the proper height by means of pumps worked by turbines, these turbines being driven by the water of the Rhine. In case of any failure of the supply of spring water, the water of the Rhine, which has been previously carefully filtered, can be turned on to the apparatus. Rows of cisterns, about a yard in height, extend through the whole length of the buildings. These cisterns are each about ten or twelve yards long, a yard in width, and eight inches deep. The ova is placed upon a glass grille, a species of gridiron composed of hollow glass bars or

¹ A metre equals about 39 $\frac{1}{2}$ inches.

tubes, placed closely together, the ends being confined in a sort of rack, made of wood. Each grille is placed in a small earthenware trough, glazed on the inside, this being the best preventive to the growth of confervæ. The troughs are placed crosswise in the cistern, and are about six inches wide and four or five deep. A tap at the head of each cistern permits the water to flow slowly over the range of about four or five troughs throughout the cistern, the same jet of water being used only for from four to six troughs. It will be seen that these troughs can, therefore, easily be removed separately for examination. In

FRENCH TROUGH AND GRILLE.

the building on the left operations requiring care are carried on. This building also contains brick basins for rearing. All these processes are carried on within the buildings, and thus extreme frost, or glare and heat of the sun is avoided.

The ova was formerly collected, by men who made

a business of it, principally from the Rhine, the Danube, and the lakes and rivers of Switzerland and Germany. The tariff for collecting these eggs was about two francs per thousand; but it was found that immature eggs were sometimes sent, and a difficulty of proper carriage resulted; and now the plan adopted is as follows: The establishment is in correspondence with all the principal fishermen at the above places. When any of these fishermen have collected together a large number of fish in a spawning state, they send notice of it to Huningue, and one of the manipulators, of whom three or four are kept upon the establishment, is sent to take the spawn, and bring it to Huningue; a certain fixed sum being paid per thousand for the various species of ova to the fishermen, who then sell the spent fish for food. The eggs which are the most difficult to obtain are those of the Ombre Chevalier; they cost the establishment nearly one penny each. All the best kinds of fish which we have in England, and some which we have not, as the Fera, the Huchen, and the Ombre Chevalier, are included in their list of operations.

When the applicant is successful in obtaining a promise of spawn, printed lists are sent to him, one comprising the fish which breed during the winter months, and one of those which do not deposit their

spawn until late in the spring. Thus, two distinct classes of operations are kept alternately in progress.

The establishment employs several men constantly, at some periods of the year, of course, to a larger extent than others. In the winter, from a dozen to twenty men or more are required to attend to the various branches of the work; and, lately, even this number has been greatly increased, as the exportations of fecundated and partially incubated eggs since 1853 has increased from one million odd a year to sixteen millions. Save for the producing of food for the young fry, or as stock fish, or where new breeds or experiments are conducted, comparatively few fish are kept on the establishment.

The method of packing and exporting the ova will be explained in another portion of this work, so I need not further allude to it here.

Several millions of partially incubated ova of the various kinds of fish treated here are thus yearly sent to the various rivers of France. But large quantities of ova are also sent abroad to various parts of Europe, for the French Government are by no means selfish in respect to the benefits they desire from the art practised at Huningue.

The total cost of the buildings, &c. from 1853 to 1863, was 265,186 francs, or 10,607*l*. The yearly

expenses in salaries, travelling, carriage, &c. are 2,200*l.*, and it is calculated that Huningue produces *twelve live fish for one penny.*

Branch establishments are springing up all over France, under the patronage of that of Huningue. I think it is stated that there are already above a score of these.

Such is the first great piscicultural institution established in Europe ; and if it is creditable to France that she should take the lead in this department of science, it is, on the other hand, discreditable to ourselves.

Since the first edition of this work was published, we have formed an establishment upon a very small scale in imitation somewhat of that of Huningue. This establishment I was the means of creating, the idea having been adopted by my advice by the Acclimatisation Society of Great Britain.

A large shed was built in my grounds at "The Firs," Twickenham. A slate cistern, capable of holding 2,500 gallons of water, erected, and two ranges of trays upon the French system set up ; reservoirs and tanks were also made in aid of the undertaking, and during the first year's operations, although everything was untried, and our resources most uncertain and unreliable, nearly 60,000 ova

and fry of various fish were distributed amongst the members of the Society, and in the aid of various patriotic undertakings for the public benefit; and this number would have been very largely increased but for the unusual sultriness of the season, which, during the months of March, April, and May, was hotter than has been known for eighty years previous, and the consequence (owing to the water supply being so limited) was, that an immense loss of fry and ova took place. In all probability this establishment will be greatly improved and extended in process of time, so as to be of national benefit, as regards the introduction of new fish and the distribution of others. The entire cost of the building and working operations was under 300*l*.

Before entering upon the subject of our inland fisheries, I shall give a brief list of the principal fish we already have in them, and of those which it may be desirable to acclimatize. Of each of these fish, I shall treat according to its importance in the proper place.

SALMONIDÆ.

The Salmon.		Charr. Two kinds.	
		The Greyling.	
Salmon Trout.	{	Powan,	<i>Corregoni.</i>
Bull Trout.		Pollan,	
Lake Trout (<i>Salmo ferox</i>).		Gwyniad,	
Common Trout.		Vendace,	

Of the common or coarser fish, we have—

The Eel.	The Gudgeon.	The Barbel.
Burbot.	Carp.	Bleak.
Lamprey.	Tench.	White Bait.
Lampern.	Roach.	Shad.
Sturgeon.	Dace.	Fresh-water Cray-
Perch.	Bream.	Fish.
Pike.	Chub.	

Fish which might be acclimatized—

The Huchen.	The Sander (<i>Lucio perca</i>).
Scandinavian Charr.	Black Bass.
Ombre Chevalier.	Maskinongè.
Ide.	Silurus. ¹
Murray Cod.	Mountain Mullet.

Of the Corregoni—

The Fera.	The Lavaret.
White Fish (<i>Corregonus albus</i>).	
Otsego Bass (<i>Corregonus otsego</i>).	

¹ Now in process of being acclimatized.

CHAPTER I.

OUR INLAND FISHERIES.

THE waters of our inland fisheries must be divided under two heads, viz. those which are capable of producing salmon, and those which are only capable of producing fish of less value.

As the salmon is of infinitely the greatest importance, I shall treat of it first.

In olden time there can be no doubt that salmon was far more abundant than it is now ; and we hear of its being a common practice of apprentices to have it entered in their indentures, in many places, that they were not to eat salmon more than a certain number of times per week ; and it is in the memory of many that servants have rebelled against being fed to a great extent upon salmon. It may be urged, in mitigation of this fact, that before railways were, the expense and difficulty of transporting salmon for long distances caused a vast supply of this fish oftentimes to be thrown upon certain limited districts, and

fresh salmon was thus, for want of outlet for the sale, frequently sold at as low a price as $1\frac{1}{2}d.$ and $2d.$ per pound;¹ and therefore the over-abundance in these particular districts, and the scarcity which exists there at all times now, is no fair criterion of the actual decrease of production. But while allowing all due weight to so reasonable a view of the case, we are fortunately enabled to set the point at rest by the irrefragable testimony of statistics. Statistics of the produce of various rivers have been kept for a long series of years, and we constantly find that some rivers have fallen to less than half of their former productiveness; in others salmon have been almost or quite extinguished; and others, again, have suffered in various degrees. The great cause of this decrease is in every instance (save where mines and factories have utterly poisoned the rivers) the same, viz. that the stock is too reduced, a sufficient amount of breeding fish not being allowed to deposit their spawn in the rivers to keep up the stock.

Now, the general reader may understand the case if we put it thus:—Let us suppose a farmer to have a farm capable of supporting a thousand sheep. Let

¹ During the present season good salmon has been sold at Billingsgate at as low as $3\frac{1}{2}d.$ a pound. These fish, however, came from Norway.

us further suppose him to be so supremely foolish as to yearly kill all his sheep indiscriminately down to some fifty, not excepting even those which are about to drop lambs, nor those lambs which are just born. It is abundantly clear that his fifty sheep will not keep his farm stocked, and that ruin must in time ensue. Yet still he goes on slaughtering, and wondering that his farm does not produce as many sheep as it did formerly. This is somewhat the case on many of our best salmon rivers.¹ But to make the case still more clear to those unacquainted with the salmon, save through the medium of a fish-monger, we must briefly trace the natural history of the salmon as it is generally set forth and accepted by those best acquainted with it. Salmon leave the sea, and run up into the rivers, at all times of the year, for the purpose, sooner or later, of depositing their spawn in the shallows and fords of the higher parts of the rivers. Some enter the rivers in the spring, and push their way up from pool to pool through the summer, until they reach the upper waters, and these are of course the first

¹ The causes of the decrease of salmon, and how it befalls that a sufficient number of fish do not run up the rivers to spawn, will be found in a practical detail of the modes of slaughtering salmon, (practised but lately, and not yet altogether in disuse,) in the Appendix.

to spawn, and, being so early, they are infinitely the most valuable fish to a river ; others, again, enter the rivers in the summer ; but the great rush of breeding fish does not commonly take place until about August or September (and sometimes they are later still), when on the first flood that comes down the river after they reach the estuary, they commence running up, being assured that there is plenty of water over the fords and shallow places for them to pass up to the best spawning-grounds.

The spawning commences with the early fish in November, and continues through December, and in late rivers even through January and February. Having deposited and covered their spawn or eggs in suitable gravel beds, in holes, or redds, as they are termed, which they burrow or scrape out for that purpose, they are so exhausted with the process, that they are quiescent for some time. Parasitic insects attack them in numbers, and the fish has not the energy to rid itself of them, and the salmon, or kelt, as it is called at this time, is often a foul and disgusting object, covered with sores. Lethargic, lank, and bad coloured, when taken from the water, it becomes very offensive speedily, and the flesh, which is white and flaccid, is mere carrion, and excessively unwholesome and repulsive.

Yet thousands of these fish were formerly caught by poachers yearly, and tons of them exported weekly to France, or were smoked or kippered, and their nature being thus disguised, they found a ready market both at home and abroad. The destruction thus caused was immense. But through the agitation of the Fisheries' Preservation Association, the Government was induced to pass an act prohibiting the exportation of salmon during the fence months, and this has, no doubt, been useful in repressing to some extent this noxious practice, though it cannot be hoped that the mischief is entirely done away with. When the kelt is in this state, it becomes necessary for the fish to seek the salt water, partly to rid himself of the parasites which are devouring him, and partly for the plentiful food which he finds there. Accordingly, with the first fresh of water the kelt drops down from pool to pool, until he reaches the sea. There, by change of water and abundant food, he soon recovers his strength; and, in from three to four months' time, he returns once more to the river, to procreate his race, a splendid salmon, with flesh firm and red, and increased in weight to an extent which bears no proportion to the growth of anything else in nature. A kelt which will go down to the sea weighing 4lbs. or 5lbs., will come

back to the river weighing from 10lbs. to 16lbs.—from 2lbs. to 3lbs. a month being a common rate of increase. This is a well-ascertained fact.

Salmon can be kept altogether in fresh water for many years, but they grow slowly under these conditions, and it is believed do not spawn, the absence of sufficient food of the right quality being, no doubt, in some measure one reason of this. I have known them grow up to about 2lbs. or 3lbs. weight, and have heard of their growing still larger, but they have more the appearance of huge overgrown smolts than salmon. I should like to see the experiment tried upon a more extended scale, as they make by no means bad fish, and are frequently much better than the trout contained in the same water. There is said to be a salmon in some of the great American lakes very similar to ours, and these lakes being above the Niagara Falls, of course the fish cannot migrate to and from the sea. But we are also told that in these vast lakes, or inland seas, there are considerable tracts of water, which, from the prevalence of salt springs, become strongly impregnated; and it is further stated that the salmon, in obedience to its instinct, migrates to these tracts. If this be so, the fact is both singular and valuable; but I should much like to get some

reliable confirmation of it, as I state it but on hearsay.

But we must return to the eggs deposited by the salmon. These, after remaining in the gravel for a period varying from 60 to 120 days, according to the temperature of the water, are at length hatched; but they do not come from the egg perfectly formed fish, nor do they entirely disengage themselves from the egg; for, having cast off the shell, the egg still remains attached to the fish in the form of an enormous umbilical bladder or sac. So cumbrous is this appendage, that the young fish moves but little more than is required to burrow under some stone of gravel at first, increasing in activity as the sac decreases. During this time it requires no food, being sustained by the nourishment contained in the sac. This, however, gradually grows less and less, as its contents are slowly absorbed into the young fish, and it finally disappears in about five or six weeks, when the fish is a well-shaped little creature of about an inch in length, and is capable of ranging about to look for food. At six months it is a lively, active fish about three or four inches in length. At the age of twelve months, when it is from four to five inches in length, a singular change takes place. The fish, hitherto marked with

transverse bands, and strongly resembling a young trout, changes its scales, and takes on it the brilliant silvery armour of a young salmon; a pretty, bright and thoroughbred-looking little creature it is at this age, incessant in activity, darting at every small fly and insect that attracts its attention. When taken in the hand the transverse marks of the parr state have apparently disappeared; but if the scales, which come off in the hand at the slightest touch, be removed, the dark parr marks may still be discovered beneath them, proving the identity of the fish with the parr-marked fish. When it has reached the stage above described it is called a smolt, and is ready for its first migration to the sea.

With the first floods in April and May it begins to drop down the river from pool to pool and from stream to stream in large numbers, and finally reaching the open sea, it for a time is lost to us, and we know little of its habits save that it feeds voraciously while there on small fish and molluscs. Some authorities declare that this change and migration does not take place until the fish has achieved its second year, but others maintain that it takes place after one year. Experiment, however, has shown that to an extent both are right in their assertions, for it has been proved that while many,

and by far the larger number, do migrate at one year, a considerable number do, nevertheless, remain behind, and stay in the river for another twelvemonth, migrating at the same period of the year as their more precocious brethren. Some of them will often remain even three years in the fresh water. Why this apparent irregularity should take place no one has yet been able to discover, nor has any rule or law whereby such an apparent freak is guided or accounted for yet been satisfactorily established. It having been supposed by Mr. Buist, the experienced superintendent of the Stormontfield experiments in salmon breeding, that this might have happened in consequence of some of the ova or milt being taken from grilse or salmon after only one journey to the sea, he took particular care in the fall of 1860 to have the whole of the milt and ova taken from full-grown salmon; but this made no difference, for in May 1861, about the same proportion of young fish left for the sea, and about the same proportion also remained behind in the ponds as usual. The smolt having reached the sea remains there for a period varying from two to four months, when it again returns to the river in the form of a young salmon or grilse, having increased in weight to a wonderful degree, grilse varying from 2lbs. to even

as high as 12lbs. in weight.¹ After its next migration to the sea as a grilse kelt, it having spawned in the interim, it returns to the river a full-grown and complete salmon of from 7lbs. or 8lbs. to 16lbs. or 17lbs. in weight, each year and each migration to the sea increasing its weight considerably; but after the first year or two it is supposed that its weight increases less rapidly; but on this point little as yet has been clearly ascertained. Having now traced its progress from the egg to the salmon, we must return to the egg.

It must be manifest, when the thousands of eggs which the roe of one female contains are considered,² that the produce of a very few pairs of salmon would be sufficient to stock a river,³ and

¹ I think it possible, as there is an irregularity in the period of the smolts going to the sea, that there may be a like irregularity as to their return, and that these large grilse may have stayed over the twelvemonth in the salt water.—F. F.

Since the above note was written, this supposition has been distinctly confirmed in the case of the Doohullah fishery; the whole of the smolts there remained fifteen or sixteen months in the sea before re-appearing as grilse.—F. F. 1864. (See *Doohullah*, in Appendix.)

² The salmon produces 1000 eggs for every pound of its own weight; thus, a 10lb. salmon produces 10,000 eggs. I have tested this calculation on several occasions, and usually found it tolerably accurate.

³ The yearly yield of the largest producing river in the Kingdom is computed at about the produce of *one female fish* of from 15lbs. to 20lbs. in weight. The produce of all the rest is lost or wasted.

doubtless they would be if a fair share of the eggs were hatched, and their contents reached maturity; but throughout its life the salmon has to battle with deadly foes, from the egg to the fishmonger's shop—from the cradle to the grave it has to run the gauntlet of one constant succession of remorseless enemies.

In the river, fish, birds, insects, and vermin assail the egg. Even whilst it is being dropped from the parent fish, shoals of small fry, dace, trout, and many other fish, lie in wait to secure and devour it. Water-rats and vermin of all kinds attack it after it is deposited in the gravel. Other coarse fish, and particularly eels, are supposed to rout up the beds, and commit the most serious devastation.¹

All kinds of aquatic birds, swans, moorhens, dabchucks, water ousels, ducks, and particularly the tame duck, are, more or less, among its worst

¹ I have seen the small river lamprey hard at work on trout spawning beds; and the process is instructive. In groups of a score or so they search the beds and remove the stones. Fixing its sucker on a small gravel stone, the fish wrenches it from its bed, casts the fragment aside, and burrows into the hole it has made after the spawn. If the stone be too large for one to remove, another will come and help him; nay, even four or five will unite their forces; and it must be a good-sized stone which can resist their efforts. Of course the mischief they do is incalculable.

enemies.¹ When it is hatched, on emerging from the gravel, possibly before it can find shelter under a stone, it lies in a helpless state, hampered by the large umbilical protuberance, and it suffers again from foes of all kinds to the full as much as in its egg state, and from this time until it becomes a smolt it is alternately the prey of the trouts and of its own species; for the salmon when in the kelt state, being so ravenous, devours its own offspring with avidity, while gulls and many other birds of predaceous habit hover over the shoals when on the shallow fords, and seize upon the young fish by hundreds; and even the angler, foul shame to him! scruples not to take them daily by the basketful, while whole bushels of them at a time are often taken by means of baskets and nets in the small mill-streams, and they are even used in others to feed pigs with, so that not one egg in a thousand ever produces a full-grown salmon. When it reaches the sea, the fish has a fresh series of perils to endure. Here fish of all kinds hunt and destroy it, and even

¹ No doubt many of these birds also feed on the larvæ of insects and predaceous water-beetles, which would, perhaps, do even more damage among the spawn beds, so that the toll they take is unimportant compared with the good they do. Still, that they do all more or less devour spawn when they can get it, I have very little doubt.

when full grown it is the prey of the grampus and the seal; but these dangers from aquatic animals are comparatively few, for it soon becomes swift and powerful, and to a certain extent is able to take care of itself. In spite, however, of all this destruction, such is the amazing fecundity of the salmon, that were it not for the machinations of man—his worst enemy—sufficient of the species would still remain to fill our rivers almost to teeming.

The most dangerous and helpless part of the salmon's existence, therefore, occurs while in the ova state and until arrived at the smolt state. Fortunately here man has the power to protect it from most of the perils it endures when left to itself in the river, and at this particular point artificial propagation is a most valuable assistant.

In this country the piscicultural undertakings which are the best known and of most importance are those carried out at Stormontfield, on the Tay; at Messrs. Ashworth's fishery on the Galway river, in both of which improvement of the fisheries was the object; at Mr. Cooper's fishery at Markree, near Sligo; and at Doohullah, in Connemara. In these two last instances fisheries were altogether created; and on the Clyde, where a new fish (the greyling) was introduced and naturalized. A fuller account

of most of these operations will be found in the Appendix. The first of these experiments was conducted under Mr. Robert Buist, the second and last but one under Mr. Ramsbottom, and the Clyde experiment under Mr. Eyre, who is better known as the inventor of an ingenious machine for the transport of live fish to long distances.¹ In the two first instances boxes were used which were three-parts filled with gravel, the salmon ova being deposited in them; in the last, boxes were thought objectionable, and the natural bed of the stream was preferred, and the greater part of the ova of the greyling was accordingly deposited in the gravel (a short account of this operation was published in the *Field* by Mr. J. Briggs; a short extract from it will be found in the Appendix).

When the ova is lying in the gravel it is often attacked by predaceous insects, which prey upon it unceasingly; and the great aim of the pisciculturist is to keep vermin of all kinds from the ova. Now, if the gravel used by the pisciculturist as the bed on which he deposits the ova he is desirous of hatching, be taken from the bed of a

¹ To these must now be added the most successful attempts to convey salmon ova to Australia, but lately accomplished by Mr. Youl.

stream without being either boiled or undergoing some other process to destroy the animal and vegetable life existing among it, it is impossible to prevent insects from being placed in the boxes with it, as their eggs and larvæ are mixed with and laid in the gravel itself. When the gravel is transferred to the boxes these eggs and larvæ in the course of time are hatched, and many of the insects immediately commence preying on the ova. Mr. Ffennel, the Inspector of Salmon Fisheries, found this a very considerable source of damage to the stock of spawn which was deposited in the experimental boxes at the Custom-house in Dublin.¹ The best way, therefore, to meet this evil is to boil the gravel for about an hour, and then to wash it thoroughly in a sieve before depositing it in the boxes.

¹ Mr. Brown, in his admirable little work on the "Natural History of the Salmon," as elicited by the Stormontfield operations, also bears testimony to the great destruction caused amongst the ova by the larva of the may-fly and by certain water-beetles.

CHAPTER II.

THE ARTIFICIAL INCUBATION OF OVA.

I NOW proceed to describe the best methods of artificially incubating ova. Very much here depends upon the natural advantages possessed by the pisciculturist as regards his water supply. If he has a fine, clear spring, with a never-failing and full supply, and a good fall for some distance after its exodus, he is lucky, and has little difficulty to contend with. If he has a stream near him which seldom or never mudds or thickens, but where there is not enough fall, he may raise the water to the required height, either by a ram or a small water-wheel and pump, or by a simple force-pump and cistern, employing manual labour to fill the cistern at stated intervals. If, however, he has not sufficient convenience, or the stream which he has at command cannot be relied on for hatching purposes, he may even trust to the main, provided the water be filtered river water, and it be passed through some filtering

or straining medium again before distribution. These are matters which in their adaptation are so likely to be governed by circumstances, that much must be left to the ingenuity of the pisciculturist. As regards the apparatus to be used for the simple purposes of incubation, I prefer the French plan as employed at Huningue, which is, I believe, the invention of M. Coste. •

This plan consists, as I have already partly pointed out, in a series of trays, which may be made either of glazed earthenware or slate. I prefer the slate for reasons that will appear anon, and chiefly because it is capable of being bored or sawed without difficulty, and is less liable to break. Within each of these trays is deposited a grating or grille, resting in about mid-water, and made of glass rods enclosed in a wooden frame, placed sufficiently near to each other to prevent the ova from slipping down between the bars, while there is a sufficient opening to allow any deposit which may be in the water to pass through the bars, and settle to the bottom of the tray. This apparatus is already shown at page 10. Level with the bottom at each end is a small, round hole, shown at (*a*), which can be stopped with a cork, but which, when dirt accumulates at the bottom of the tray, can be removed; the dirt may then be swept

and run out with the water, and, if needful, the tray scrubbed, the cork replaced, and the tray refilled, perfectly clean and purified. By keeping a spare tray at the foot of any range of trays, and simply shifting the grilles tray by tray, the whole range of trays may thus be cleaned thoroughly without risk of danger to the ova, particularly after the eye becomes visible in the egg.¹ When the embryo hatches out of the egg it falls between the bars to the bottom of the tray, and as soon as a good number of them are collected, the unhatched eggs can be shifted on the grille to another tray *pro tem.*, and the alevins drawn off through the hole (*a*) into a suitable vessel held to receive them, and deposited in a proper rearing tray. These French trays, as they are at present constructed, are bad rearing trays, however. In the first place, they are too deep. Alevins and fry require more stream than they get, and to this end two inches depth of water is ample. Three inches or three and a half inches is too much; for it does not allow of a sufficiently rapid change of the water, as the running water goes off on the surface without touching the lower depths, conse-

¹ I may remark here, that *until* the eye is developed in the egg these shiftings should be *as seldom as possible*, as perfect rest is very advantageous to the egg.—F. F.

quently there is always at the bottom of the tray a mass of water that does not change often, and may almost be held to be stagnant. Now, as long as the ova are supported to within one and a half inch of the surface, this does all well enough. The stream goes along the surface over the ova; impurity is buried inches below in the water; and when we consider that at Huningue they do not undertake to hatch fish so much as to distribute the ova in an advanced state of incubation, we must own that no better plan for *their* purpose could possibly be devised, but for the rearing of fry a change is certainly advantageous. As, however, we are not come to the rearing of fry yet, we will consider that point in its proper place. The best size for the trays is, I think, upon consideration, that employed by the French, viz., twenty inches long, five inches wide, and three and a half inches deep, measured on the inside. The spout whence the water is ejected should not be an open spout, as is shown in the French trough, but should be a round hole of at least three-quarters of an inch in diameter¹ in the clear, and instead of an open spout, it should be a bent metal pipe, curved slightly downwards like

¹ It must be at least this size, or the tray will be useless for rearing when a larger stream of water is needed.

a tap, to prevent the back-flow of the drip. I may mention here another of the objections to the earthenware trays. Everything is cast, even to the lips or spouts. These are very liable to injury, projecting as they do, and being of soft and brittle material the slightest blow breaks them or knocks them off completely, when the trays are almost, if not quite, useless, as it is very difficult to put a supplementary spout to them, save at a trouble and cost equal almost to that of a new tray; and when such a spout *is* put, the slightest touch deranges it, and causes a leak, which not only wastes the water, but makes a slop, and creates a damper atmosphere than already exists, which is quite unnecessary. With slate all this is needless. The spout can be fitted by any village plumber without the least difficulty, and at the end of the season can be taken off, and put carefully away, while the trays can be packed or stacked into a compact mass without danger of breaking, all of which cannot be done with the ordinary earthenware trays.

Now, we have decided that the slate tray is the best for general piscicultural purposes. The top of the spout, or hole through which the water runs, should be three-quarters of an inch from the top of the tray, so as to allow for a sudden flush of

water, or any momentary obstruction. If this be not so, overflows and loss of fish will occur. The spout takes another three-quarters of an inch of the depth, and two inches, therefore, will be the height of the water in the tray when not running instead of three and three-quarters as in the French trays; when running it will mount from a quarter to half an inch. At one inch from the bottom should run a shoulder or ledge on either side of the tray, on which to deposit the grille. The projecting earthen pegs, as they may be termed, in the French trays are very much in the way of the pisciculturist should he want to clear out any fish without withdrawing the cork at the bottom, as he will find by experience. This ledge should be just wide enough to rest the grille steadily; and now, allowing a quarter of an inch for the glass bars, &c., when the ova is placed on them and the water set running, there will be a gentle stream on the ova of about from one and a quarter to one and a half inch deep; when the grille is withdrawn there will be from two and a quarter to two and a half inches of water, which is fully enough for all purposes. Such is the individual tray itself. When you want to stock it, you take the grille, which fits loosely and easily into the tray, resting on the ledge described. At first the grille will float.

Place a bit of tile across it to keep it down. In a day or two it will be soaked, and the tile may be removed. Then take the ova in a spoon carefully, and strew it on the bars thickly, so that all are well covered, but not so that one ova rests upon another; whenever this occurs, with a soft camel-hair brush gently pass it to the nearest vacant space. It is not advantageous for the ova to lay on one another. Indeed, it is decidedly objectionable. The ova being placed, do not disturb them, if you can possibly avoid it, until the eye becomes visible in the eggs, when you may do almost what you like with them—pack them up in wet moss, and send them 500 miles off if you please, and even a little squeezing or tossing about (although it is not at all to be recommended) will fail to destroy them, so great is the vitality of the embryo in the egg at this period. But I must confine myself strictly here to apparatus. A tray such as I have described will accommodate about 1,100 salmon ova, and about 1,400 trout, and perhaps from 1,800 to 2,000 greyling. For greyling those grilles which have the bars the closest together should be chosen, or the ova is so small and soft that it easily slips through, when it causes much mischief and trouble.

The volume of stream required is governed a good deal by the quantity of ova you wish to hatch.

Let us suppose it is desired to hatch one or two traysfull, a stream which may be described as a strong drip or dribble will be ample. If pure, cool, and well aerated, you may pass such a stream through three, but beyond that it is advisable to increase the stream. I am supposing now that the water is supplied from a cistern or some reservoir over which the pisciculturist has full control. As this is the most general, and perhaps the easiest way of conducting operations, I shall speak of fish hatching in streams by means of boxes filled with gravel, &c., presently. To run such a stream as I have described for twenty-four hours without failing, it would need a reservoir or cistern capable of holding from 1 to 200 gallons; a very little *visible* increase in the stream will be found to make a considerable increase in the volume of water that runs away. If the cistern can be filled twice in the twenty-four hours, of course a considerable reduction in the size of it may be made, but it should always be full large for the purpose, in case of accidents, which at times no amount of foresight can altogether prevent. All cisterns should have a float on the inside, and compensating plumb on the outside, ascending and descending over a graduated scale, similar to that which I use for the Acclimatisation Society, which will be

fully described presently, so that the attendant may see at a glance how much water is in the cistern. In turning the water into the trays, it must always be held in mind that when the cistern is full the weight of water drives the stream much faster through the supply tap than when it is low. To keep up an equable flow is therefore somewhat difficult, as in order to do so it is necessary to open the tap slightly, more and more from time to time as the water gets lower. The only way of reducing this to a certainty, and so being tolerably sure that you do not run more than your proper calculated allowance away, is to have a tap which turns by means of a straight handle or key (like those under kitchen boilers); under this key fix a semicircular plate with the degrees marked on, somewhat like to the compass card. Then, having filled your cistern, you can experimentalise upon the flow of water, comparing the quantity run away in such and such a time by means of the graduated scale against the angle you have set the key of your tap to on the plate; by this means, after a few experiments, the matter can be reduced to a tolerable certainty. Having arrived at this, draw up a regular code of instructions for the management of the cistern, and see that whoever has the charge of it attends to

them. As taps are apt to clog if there be any sediment in the water, once a week fix a loose india-rubber hose on to the nozzle and let a strong stream of water run through into a pail as waste for about a quarter of a minute; thus filth will be got rid of and a fair run provided. If this is not done the stream will diminish by degrees without perceptible cause, and then perhaps on a sudden will burst forth, bringing a mass of dirt and collected sediment with it, which will not benefit the ova. To the part of the tap which comes through on the inside of the cistern attach a short india-rubber hose, carefully cleaned and sweetened, and float this to within three or four inches of the top of the water, (when *the cistern is full, remember,*) and if there be any sediment it soon begins to settle and to leave the surface water, which is the most aerated of all of course, tolerably clear. Nevertheless there is hardly any unfiltered water which does not contain a sediment of some kind, and therefore it is always advisable to employ a filter. This, however, need not be a very formidable affair. A large earthenware pot provided with a hole on one side, near the bottom, from which projects a short pipe, and filled with a mixture of the finest gravel and sand thoroughly cleansed does very well. I have used

a large flower-pot, some fifteen inches deep, stopping all the side holes (which such large pots usually have) but one, and fixing on that a short leaden pipe. The entrance to the pipe requires to be fenced by means of a piece of perforated zinc, or the fine gravel and sand will work through it. About once a fortnight the contents must be taken out and carefully washed and cleansed and then restored. To do this properly it is advisable to have two pots, so that one shall be always ready to put up when the foul one is removed. This will be found a capital safeguard against vermin or filth, and very little but fairly pure water will pass through it; but it offers no material hindrance to that, and any reasonable stream will run through it with sufficient quickness for almost any requirements. As an additional safeguard, however, I always let the water fall into a perfectly empty tray before it is conveyed to the trays with ova in them; for one cannot always be sure that some kind of dirt or objectionable matter will not find its way through, but by the above means the chances of damage are greatly reduced.

Now we come to the question of how many trays it may be desirable to use; for according to the number so you must increase the stream of water.

Of course a great deal depends upon the temperature of the water: if that can be kept down, much more can be done with it; but contingencies, and not the most favourable results which we are *perhaps* likely to obtain, must be calculated.

Spawn is obtained from November until February. To the end of January the weather is certain to be cold enough, often too cold, for our purpose—so much so that artificial warmth is rather required; not so always February and March. Of late years, particularly, we have often had a warm February and March, or a warm March and April. February and March are most important months for the pisciculturist, and much depends on them. If they are warm the temperature of the water, which has perhaps been vibrating about 38° and 40° , often jumps up to 46° or 47° , and the same stream of water which could be safely employed at 38° , through from ten to twenty trays will not answer at 48° . Moreover, as it travels from tray to tray it gets warmed by the atmosphere and by exposure, until there will frequently be a difference of 3° or 4° between the temperature of the water in the first tray and the last one. A raised temperature quickens the development of the egg considerably; with salmon a difference of 10° or 12° in the temperature

of the water will make a difference in the period of incubation equal to something like a half of the entire time—*e. g.* at 33° or 34° , say a little above freezing, the ova will be above 120 days hatching, whereas at 45° or 46° it will be something like sixty-five or seventy days, and at 50° perhaps from forty to fifty days; but that which is the longer period in coming forth is often the most healthy and the strongest alevin. But added to this there is a greater evil possibly. With increased temperature a variety of matters come into existence which are not favourable to ova, and which a colder temperature has kept in abeyance; confervoid growths of various kinds begin to vegetate, and insects previously unseen and harmless spring into life and action. The ova turns bad and byssus attacks it with far greater rapidity, spreading under the genial sun as rapidly as fungus does in a cellar. Putridity in every form is encouraged far more by the warmth than by the cold, as we are all well aware, and putridity of any kind is more or less fatal to ova—of the salmonidæ at least. Therefore, it will hardly do to calculate what we can do with so-and-so in the depths of winter, but what we shall be able to do if the weather should prove open and warm in February and March. In the matter of pisciculture, as in all others, to

use a homely proverb, it is as well to be "on the right side of the hedge," and we may add, with a comfortable margin between us and the ditch. Calculate the worst that you think can befall, leave a little margin for something a little worse, which you may not foresee, and you may sleep in peace.

Now, I have seen it stated, and by a gentleman who is supposed to be an authority on such matters, that the same stream of water can be carried on from tray to tray, *ad infinitum*, and will hatch any quantity of ova it may be required to put under it. He neglected, however, one rather vital condition in forgetting to add, provided it be only large enough. This, however, resolves itself very much into the old joke of How many cows-tails will reach the moon? One, if it is long enough. The fact is this, if you drive a stream of more than reasonable bulk through ordinary trays, you drive the ova about all over the trays in heaps, causing eddies and whirls, and keeping the wretched eggs in a perpetual turmoil, whereby a vast number of them come to an untimely end, as eggs, and many more as weakly, stunted, and deformed bantlings. If the stream is so strong as to disturb the ova in the immediate neighbourhood of the fall, you may most beneficially break that fall by placing a bent strip of perforated zinc under

it. This is always useful, as it breaks up the stream and scatters and aerates the water. If, however, the volume be still so great that notwithstanding this it still drives the ova about, then there is too much stream and it must be reduced. By watching this it will soon be seen what is the correct *extreme* volume of water to supply to ova, and with that extreme volume I hold that a dozen trays of the size stated,¹ or half a dozen of double the size, are quite as many as can be safely placed under one stream of water. I do not, of course, mean to say that under *favourable* circumstances more may not be employed, but taking all reasonable chances into consideration, I think that number ample; and if it be required to hatch more ova, I would establish another range of trays and another stream rather than drive such a stream through a single and more extended line as might be harmful to the ova. The French, however, who perhaps are subject at Huningue to a higher temperature in the early spring months than we are, do not allow the same jet of water to percolate through more than four trays usually; occasionally six or seven are used, but this is exceptional. They do not, however, employ so strong a stream as

¹ This will give an available stream of some thirty-four feet in length, while it occupies a space of about ten feet by two.

we do. If they find anything unusual taking place, they turn a stronger stream on, and that has often a sanitary effect.

I have not yet shown how these trays are to be arranged. I cannot do better than call the attention of my readers to the engraving at page 47, which will show the arrangement better than any words. There should be a fall of from one to two inches or more, if it can be conveniently spared, between each tray. The water falls in at one end of the tray, and out by a pipe near the end into the next; then travels to the other end of that tray, where it finds a similar exit, as depicted, and so on throughout the entire range. If it be more suitable to the space, the spouts may be placed at the ends of the trays, so as to run straight from end to end, the trays being placed in a line. Or one end spout tray may run into a side spout tray, and that into another end spout, and that again into a reverse side spout, but this is an inconvenient plan, and I do not recommend it. However the trays are placed, they should be easily approachable, so that the operator can, without the least difficulty or constrained position, get at them to remove the dead ova or extract the live fish.

The supports of the trays depicted in the engra-

ving are two beams of wood in which notches are cut, or on which, to prevent weakening, the support

INDOOR APPARATUS.

wedges are nailed. The letter (*a*) shows the corner of the cistern, (*b*) is the supply tap, and (*c*) is the

waste pipe. This should be of india-rubber, so as to be capable of being moved at will. If a long-spouted funnel be let into the upper end, by the aid of a gas-pipe hook, it can be fixed to one of the supporting beams in the most suitable position to receive the waste water.

Before concluding the description of this indoor apparatus, I append a sketch of the section of a cistern. (*a*) is the waste or stand pipe, by which the cistern can be emptied at will and cleaned out if requisite; (*b*) is the supply pipe; (*c*) is a tray to catch

the water in and break its force, or to stop vermin should it be needed for that purpose; (*d*) is the flexible tube attached to the inside of the tap, floated as shown, and (*e*) is the tap itself. The indicator spoken of at p. 38, is not shown here, but I will describe it. A stout zinc box was constructed to act

as a float, to the top of which a fine but strong chain was soldered. The other end of the chain terminated in a flat, round lump of lead. Fixed on the top edge of the cistern was a freely-working grooved transverse wheel acting like a pulley. The chain hung over this groove, the box being inside floating in the water, and the lead outside hanging upon the upright scale, the chain being just long enough to allow the box to sink to the bottom. The box being heavier than the lead fell with the water, and as it fell the lead rose; when the water rose the box floated and the lead fell, the scale outside being calculated to show the depth of water inside. I have found this answer admirably, as it reported most accurately and never got out of order for eight or nine months together. The pisciculturist, however, must see that the chain be suitably strong and does not open at the links by use, or it may stretch and deceive him; this, however, would not make an inch difference even at the worst.

Before commencing operations see that the cistern and its supports be thoroughly tested, and every experiment that it may be desirable to make be made in good time, as none can be made and nothing disturbed when once operations are commenced. The foundation supporting the cistern should be even

more than safe, as the slightest settlement of only the twenty-fourth of an inch, the shrinking of a piece of woodwork, or the subsidence of brickwork, may cause a leakage which it will be most difficult to stop until the ensuing season, and may be a constant source of annoyance. Cisterns should be made of slate, if it can be conveniently managed—not of metal nor wood, nor brickwork cemented. Slate gives off nothing, will last for ever, and will always fetch its value when you have no further occasion for it, whereas the others are perishable, worth nothing, are always dirty, and sometimes slightly poisonous (to the fish).

I have now described the best kind of apparatus for sheltered work, and where the supply of water is artificial. The best place to put such apparatus in, is where the attendant can, when he desires it, have plenty of light to see his work by in all positions, and where it is alike defended from frost and heat. Considerable cold retards the process needlessly, and heat destroys the ova outright. Heat, therefore, is the most to be guarded against of the two. Sudden or great changes of temperature should be guarded against, as they are hurtful. The French use brick sheds, well built. The Acclimatisation Society has, to an extent, followed their example.

From 40° to 45° is the best medium temperature. A greenhouse is a very good place *in the winter* for early operations, because a fair equable temperature is kept up; but if the early spring be warm and sunny it is obviously the worst place possible, as it is not easy to keep down the heat. Although light is required for the attendant, it is not required, nay, it is most undesirable for his charges, unless they are perfect fish; and so delicate is the organization of the eye in the alevins that they cannot bear the light, and the trays, therefore, should always be kept covered, save when under examination. The exclusion of light has also the effect of checking confervoid, or other growths. I here give a plan which has occurred to me of keeping down the temperature of the water, when the weather becomes warm, which I think will in use be found very effective. It is not desirable by any means to attempt to cool water by putting ice into it. In the first place, ice water is not advantageous to the fish; in the second, the dropping of lumps of ice into the water will induce sudden changes of temperature, which are very undesirable. Now, I would have a refrigerator, say of about double the size of the trays, but shaped somewhat like a tray, for the water to pass through after it leaves the cistern, and

before it reaches the hatching trays. Let the reservoir which contains the water be enamelled, in the same way that saucepans are; and as water passes through this tray or reservoir it will pass over surfaces many degrees cooler than the air, which cannot but have the effect of cooling the water. The ice can easily be renewed from time to time, and drippage, &c., be provided for. This plan has occurred to me by the desire which I had to be able to cool the water in some reasonable and easy manner during the past spring, when I was losing large quantities of greyling ova and fry from the high temperature of the water.

I now proceed to describe the best kind of stream apparatus.

In dealing with streams, those should be selected in preference where the water supply comes from a cool, clear spring, as near to the spring-head being chosen as can be conveniently done. A reservoir should be made, so as to dam the stream up to the highest possible level—an open cut being left at the down stream end to allow the water to run through: a zinc trough, or shoot, is fixed in this aperture to deliver the water. If the reader will consult the engraving at p. 53, which represents a portion of an apparatus I designed some time

since for the Thames Angling Preservation Society when I was on the Piscicultural Committee of the Society, he will at once understand what I mean. (1) Is the reservoir, and (2) the zinc shoot. This shoot should be projected as far into the inside of the cistern as it is on the outside, as much rubbish will thus be prevented from finding its way into the

shoot. Under this shoot should be placed a long box, three parts full of fine gravel. The boxes we had made were of elm, well seasoned. In the ends were deep cuts, of nearly the entire width of the box. The upper end (4) was defended by perforated zinc, and over the outside of this was fixed a tray (3), which caught the water. The water ran over the gravel through the box, and through another zinc shoot into another box, which fitted on to the end of the first with a slight fall from the first to the second, in

order to freshen the water. The lids were of perforated zinc, as shown in the engraving, in order to keep out vermin, and were padlocked down, so that no one but the proper attendant could get to the ova. These boxes may be made of any length, 4, 6, 8, or 10 feet, if required. The one represented was 4 feet long, 15 inches wide, and 10 inches deep, and about six of these boxes were used, fitted on end for end: six such boxes would easily hatch from 30,000 to 40,000 ova or more.

If there be a good supply of water, and a fair fall, and it be required to hatch a large number of ova, an outlet should be made from the supply stream; a filtering pond made by means of a bank of fine gravel, through which the water would filter into a small canal or narrow reservoir, whence regular outlets can be made to supply any number of boxes laid down in parallel rows, with a narrow walk between each row, each separate row being laid down as pointed out above in the single row.¹ For this kind of apparatus gravel is preferable, and on this gravel the eggs should be distributed pretty thickly; but not so as to lie upon one another, in order that the attendant may be able to detect and remove dead or putrid ova. Some persons bury

¹ This is the plan adopted at Stormontfield.

the ova under the gravel as in the natural state, and the plan in some instances answers well enough; but I always prefer to see how the ova are progressing, as, for the want of the attention which ought to be paid to them by the removal of dead eggs, &c., I have seen large quantities of ova lost. It may be urged that we ought to imitate nature as closely as possible, but in the natural state the loss of ova and alevins is enormous; if it were not, our streams would be literally packed with fish, as the produce of a few pairs of trout or salmon, if they all came to fry, would stock almost any ordinary stream. To avoid this loss, and to provide for the heavy drain caused by constant fishing, we have hit upon this artificial plan of incubation and protection, and the best plan is that which gives us the best results with the least (reasonable) amount of trouble. If the attendant had to move numberless stones every time he searched for dead ova, his labour would be endless, while the very act of moving the stones would often destroy the ova.

Now, the difference between the glass rods and the gravel is this. The gravel, offering an infinitesimal number of salient points and angles, arrests and collects the sediment which is held in the water: for there will be some sediment, even when the

water be filtered as shown above. The greater this collection of sediment, the more likely conferva is to grow, as soon as the weather warms a little. The slightest disturbance of the water raises this sediment in a fine cloud, and it then settles on the eggs. This is, of course, very objectionable; for although in moderately cool weather no great harm may result, as I have said in warm weather conferva will grow, and this will by no means improve the condition of the eggs.

Gravel also forms a home and a hide for vermin, which, with every precaution, will at times find its way in amongst the ova, and here, undetected for some time, it will often work much mischief. The ova cannot be so evenly spread upon gravel as on the grilles, and much space is lost. A bad egg cannot be detected nearly so soon on gravel as on the grilles, and it often happens that a dead ova will not be discovered until it has caused the death and putrefaction of a dozen others, when the mischief is, perhaps, discovered too late. Again, where a case of this kind takes place, the gravel itself for some depth becomes tainted, and ova, which may be placed in the same spot, are very apt to take the contagion. It is astonishing how gravel will become tainted, and affect not only the ova but the fish; and when this

once becomes the case, nothing but the entire removal of the tainted gravel, and the substitution of fresh, will stop the mischief, as I have had very good reason to know. For indoor apparatus I think, for the purpose of incubation, there is nothing like the glass grilles, because the stream which can be used for hatching purposes is so small that great cleanliness is required: for if great cleanliness be not enforced, although it is quite possible to scramble through the operations somehow, if you have good luck and a cool season, with a dirty apparatus, yet, with bad luck and a hot or bad season, if anything does go wrong, everything goes wrong, the dangers that wait upon fish-hatching are multiplied tremendously, and a grand and inevitable slaughter is the melancholy result. I once heard of an old Puritan whose dictum was regarded with great veneration by his fellows. A chapel was about to be built; two plans were discussed, one plan was for a handsome building in good taste, the other, which the saintly affected most, was not only plain, but was painfully, hideously so. On submitting the plans to the venerable elder, he heard the arguments, and gave his voice for the handsome building, saying, "There's nae godliness in ugliness." And I say there's no virtue in dirt, so by all means get rid of it where you can.

The out-door apparatus usually commands a much larger stream, and here deposits are less felt, and putrefaction is more liable to be carried off to some extent by the greater body of water ; therefore, gravel will answer there tolerably well. Moreover, when the ova are hatched in the large out-door trays, the greater part of the produce must stay where it is hatched ; it cannot be drawn off into a can and re-distributed as it can from the indoors tray and grille. Besides, the spaces are much larger, and the glass rods less applicable ; so that on the whole I think for indoor apparatus the grilles are best, and for outdoor perhaps the gravel is preferable. Having determined this knotty point, I will mention one more species of apparatus applicable to streams, and that is the floating apparatus. Have a basket made of fine close wicker-work, somewhat similar in form to those baskets known as flats ; on the bottom of this the eggs should be deposited, and the flat moored in a clear stream, so as to avoid swaying about, and loaded so much as to sink it about an inch or so in the water. This is a very handy style of apparatus where a side stream cannot be cut off, and where the last-described plan is not applicable.

We will now suppose that the apparatus is ready for the ova. We will, if you please, go to the river-

side, and take it. The first thing to be discussed is, what fish you are going for; and next, how you are to catch your fish. The old recommendation of Mrs. Glasse is by no means to be despised in this instance. The catching of salmon on the redds may be a very easy matter, or it may be a somewhat heavy affair; all depends on the river you have to fish. If the salmon are up the small brooks, a short handy net, and a couple of men with your assistant, may be enough for you. But if they be in the fords of a large river, it becomes a very different and a difficult matter, often requiring ten or a dozen men, and a net of above 100 yards in length. This is a point which will be best arranged with the keepers or bailiffs of the river about to be netted. One thing the pisciculturist will soon discover—viz. that he takes five or ten, and perhaps twenty, male fish for one female; and this is the case not only with salmon, but with trout and greyling also. Why this is, it is difficult to say; and whether there are actually many more males, or whether the female, conscious of the valuable burden she carries, is more shy, or whatever the cause may be, the fact is indisputable. I have heard it argued that there are far fewer female fish on the beds, because there are more female fish caught; the female, being more ravenous,

and feeding much more often, to fortify her system for the exhaustive process she has to go through, is more readily caught. This argument might possibly hold good with trout and greyling, but it is scarcely so reliable for salmon, as the great bulk of salmon are taken by nets and cruives, which are no respecters of sex, and where the sex has no choice whatever.

Take a male or female salmon, perfectly ripe for the process, and the ripeness may be known, in the male, by the milt running from the vent at the slightest pressure, and in the female, by the ova doing likewise, if she be very ripe. But it often occurs that though the female be quite ready to yield her spawn, she will not give it at the first pressure. Now, if a fish be unripe, the belly is hard and tight, and the mass of ova contained in it is immovable, being still fixed to the membrane. In a trout, if it be held up by the head, in the attitude shown in the first figure in the frontispiece, the ova, if ripe, will drop down in a mass towards the vent, distending the stomach somewhat in that region, as shown in the cut, and the belly will feel soft, and the ova granular and movable under it. The operator would probably find it somewhat difficult to hold a salmon in that condition. In fact, if a salmon be large and vigorous,

he will find it difficult to hold it at all, and it will require at least three men to hold it, and then the task is not easy. I have known a salmon, in its struggles, send pots, pans, water, and ova flying with one dash of his tail. The softness of the belly is the best test here. In greyling, the belly is less soft, the fish being more of a hard and scaly nature generally. A slight pressure, however, if greyling, or salmon, or trout, be at all ripe, will usually be sufficient to extrude two or three eggs, when the fish should be carefully put up until all preliminaries are prepared for operation. How the fish are to be kept alive depends entirely upon the conveniences at hand. In some rivers, a little pool can often be made at the river's side; in others, pails, or even washing-trays, are used. A salmon can be tailed—that is, tied up—by means of a cord, a slip-knot being passed over the tail. A male or female fish being secured,¹ obtain one of the other sex as soon as possible.

The requisites for spawning the fish properly are, first, a shallow open tin dish, with a lip to it—for salmon, this dish should not be less than twelve or thirteen inches square at the least, for trout it may

¹ I may add here, that it is always as well, if they can be had without difficulty, to retain two males to one ripe female in case of a scarcity of milt.

be less ; a large jug for fresh water ; and a tin can with a perforated lid, to carry the ova in—this should be a can capable of holding at least a gallon of water. First, half fill the tin dish with clean water ; take the female (if a salmon, in the best way you can), one person holding the head, and another the tail, and, if necessary, a third steadying the body. If the head be held between the knees, a better hold will be got ; and if a *dry* cloth be used to hold the fish, there will be less chance of her slipping. Now, the fish being held with the tail downwards, and the body rather sideways, or with the belly a little towards the operator, the vent being as closely over the water in the tin dish as may be convenient, the manipulator should, steadying the fish with one hand, compress the body with the other, passing the fingers and thumb upon either side with a gentle pressure from the thorax down to the vent. This pressure, be it remarked, must not be harder than is sufficient to expel the eggs without difficulty. If the fish does not give up her roe, no force must be used ; but lay her aside on the grass, or even in the water, for a few minutes, when, perhaps, she may be more easily persuaded. If, however, she still declines, she is not quite ripe enough ; and if you have the means of keeping her for twenty-four or forty-eight hours, it

will be advisable to do so. But, I repeat, no force must be employed; if the ova is ripe, it is detached from the membrane to which, during the period of gestation, it has hitherto been attached, and it will pass out easily. If, however, it be not quite detached, but the process has only barely commenced, by too much force you will tear the eggs from the membrane, which are then totally useless, as they are immature, and will not hatch, and you will cause a slight discharge of blood with the ova. When this is the case, you may conclude that you have ruptured the membrane, and the chances are two to one that the fish dies, and, as I have said, the eggs are useless, or worse, because they do not, for the most part, show that they are barren for weeks after—perhaps months—during which time the pisciculturist is in a fool's paradise, thinking what a fine stock of ova he has in his trays; and he sacrifices time and space, which are invaluable to him, to infertile ova. Inexpert attendants are very liable, for the sake of bringing home an apparently good stock of ova, to do this; in fact, it may be termed the vice of inexperience. If the ova be ripe, it flows in one unbroken stream from the fish, while under pressure, until the whole is exhausted. When as much ova is in the dish as can conveniently be milted, lay the female

aside, and take one of the male fish ; serve him precisely in the same way as the female, allowing the milt, which will flow like thin cream, to fall upon the ova, and moving the fish about over the surface, so as to distribute it. When you have as much as will thicken the water to a chalky-white colour, lay aside the male, and stir the ova and milt *thoroughly*, but gently, up together with the hand, and then lay the dish aside for five minutes. At the end of that time, pour off the dirty water, and, as you pour it off, pour in fresh from the jug, until all thick water, dirt, &c., be washed away, and the ova remains clear and bright, when it should be gently deposited in the carrying-can, and the operation completed until sufficient ova be collected. The ova being exhausted, put the fish gently back into the water ; and, if you have done your office properly, they will dart off, as if overjoyed to be rid of their burden.

If the pisciculturist has not a stream of his own whence to obtain trout or greyling, he will have to rely upon the keepers of the water, or upon some one on the spot, to tell him when the fish are spawning.

Keepers are often so jealous of any spawn being taken from the water under their charge, that, although the taking away of some portion of the

spawn rather does good than harm to the stream, they are not always to be relied upon to let the pisciculturist know the proper time to come for the spawn. I have been deceived so often in this way, and had so many fruitless and vexatious journeys, from this jealousy of keepers, that I warn my brother pisciculturists to keep a sharp eye upon them. Trout and salmon appear on the beds a week or so before they spawn, at any time from November to March. The season lasts some weeks, but it must always be borne in mind that the earlier spawners are by far the best, not only as yielding stronger and more advanced fry for the next season, but as yielding even a larger per centage of fry. If, therefore, the keeper be ordered to send word as soon as the fish come on the shallows, and the pisciculturist goes a week or ten days after they are first seen to come up, he will be in good time. This is not the case, however, with greyling; they are so short a time over their spawning, and in March and April, when they are thus engaged, the netting is so likely to be interrupted by floods, that no opportunity, not a day, nor an hour, should be lost; very many times have I known a delay of a day cost the pisciculturist his stock of ova for the year. As soon as the large greyling are observed to come on the shallows the

nets should be set to work. The best nets to use for trout and greyling it is most difficult to decide, as the modes of netting differ in various rivers, and the net that suits one water will not always suit another. Some waters require small and light nets, and others heavy and ponderous ones. As a rule, a net of stout thread, or finest twine, double walled, with plenty of lint in it, and well weighted, will be found to answer best. If the net be from twenty-five to thirty-five yards long, it will be long enough for most ordinary rivers. It should be split in the middle so that two fourteen or fifteen yard nets can be made of it, these being handier for small streams, and answering as drag and stop nets; when it is required to use the larger net, or the two together, the river will be usually so large that a stop net cannot well be used. If a stop net be used, however, it should be of moderately stout twine, heavily walled, and well roped and weighted. (N.B.—On all nets the walling should be set on the ropes *square* and not diamond shape, as they work better, and catch far more fish.) In weedy rivers four or five half bricks should be tied on so as to hang loosely to the lead line, to prevent the net from rolling up; but as a rule, particularly if the water be at all heavy, swift and weedy rivers are very difficult to net fish out of. The net should always,

if possible, be kept moving, to confuse the fish, and should be worked as quickly as possible coincident with the lead line being kept on the bottom, a condition which it is needless to say is absolutely necessary.

There is a very handy net called a "shoe net," which is sometimes used in shallow rivers and ditches, up which the fish will work to spawn. It consists of a longish bag set upon a bow of arched ash strung with stout string, and some four or five feet in width. To this is a long handle, so that the net has somewhat the appearance of a common shrimp poke-net. If a fish is seen to dart into a weed in shallow water the mouth of the net is held at the tail of the weed, and the fish is trodden out into it.

I mention these points because it has often been my lot, as no doubt it has that of others, to reach the river I desired to net, perhaps, after a long and expensive journey, with a net quite unfit for it, and possibly to lose a whole day in fruitless endeavours to net the river, albeit the same was full of spawning fish.

I have, in the frontispiece, shown how to hold a trout or greyling when taking the spawn from it; a large fish, however, will, like the salmon, often need

assistance to hold the tail. Of course the same method of treatment, as regards the spawn, is employed to both trout and greyling, as I have already related.

As it is often desired to hatch ova, not only indoors, but in a sitting-room, for purposes of study and inquiry rather than the stocking of fisheries, I offer the plan of an apparatus suitable for this purpose. The annexed cut is not a very elegant form of apparatus, still it has the recommendation of convenience. It makes no mess, and takes up very little room; a mere drip of water is all that is required, as two or three hundred of ova would be as many as would be necessary.

All that is required is a small cistern, capable of holding a few gallons of water, with a small stop-cock to regulate the supply. Around this cistern may be coiled, as it were in lengths, a small permanent gutter, or way, about an inch or two in width, and neatly gravelled. On this the ova can be deposited. Each coil or length, of course, must be lower than the other; and, supposing the apparatus to be square, a little fall could be contrived at each corner. This coil or gutter, after passing two or three times round the cistern, should end in a water tank; and if the water tank be surrounded with a cooler, and furnished

with a small force-pump, the water can be forced up again into the cistern, and may be used again and again. If, however, the house be one well furnished with water and large cisterns, a very small pipe to convey the water to the troughs or gutters, and another to carry it off, will then be all that is necessary. Of course, such an apparatus may be made as tasteful and appropriate to the place it is consigned to as the owner may please. In the accompanying

FIG. 1.

cut (Fig. 1) engraving shows the lid of the upper cistern (1) open; while (Fig. 2) has the cistern

shut, but the sides are let down to form a tray (7), into which the young fish can be removed for rearing. The lower cistern is shown by Fig. 2; the waste tap at (3), whence the water can

be drawn off; the supply tap at (5); this either into the hatching trays (4, 4, 4), or into the rearing tray (7). The force-pump is indicated at (6); (8) is a waste-pipe screwed on to let the water run from the rearing tray into the lower cistern. Fig. (a) shows an enlarged end of each of the trays with the lip, whence the water drips into the next tray.

CHAPTER III.

ON THE TRANSPORT OF OVA.

HAVING taken the ova, the next question that occurs is how to convey it to its destination. It has been a very popular error that ova will not admit of carriage without some one to carry it or attend it until it is so far advanced that the eye became visible. Now, this really is not so; for I hit upon a plan, which was carried out by Mr. Woodcock, of Bury, during the past year, by which we managed to convey thousands of ova by rail some 200 miles, with little or no attention. The plan was simply to obtain permission from the railway authorities to have the vessel which contained the ova swung from one of the beams of the van. A hook was screwed in; the vessel containing the ova, filled to the top with water, *so that no motion of the water in the jar could take place*, was then hung up, depending from the hook; a small half-pint bottle of fresh water was given to the guard, to fill in a little

once (or at most twice) during the journey, so as to keep the water up to the top; and the can swung easily and steadily all the way to London, with the loss of very few ova indeed. I need not say that had the can been placed to stand on the floor of the van, like any other luggage, almost every egg would have been killed from the incessant jolting.

In the course of our transmissions one lot only was spoilt, and that was spoilt, I believe, by the bottom of the can not being firm enough. It cockled and buckled at every swing from the weight of water in it, thus keeping the mass of ova within in one incessant dance. The cans used were cans that would hold about a gallon, and were shaped like oil-cans, with handles on either side to swing them by. The cork was perforated, and through it was pushed a very small but long-tubed funnel. This supplied air to the water, prevented splashing, and allowed any water to be poured in without waste. I believe this was due to Mr. Woodcock's ingenuity. Near the bottom of the can was a small stop-cock, so that when the ova arrived, or if it had to pass a night *en route*, the water might be run off from below, and fresh let in from above, so as to be sure that the fresh water quite percolated the ova. I must note one point here, viz. if the can be set

under a tap to catch a drip all night, be certain that the stop-cock does not run away the water *faster* than the drip supplies it, and be sure also that no accident can happen to stop or even impede the drip. Should either of these happen, the ova will be run dry.

It is advisable that there should be no break in the railway journey, and it will of course be necessary that some one should be on the look out for the ova on its arrival. A telegraphic message should be sent off, as soon as the ova is deposited in the van, to the recipient, warning him of the train it will arrive by. This is the method we adopted, and with perfect success.

I must here cite the most remarkable instance of the safe conveyance of ova which has in all probability ever been carried out. I refer to the sending of ova to Australia. After many attempts and many failures, in all of which water was employed, Mr. Youl (to whose energy and perseverance the success of this experiment is entirely due) determined to try whether the ova could not be sent out in wet moss, packed in ice; and after trying some preliminary experiments, by the co-operation of the Wenham Lake Ice Company, which gave encouraging results, during the spring and summer of 1863, he, during

the succeeding winter, prepared to send out a large stock of salmon ova packed in ice. Having obtained the necessary space in the *Norfolk*, a fine clipper ship belonging to Messrs. Money Wigram and Sons, who gave Mr. Youl every possible assistance, Mr. Youl succeeded in depositing in the hold of the vessel about ten tons of ice; and in the heart of this mass were deposited the boxes of ova. The boxes were about two feet long, and were drilled full of holes, to admit air, and so that the drip from the ice could find its way to the moss within, and keep up the moisture. Each box was filled with wet moss and ova in layers, and was then *completely surrounded with ice, the ova being deposited within three days of its being taken from the parent fish.* The common belief has been that ova would not bear transport of any very disturbing kind until the eye of the embryo was visible within the egg. This doctrine is now exploded. It is true that when deposited *in water*, after some days, a very slight disturbance kills the ova; but I conclude that the facility of destruction in this way is very greatly lessened by the lowering of the temperature, and rendering of the vitality, and consequently of the nervous system, in the embryo less active. I imagine that the faculties are in a sort of trance, equivalent somewhat to the

trance produced by extreme cold on the human system, and that during this period the egg is much less sensitive to shocks. It would be well to try the effect of similar measures upon the eggs of birds, as the acclimatisation of scarce and tender species might be greatly simplified if it should be found to answer.

Mr. Youl's plan answered perfectly, and 30,000 of the eggs arrived at Tasmania in perfect condition, and were safely deposited in the river Plenty, in beds prepared for them. Unfortunately, soon after their deposition the temperature of the water rose to 54°, and the consequence of this high temperature was, that vast quantities of the ova died, and they only succeeded in hatching out about 3,000 of the 30,000 ova. That the experiment should have so greatly failed after the most onerous part of it had been so nobly got over, is much to be regretted.

There need, however, now be no longer any difficulty in transplanting various breeds of fish from place to place, and from clime to clime, wherever ice can be obtained; and, no doubt, ere many years are over, we shall have introduced into this country every fish that exists in others which is worth the transit. Before quitting this subject, I must note, that it appears to be quite possible to incubate ova alto-

gether, to a certain point, in wet moss; if this, on further experience, be found to be so, much trouble and risk will henceforth be avoided. This, however, is an experiment for the future.

If it, nevertheless, be desired to send the ova by an attendant, then the matter is simple enough. The ova should be placed in a can with a perforated lid: not more than one-third ova to two-thirds water. If the journey is to be made by rail, a stout stick rested upon the opposite seats, upon the middle of which stick the can may be swung by the handle, will be found to answer the purpose; or the stick may be supported on the knees of the attendant where this is inconvenient, and the can swung between them. A very little occasional attention to prevent too violent oscillation is all that is needed. In this way, I have conveyed thousands of ova long distances, with scarcely any loss at all. Coolness and fresh water are both, of course, very desirable, if they can be obtained.

To send ova a long distance, the safest way is, undoubtedly, to wait until the eye of the embryo becomes visible in the egg, and then to pack the eggs in wet moss, when they can safely be sent long distances. The plan adopted at Huningue is as follows:—A wide-mouthed bottle, five or six inches

deep, is used ; a slight layer of wet moss placed on the bottom ; a thick layer of vitalized ova placed on it ; another layer of wet moss inserted ; then another layer of ova ; and so on, till the bottle be full. A plug of moss is then put into the neck, and the bottle tied over with a piece of stout paper (after the fashion used on jam-pots). The paper is pricked full of holes, to let in the air. This bottle, or two or three such bottles, are then placed in a box of damp (not wet) moss, well packed, and that box inclosed in a still larger one of the same shape, the smaller box being packed in with more moss. If the weather be warm, and the ova in an advanced state, a few lumps of ice may be distributed amongst the moss to retard hatching. In this way the ova will stand any amount of shaking, and the temperature will be kept down.

This is certainly the best, the safest, and least expensive method I know of for transporting ova from one country to another. If the distance be long, the ova should be sent off *as soon as the eye becomes visible*, for, if too long a period be allowed to elapse, the eggs may hatch on the journey, when they would be lost. In this respect, if taken in moderate time, there is little to fear from the eggs of salmon, sea trout, or trout, as they develop slowly,

and the weather is usually cold when they are transported. But this is not the case with greyling. So rapid is the development, that, if the weather be at all warm, and it often is in May, it is almost impossible, even with the assistance of ice, to send them on a journey after the eye becomes visible, for in a warm season there are hardly three days between the showing of the eye and the hatching of the egg; and the mere act of taking them out of the water will set the eggs hatching.

CHAPTER IV.

THE HATCHING OF OVA AND TREATMENT OF ALEVINS.

WE must now go back a little in our process. We will suppose the ova safely taken and conveyed to its destination. Suppose the trays all ready and the water running. The eggs should be deposited without loss of time, and, when once deposited, disturbed as little as possible until the eye is developed. Even in picking out the bad ova the operator should disturb the surrounding ones as little as possible. There are various plans in use for the removal of dead ova. Some persons use a sort of glass syphon. This was invented by the French. I furnish a cut of it. The thumb is placed on the top of the implement; the nozzle is then plunged into the water and placed before the ova or small fry it is desired to extract, and the thumb being suddenly withdrawn, the ova is drawn up into the body of the vessel and can be dropped out at the thumb end if required, or examined in the

bowl of the instrument. This is a useful implement if it be wished to examine eggs or fry without damage, but it is a clumsy affair to remove dead ova with, as it draws up everything that comes

within its influence and often more than the operator requires. Some persons use tweezers of various shapes. These are also clumsy and disturb the surrounding ova more than is necessary, and often crush the ova and scatter the contents, which speedily putrify, all over the tray. Some use a fine spear—a small needle tied to a stick—and this is jobbed into the dead ova; but I have tried this plan, and the ovum being toughish as to its skin, often resists the prod of the needle and goes slipping about from place to place, delaying its removal and disturbing

the other ova. The best plan, by very far, is the one which I have introduced. Twist up a piece of fine brass wire into an eye just big enough to take the ova, tie it to a fine-pointed handle, bend it to the most convenient angle for lifting, softly introduce it between the ova and under the one you wish to withdraw, and fetch it out swiftly but steadily; no disturbance is created, and the method is almost infallible if quickly and neatly done, while the rapidity which can be exercised after a little practice is astonishing—a dexterous operator can pick the ova up almost as quickly as a fowl can pick up barley. I first hit upon the plan by necessity, who is, as we have been taught, the mother of invention. I had a quantity of ova sent with many bad ones, and I had no implement to remove them with. In this strait an old barbel float caught my attention, and the eye appeared likely to answer. I tried it and it did answer, *et voilà*. This may seem a trumpery thing to dilate on, but if the reader has under his charge forty or fifty traysfull of ova, with the thermometer at 50° in the water, byssus forming rapidly, and a hundred or so of eggs dead in each tray, he will be uncommonly glad to know the speediest possible method of removing the dead ones before worse come of it.

The ova being deposited, the embryo within proceeds towards development with greater or less rapidity, according as the temperature of the water is high or low. The higher the temperature the more rapid the development. Salmon ova will take from forty or fifty days to 120 or 130 days; trout from thirty to eighty or ninety; greyling from twelve or fifteen to thirty; charr about the same, or rather less than trout; other fish, as pike, perch, &c., a shorter time, but temperature more or less affects them all. I have known ova deposited at the same time to hatch out in the lowest trays of a series of trays several days before those in the top trays; the water in the lower having been exposed to a warmer temperature, and being some 2° higher than the water in the topmost trays.

The ova of trout varies more in colour and size than that of any other fish. I have seen some of a deep salmon colour, and those of the next fish would perhaps be of a pale hue, almost white. A curious change takes place in the ova of greyling within a few hours of its taking; when it first comes forth it is of small size, not larger than a No. 7 shot; after a time a sort of false skin appears to swell round it, no doubt to protect the egg, which is then doubled in size. I will describe the develop-

ment of a salmon egg, as the same process applies to the others.

Salmon ova, when first taken, is of a clear reddish-salmon colour; after the milt is mixed with it, it assumes a shade of darker red, and a sort of disc, like the yolk of an egg in form is observable, which was not there before. Then globules of oily matter form and collect round this disc, some of larger size than the others. As time goes on these globules become more various in size and the series is more irregular, and if the egg is good it goes on extending. It often happens, however, that these globules do not alter at all, but the disc and globules remain unchanged as in the early stage. When this is the case, while other eggs are changing in the form and density of the disc and globules, it is extremely probable that the eggs are bad: either they were immature, or not properly fertilized, or some other accident has occurred to render them useless. To the uninitiated, however, these eggs appear to be perfectly good, and thus they will remain totally unchanged, and, if anything, getting more transparent, until the other eggs are hatched out; but hold them up to the light and compare them with a good egg, and three parts of the bad egg will be seen to be filled with a perfectly clear transparent matter with a

mere ring of small oily globules, while the whole of the good one will be filled with a network of globules.¹ After a further period has elapsed, on looking closer a small, thin, semi-opaque white line of some quarter of an inch, or less, in length will be visible on one side of the egg. This is the tail of the fish, and is the earliest visible formation of the spinal column; on the opposite side of the egg will be seen the head. This is shaped somewhat like the bowl of a tea-spoon or the head of a snake. In time this line densifies and grows distinct, and about the fifth or sixth week (in water of moderate temperature), two black specks will be observable. These are the eyes of the embryo, which may now be discerned moving and often turning round in the egg. The articulation of the veins may be plainly traced. The pulsation of the heart and the rapid flow of the circulation can all be distinctly seen through the outer shell, forming a very wonderful and most interesting spectacle.

¹ When an egg is visibly bad, it turns an opaque white. Dr. Davy states that this is owing to the absorption of water. That he is right we have only to break the shell of an egg in the water to prove. The contents, previously a clear and glutinous fluid, at once become turgid and solid; though why these clear eggs resist the absorption of water so long, while others absorb it instantaneously, has not yet been discovered.

From this time till the hatching, which takes place from a fortnight to three weeks or a month subsequently, the shell of the egg gradually grows thinner and thinner, and the motions and development of the embryo within more rapid and constant, and more clear and distinct. Some morning, when you visit your trays you observe a small reddish shining spot amongst the ova, rather larger than a pellet of ova, which catches the eye instantly; and on looking closer, you find that one of your fish has thrown off its shell, and emerged to life.

“ Take it up tenderly,
Treat it with care,
Fashioned so—”

No, not “slenderly,” for a more unwieldy, delicate, clumsy, welcome little stranger does not exist to gladden the eyes of the delighted pisciculturist withal. Now you have it in the little glass reservoir, with a drop or two of water around and over it, under the microscope. How it wriggles and kicks! what vigorous vitality is here, in this little curious object! Now it is quiescent, and what a wondrous spectacle is revealed to you! Is this a fish or a new kind of tadpole? Verily, Sir Philosopher, it is of fish, fishy—though not, perchance, fishlike. Could this strange, helpless little thing ever become

the magnificent twenty-pounder, that takes you down with breathless haste, with bending rod and whizzing reel, stumbling and panting, full five hundred yards of that terrific torrent, and flinging somersaults that rival those of the deftest acrobat, gives you a full half-hour's hard work and awful excitement in the dark pool below? Can this little marvel, I say, be the foundation of that which has had hundreds of laws made for it, thousands of pages of reports collected on it, myriads of law-suits fought about it, Royal Commissions without end imposed upon it; treatises unnumbered, written by great lights of science and genius, concerning it; by the catching of which thousands live, and hundreds realize fortunes, *or the reverse*; which millions feed on; and which should be, if properly understood and treated, one of the richest veins of our national wealth and subsistence? Verily, indeed, wonderful are the works of Providence! Stay, let us look closer: a thin streak, of almost transparent substance, about half an inch in length, at one end of which two wonderfully disproportioned eyes goggle at you through the lens; at the other end the thin streak turns upwards, and forms the tail part. From immediately below the throat, and along where the belly should be, depends a huge, unwieldy, umbilical bladder, larger, apparently,

than the egg it has just emerged from. This bladder is distended with a clear gum-like liquid. Up towards the throat are a collection of those oily globules before noticed, when in the egg state, just over them. Stay; can that little red spot be the heart? As I live, it is; and those thin filament-like cords, extending from and branching off towards the end of the bladder, are the veins. Now the red heart pulsates; and the injected blood rushes, with quick, steady action, through every vein—its progress being distinct, even without the aid of the microscope, and as traceable as in an anatomical preparation. Second by second the pulsations continue—But the animal is uneasy, and kicks and wriggles again. Place it carefully back in its trough. There, it darts to the bottom, ensconces itself between two stones of gravel, and lies prone on its side. In a few days you will be able to distinguish the rapid and unceasing beating of its little fan-like pectoral fins. But now glance over the trough, and haply you will find three or four more red-spots, indicating an increase in your registry of births. Here and there you will, perhaps, see eyes very distinctly. Look closer. They protrude from the shell; and this is how the fish hatches out. Now the head is thrust out, and the eyes stare forth at the wonderful world they are

about to come out into. The embryo wriggles, and shakes the egg; gradually the shell splits across the back, and the back is thrust out;¹ wriggle after wriggle ensues, and the work of parturition goes on with tolerable rapidity. A few more convulsions, and the little fish springs forth from its shell, leaving its empty case behind, and darts up to the surface of the water in its glad joy at being released from its prison, and then sinks slowly down again on the gravel prone upon its side. Helpless innocent, what a nice morsel now for a hungry trout! and what havoc a monster of six ounces would make among a hundred or two of them! Perhaps, after getting its head out, it finds a difficulty in releasing the tail, which is curled round the umbilical bladder within; again and again it tries fruitlessly, resting between each convulsion to concentrate its force for the next effort. Take pity upon it; place your camel-hair brush softly and caressingly upon it. See; there—it is out. May you catch it, in return for your kind offices, when it *is* a twenty-pounder!

At first the work of hatching goes slowly on; and these early-hatched fish are seldom strong specimens,

¹ Sometimes the tail protrudes first, and sometimes the shell splits across the belly, and the bag shows first. In these instances the struggles of the fish last much longer.

very many of them paying the penalty of their premature appearance;¹ but as the days go on, they increase in number, and soon a day arrives, as in "the rise" of the May-fly, when Nature bends all her energies to the work, and out they come by hundreds and thousands; every hour, nay, every minute, adds to the wriggling tenants of your trays, and after another day or two but a sparse few lazy fellows, indisposed to tempt their fate too early, remain to come forth. Remove them to some spare corner of an empty tray, that they may hatch therein at their leisure.

The hatched fish, if contained in the indoor apparatus first described, now require to be removed to rearing trays, and to be separated from the filth of egg shells, dead eggs, and alevins, with the contents of either burst or dead during hatching, and all the deposit which usually attends the hatching process; and here it will be seen at once what an advantage the French plan affords. Remove the grille. Draw out one of the corks and hold a pail under the hole, and with a little assistance from a soft brush to sweep the tray, the contents come into the pail. The dead and refuse can then be poured off gradually, and

¹ The bladder should run back almost to a point behind in healthy *young salmon*; when it is rounded too much the fish seldom does well.

the living deposited in the rearing tray. This is the work of but a few minutes, and perfectly clean quarters can be afforded the newly-hatched fish—a matter of no little importance to their health and well-doing, for if cleanliness was needful in the egg state, it is of vital necessity to the fish. Where gravel is used for the ova this cannot be insured without a great deal of labour and trouble; either the fish must be picked out as best they can be—a process involving the slaughter of many—or the dirt must be picked out, and this latter is impossible. The gravel will, in spite of all you can do, retain some impurity. However this be accomplished, it is a long, tedious, dirty, wasteful, and imperfect job; whereas the French is speedy and clean, and entails no loss whatever. The same trays that the fish were hatched in may, if it be wished, be used as rearing trays, a very thin coating of gravel being put on the bottom, and the number of fish hatched in each tray reduced. The greatest cleanliness is necessary during the period of alevinage. Even into the purest water minute particles of matter will find their way somehow, and in the earlier stages of the alevins' existence the skin is soft, and, according to Dr. Davy,¹

¹ "The Angler in the Lake District," an interesting and scientific little work, by Dr. John Davy, F.R.S.

it is covered with mucus, to which these particles, of course, readily adhere. The greater portion of these impurities are, of course, attracted to the gills, through which the water passes in the act of respiration. The gills, acting as a kind of filter, catch and detain these particles, which speedily multiply and check the flow of water, and consequently the aeration dependent on it ; when, if the fish be unable to rub them off, death from suffocation ensues. The more impure, therefore, the water, of course the larger the loss from this cause. Dr. Davy states that these floating matters consist usually of fibres of the simplest form of vegetation, particles of root entangled in them, and granules and nuclei of various kinds. Dr. Davy further recommends, as a means of keeping the water pure, aquatic plants. But the Doctor did not employ a running stream in his experiments, merely changing the water occasionally. He further adds, that these will increase the infusoria which form the earliest food of the little fish, and in this light the suggestion is a good one ; moreover, the plants may serve to rub off the above parasitic obstructions against. I have always experienced much difficulty in keeping the fish in the tray. They will wriggle through any hole or crack, however small. I have usually employed a piece of perforated zinc,

extending from the corner of the tray opposite to the outlet, to some inches beyond the outlet itself, so as to divide that part of the tray in which the spout is entirely from the rest of the tray. But the difficulty is to fix the zinc. In wooden trays you can tack it, and the division is effectual, as the fish cannot get by. In slate trays you might have a small slit sawed, down which the zinc might be slid, the other end being jammed in the angle of the tray; but in crockery the difficulty is considerable, and either a small sieve must be immersed under each spout in which many fish are daily killed; or the fish must be constantly fished out and put back into their trays. But this can only be done when the fish are all of one sort and of one hatching. When they are of different species, or there is much difference in their age, the difficulty in keeping them apart, without separate ranges of trays, is much increased. If the pisciculturist has a good stream of fresh clear water at command, all this is very much simplified. A wooden box of white deal, *well seasoned*, half-full of gravel, with a good stream through it, and some large stones scattered about for the fish to burrow under, will be all that is needed. Across the exits and entrances to this a slab of perforated zinc can be nailed, and

the isolation of species is complete. But where the rearing is perforce conducted in indoor trays, difficulties such as I have described will be experienced, if the operations are at all on a large scale, and the water supply is limited. The fish being deposited, little now needs to be done with them. They will

1. Egg with eye of embryo visible.
2. Young salmon just hatched.
3. Salmon having absorbed the vesicle.
4. Salmon three or four months old.

burrow under the gravel, or under stones, getting out of sight, and out of the light, which suits them not,¹ as much as possible, gradually absorbing the large bladder which attaches to them, the contents of which affords their sole subsistence. In about six weeks, as they grow larger, you will have to remove a large portion of them to some other tray that they may not be overcrowded. Little by little, the bladder is drawn up and absorbed into the system; as it

¹ A slight awning over them as a shade is desirable.

disappears the fish grow more and more active, darting and skipping about the troughs. Soon no trace of it is to be seen; and now they begin roving to and fro searching for food, and they require to be fed. It will be found also that they require still more room; and unless the pisciculturist has at his command a small stream of some kind, he will find it advisable to turn his fish out into the river they are destined for, as he will lose fewer of them in that way than by trying to rear them in a scarce water-supply. If, however, he has such a stream, and still wishes to keep them under his notice for some time, he should have either a small shallow pond constructed, or a large and long box or two of considerable extra capacity. These boxes should be gravelled, but should rise to full six inches out of the water, as the small fish are very active and apt to jump out. The tops should be covered with fine sparrow-netting, to keep mischievous birds, as kingfishers, &c. out, but so as to admit plenty of light and air, and to allow small flies to find their way to the water, which at this period form the most natural, and by no means scanty, supply of food. About two inches depth of water will be sufficient, and a fair but gentle stream should be turned on. In places the gravel should

be heaped up slightly to make mimic shallows for the fish to bask on, and at intervals of a foot or eighteen inches along the side of the box should be placed half bricks, these causing an eddy and a still resting-place, behind which the little fish will shelter. If this be not done, and the stream chance to be at all strong, the weaker ones will be driven down against the lower grating, and will there, in all probability, perish. A pond, of course, should be made upon similar principles, and should be carefully gravelled. I do not, however, hold with keeping the fry a day after they are able to roam about and seek their own living. I have heard people urge, that if the young fish are turned into the river at that early age, they will fall a prey to predaceous fish. It is possible that a small percentage of them may, but the remainder will early learn to know their enemies and avoid them; besides, in putting them into the river, the most shallow places at the sides and the most sheltered spots should be selected, and the fish should be distributed in small numbers in such places as predaceous fish are least likely to come and look for them. Added to this, the remainder will thrive so much better in the wider area of the river, and will grow so much faster, that this will almost

counterbalance any slight loss. If the fry are kept until they are of fair size, fed regularly every day, never seeing an enemy of any kind, what will become of them when they are turned at once into deep water amongst foes, without the preliminary and probationary life on the comparatively safe shallows, being all unaccustomed to seek their own food or to see enemies? In my opinion they are far more likely to fall victims then, and less likely to thrive on their own exertions, unless it be proposed to keep them until they are beyond the size taken by pike or large trout, in which case I do not think the pisciculturist would be likely to repeat his experiment. The trouble and expense of looking after and feeding the young fish is very considerable; so that, all things considered, it is far better to turn the fry in as soon as possible. Still, it may be thought desirable to keep some of them at any rate for a time, so we will consider their feeding. This at first must be done very sparsely, or they will surfeit themselves if the food be strong, such as liver or meat. The best and most natural food is the roe of coarse fish. One of the best for this purpose is the plaice, a common fish in which the roe is plentiful during March, April, May, and June. Parboil it, and then put it in water to dis-

integrate it. A little ox or sheep's liver well boiled, and ground or grated as fine as possible, or worms chopped very small, may be scattered to them daily. The smallest insects or midge flies thrown in the water, they will rise to and take with avidity. Various other matters are used for their subsistence, amongst which I will notice one or two only, since almost any animal matter, if reduced to sufficiently small dimensions, forms food for them.

In feeding young fish, care should be taken to keep the bottom of the pond in which they are as clean as possible; as, if animal food is left in any large quantity deposited upon the gravel, it will of course putrify, and much damage the fish.

A few of the little gammari or freshwater scud-lidæ turned into the ponds then will be found useful in clearing up such matters, if no other means be practicable. While the fish are yet in the boxes, you may remove refuse with the siphon which you have used to suck up the eggs; but this will be found a somewhat tedious process. *No means, however, should be neglected which will tend to keep the water pure and clean.* Lean meat, cut very thin, boiled well, and then macerated or pounded to a pulp, makes good food, the small fibrous particles being of the right size for the little fish to feed on.

Mr. Fry recommends a variety of matters, as the flesh of coarse fish pounded small; and chiefly he advises that the ova of various of these fish should be procured *and hatched*, as the young fry will take the embryo as soon as it appears with great avidity. One of his reasons for preferring this food is certainly a very reasonable one, for he points out that it is not likely to die and putrify, and there is not much difficulty in obtaining large quantities of such spawn or in hatching it, as very many of the coarse fish are spawning from April to June, which is just the period when this food is required; as the fish increase in size other food can easily be substituted. He also mentions the almost microscopic crustacea of the species *Cythere*, *Cyprès*, and *Cyclops*, which abound in stagnant waters, newly-hatched earthworms, &c. &c.

CHAPTER V.

THE TRANSPORT OF FRY AND FISH.

THE transport of fry when small is not a very difficult matter, and the transport of alevins (the small fry with the bag yet attached to them) is even less so. Indeed, in this latter instance I make no doubt that the plan of swinging the can advocated for ova at page 76 would answer well enough. In sending fry, however, it is not safe to send them without an attendant for a journey of any length. Cool weather is a great advantage in the conveyance of fry, and a little fresh water from time to time equally so. When I wish to be very sure about the conveyance of fry, I usually write to some station-master on any line, and ask him to allow one of the porters to have a pail full of river-water ready, which has never yet been refused. It must be river-water, however, as pump-water would inevitably kill the fry, consequently a station with a stream handy to it should be selected. If I cannot obtain it in this way, I make the attendant take two

cans with him, one for the fish, and the other holding fresh water. In fairly cool weather a thousand of fry will do well enough in a can holding one and a half gallons of water for from one and a half to two hours. The aeration of the water is a matter of great importance, and a small pair of bellows should be provided. When the fry begin to come up to the top of the water, which is always a sign of deficient aeration, put the nozzle of the bellows to the bottom of the can, and give three or four vigorous blasts, and the fish will at once seek the bottom, and stay there. This process repeated at intervals will be found to have the most valuable effect in prolonging the life of the fry. Failing in the possession of a pair of bellows, if the attendant be reduced to straits, he may employ a clean clay pipe, and blow through it, and this process, though less useful than the other, will be found very beneficial. Of course the pipe *must be a clean one*. Failing in this, dip up some of the water in a cup, and pour it in from a height; but the other methods are preferable. If possible, always remove dead fish or filth.

I last year saw a thousand salmon fry lost in a singular manner. I had taken them down to a friend who was a brewer. The person who was to carry them to the water had not arrived, and

they were obliged to be left standing in the yard. As the weather was very hot indeed, the fish showed symptoms of exhaustion, and fresh water was given to them. In moving them about from can to can about two-thirds of them were inconsiderately poured into a pail. This pail chanced to be one of the brew-house pails, and, though apparently perfectly clean, there can be no doubt that the wood was saturated with carbonic-acid; for the instant the fish touched the bottom nine-tenths of them turned up dead. I never saw so direful and sudden a slaughter. For a thousand fry a good large bait-can is as good a medium of conveyance as any.

The larger fish are, the more difficult it becomes to transport them. Fish so tenacious of life as eels, tench, carp, and even jack, may be transported with tolerable ease. The salmonidæ require more care and attention. In Holland, tench and carp are conveyed to market in wet moss, are put into tanks, and if not sold are re-consigned to the wet moss, and taken home again. Indeed I have heard of their being kept for a considerable time in wet moss during the winter. Young salmon, trout, or grayling are more difficult to transport, particularly salmon. The best apparatus for moving the larger fish is Mr. Eyre's fish-carrier. This is a large vessel, with a force-

pump attached, by means of which air can be driven through the water.¹ Thus the water is kept aerated and wholesome. When this apparatus is put in action, fish that have previously appeared sickly, and have been turning on their sides in an apparently dying condition, instantly dive to the bottom and assume their natural position. By this means largeish fish may be conveyed a considerable distance.² If one or two, however, really die, they should always be speedily removed; and this should not be done by the hand, but by means of a small net; indeed, the hand should not be used in contact with live fish oftener than is positively unavoidable.

¹ The following description of the Fish-carrier is from the pen of Mr. Eyre himself:—

“The apparatus consists of a zinc cylinder, about three feet high and two feet diameter, with a strong iron handle running round the middle. To the top a small force-pump is attached, and by this fresh air is forced through a star-shaped distributor at the bottom of the cylinder. A ring-net, to bring the fish up for inspection, and a loose concave rim, to prevent splashing over, completes it.”

The reader can extemporize a fish-carrier from a nine-gallon or larger cask; this must be thoroughly sweetened in the first place. Fasten a small force-pump down the inside, and from the bottom of it carry a small leaden pipe across the bottom of the cask. This pipe should be drilled full of small holes, and at every stroke of the pump a shower of air bubbles rushes through the water. The top should not be thoroughly open, but a large round hole should be cut for air.

² Large grayling have been conveyed a distance of 250 miles in it with little damage or loss.

While correcting this sheet, an event has occurred, in the introduction of the *Silurus Glanis* into this country, which in the transport of fish has never been equalled in modern days. I do not mean to assert that specimens of fish have not been brought even longer distances, but they have usually been by sea voyages, when the arrangements once made were complete, and little or no change has been required; but in this instance the changes and chances of failure have been infinite, but have all been overcome by the energy and perseverance of Sir Stephen Lake-man. I cannot do better than allow my friend Mr. James Lowe to tell the story in his own characteristic way, and therefore extract his letter from the *Field* of September 17th. :—

THE ARRIVAL OF THE *SILURUS GLANIS* IN ENGLAND.

“That much desired fish, the *Silurus*, has at last been brought alive to this country, after various failures. The success is entirely due to the intelligent enterprise and perseverance of Sir Stephen B. Lakeman, who himself accompanied the fish all the way from Bucharest, a distance of 1,800 miles; and on Thursday night (*September 15th*) I had the pleasure of assisting Mr. Francis Francis in placing fourteen

lively little baby-siluri in a pond not far from the fish-hatching apparatus belonging to the Acclimatisation Society on Mr. Francis's grounds at Twickenham.

“When I state that Sir S. Lakeman had to change railway carriages more than thirty times during the journey, not to mention other vehicles, such as horse-carriages and steamers; that he started on the 23d of August, and arrived in London with the fish on the evening of the 15th of September; and that during all that long journey he had to wage perpetual battle with the indifference and stupidity of officials, from station-masters down to porters (most of whom seemed to regard the fact of his travelling with a strange fish as rather a misdemeanour than otherwise), the reader will have some notion of the difficulties which have been overcome.

“The fourteen little siluri (or siluruses) which have arrived are what remain of thirty-six of the same species, which started from Kopacheni, where Sir S. Lakeman's estate is situated. This place is on the banks of the Argisch, a tributary of the Danube, and is about ten miles from Bucharest. The Argisch abounds in Silurus, and in all the other curious and unknown fish which swarm in the Danube, some of which (thanks to Sir S. Lakeman) we hope, at no

very distant day, to reintroduce to their old friends, the siluri, in Mr. Francis's pond.

“By way of preparation for the journey, the Siluri were placed in a water-cask, covered with a net, and placed in a large pond or lake of about thirty acres, belonging to Sir S. Lakeman; which pond abounds with fish, and yields silurus weighing up to 30lb. and 40lb., which may be caught with the line.

“The contrivance which Sir S. Lakeman adopted for the transport of the fish, and the simplicity of the arrangement whereby he managed to aerate the water, is worthy of great commendation. Of the thirty-six fish which started from Kopacheni, some were comparatively large (weighing up to 4lb., and one of about 6lb.), and some were mere fry. They were separated according to sizes, and placed in three barrels of about the capacity of quarter-casks, twelve in a barrel. The lids of the barrels were perforated, and inside the lid was a perforated inner lid with a hole in the centre large enough to allow the fish, or a man's arm, to pass. The barrels were mounted upon rockers, like those of a child's cradle, and being kept about three-parts full of water, the motion of the vehicles in which they travelled (whether drawn by horses or driven by steam) rocked them about and kept up a constant splashing, and, consequently, a

constant aeration of the water. Sir S. Lakeman observed that so long as the barrels were in motion the fish remained lively, and it was only during the stoppages at stations, &c., that they exhibited signs of distress. A servant was directed to remain by the barrels throughout the journey, and at intervals of two or three hours to pour in a bottle of fresh water.

“Sir S. Lakeman started (as I have stated) from Kopacheni on August 23d. He brought the fish, by Bucharest, to Giurgevo, a distance of fifty miles; thence by steamer to Basias (in Transylvania), and so on by railway to Pesth, Vienna, Nuremburg, Cologne, Brussels, and Boulogne. The larger fish died first, all but the six-pounder, which endured to Vienna; and he only died there, it is supposed, because the servant in charge put his barrel into a stable, and it is likely that the ammoniacal atmosphere of the place disagreed with him. It should be noticed that during the lifetime of this gentleman some of the smaller fish which had been drafted into his barrel *disappeared* very mysteriously, and a large number of specimens of the ‘tiger eel’ of the Danube, which were assigned to him as travelling companions, were also *non est*.

“The difficulties which had to be contended with

were infinite ; but the worst accident happened at Boulogne, where the stupid railway porter hoisted upon his back the solitary barrel which contained the survivors, just as if it had been a bale of goods, and finding the water running over his head and down his neck, flung it down, scattering fish and water all about the station. Happily, they were almost all recovered without damage, and that they should have survived such a mishap is certainly a remarkable proof of their hardiness and tenacity of life.

“On arriving at Folkestone, there were fourteen survivors of the thirty-six which started from Kopacheni, and I am happy to say that every one of these reached Mr. Francis in the most lively and promising state—somewhat thin, it is true (for they had been kept upon short commons all through the journey), but apparently as full of life and vivacity as such little creatures could possibly be.

“Immediately on his arrival in London, Sir Stephen Lakeman, with most praiseworthy public spirit, thought more of the fish than of himself ; for without even driving to an hotel, he made his way to *The Field* office ; and I need not describe with what delight he and his charge were welcomed. In a very short time we were on our way to Twickenham, having (as we thought) deposited the siluri safely in

the guard's van. Alas! the troubles of the little fellows were not yet over. When the train drew up at Vauxhall, the guard rushed to our carriage with consternation upon his face. 'Oh, pray, gentlemen, come to the van! I hadn't turned my back half a minute before a [blank] fool of a porter shoved in a package, and turned over your barrel of fish, and nearly all the water has run out.' This was sad news—to weather this long journey of nearly 2,000 miles successfully, and then to be shipwrecked between Waterloo-bridge and Twickenham! Out we rushed, and into the van. The guard's report was too true; but I at once ascertained that *some* water was left in the barrel. 'Water! water;' I shouted, louder than Coleridge's *Ancient Mariner* probably did, and fortunately a porter had time to fetch just one bucket from the pump, which we managed to get into the barrel. The rest of the journey Sir S. Lakeman and I performed in the van, determined to leave our precious charge no more to the care of either guards or porters. I must do this particular guard, however, the credit to say that the accident was no fault of his; that he did all that lay in his power to remedy it as soon as he discovered it, and that he manifested very great concern at the occurrence and interest in the welfare of our charges.

“So we got them safely down to Mr. Francis’s, and on the brink of the pond turned them into a trough,—fourteen little siluri, all alive and kicking, and as spry and frisky as possible. Their size varied from an ounce and a half to two ounces, for they are not more than three months old; but Sir S. Lakeman (who is well acquainted with the fish) declares that in a few weeks, when they have had the benefit of fresh water and plenty of food, their increase will be rapid and astonishing. When put into the water, they dived down to the bottom at once, with an easy vigorous movement, and waving their long barbels about, quite as if they knew their way about the pond which they then saw for the first time. From their flourishing condition, there is every reason to hope that they will increase and multiply. Indeed, I have now very little doubt that, with ordinary luck, this country has now acquired the *Silurus Glanis*.

“This is, so far as I am aware, the first time that this valuable fish has been brought to our shores; and the gratitude not only of the Acclimatisation Society, but of the country, is due to Sir Stephen B. Lakeman for the admirable manner in which he has effected the task which he unselfishly, and let me say patriotically, imposed upon himself. That the silurus is a most valuable fish there is no reason to

doubt. Its extraordinary rapacity and the enormous size to which it grows will require that it shall have lakes and ponds specially allotted to its use ; but all witnesses concur in pronouncing it to be one of the most delicious fishes that exist.

“JAMES LOWE,

“Joint Hon. Sec. of the Acclimatisation Society.”

To the above I have but to add, that seven days afterwards, when this sheet was sent off, the young strangers were exceedingly well and hearty, and feeding ravenously.—F. F.

CHAPTER VI.

ON THE FOOD OF FISH AND ITS PRODUCTION.

THERE is not an insect or small reptile that inhabits the soil beneath us, the air above us, or the waters around us, that is not food for fishes in a greater or less degree. Worms of all kinds, flies of all kinds, grubs and larvæ of all kinds, cockchafers, crickets, leeches, snails, humble-bees, young birds, mice, rats, frogs, beetles, all serve the turn of one fish or another, and so in turn help to produce food for man. Black beetles, for example, often looked on as a nuisance in houses, are caviare to the trout; and I have seen two or three trout devour a panful of them with the greatest avidity. Nay, I have seen a wary old six-pound stream trout, that had been tempted with every conceivable variety of bait, succumb to the temptation of a black beetle. Small frogs, just emerged from tadpoleism, they rejoice in exceedingly; and I have even seen them take young toads, though some do repudiate the taste on the trout's

part. Nothing living comes amiss, but doubtless some kinds of food agree with them far better than others. But we know very little on this branch of the subject. It is dreamland to us, with a very little ascertained waking reality. What do we know even of the various breeds of the same species of fish, save the bare fact of their existence? What do we know of the food and conditions most favourable to them? Consider the trout. Can any fish display greater diversity or variety of size and value than trout? And how do we account for it?

Trout in one stream will be much larger, firmer, redder, and better shaped than in others. This may, in a measure, be owing to *the greater abundance* of food; but I have every reason to believe that it proceeds quite as much from the kind of food that they are enabled to obtain. In some rivers and lakes we find the trout large, handsome, red, and vigorous fish; in others, we find them small and meagre; nay, even in the same lake the fish will be influenced in a strange way by locality, so much so that the very breed even appears to be different. It would seem difficult to account for this peculiarity upon any other hypothesis than that of food and the nature of the water and soil around them, and yet the fish appear to be a totally different breed; and it

certainly appears possible that the character of the fish may have changed by degrees, through successive generations, and owing to being bred and fed in a different manner from the other fish. I have placed trout from one stream into another, and after years could very easily distinguish them from their compeers of the stream. But it is doubtful if their progeny would show and retain their special characteristics, though if they interbreed with the fish of the stream, as they would be pretty sure to, the breed might possibly be improved by the infusion of fresh blood.

Few experiments of any note have been tried in the feeding of fish, this being as yet almost untrodden ground; but I once heard of an experiment being tried in the following manner:—Equal numbers of trout were confined for a certain time by gratings to three several portions of the same stream. The fish in one of the divisions were fed entirely upon flies; in another, upon minnows; and in the third, upon worms. At the end of a certain period, those which had been fed on flies were the heaviest and in the best condition; those fed on minnows occupied the second place; while those fed on worms were in much the worst order of the three. The probability is, that had another pen been set off, and the fish

fed with a mixture of all three species of food, the fish in it would have far exceeded any of the others in weight and condition.

Some rivers notoriously produce larger trout than others, although the character of the soil they flow through may to all appearance be very similar. I will instance two, both of which are tributaries of the Thames—the Chess, a branch of the Buckinghamshire Colne; and the Wick, a little stream running through High Wycombe. I select these two streams because they are only some ten or twelve miles from each other, and because they are as nearly as possible of a size. Now, it is generally supposed that the very best and most fattening food provided by Nature for the trout is the may-fly, or green-drake. This fly abounds in profusion on the Chess; it is rarely if ever seen on the Wick—in fact, it may be said not to exist there. The minnow, likewise supposed to be most excellent and nourishing food for the trout, is also a stranger to the Wick; or if it exists there, is not found in any considerable number. Sticklebacks and miller's thumbs are found in places, though they do not abound in all parts of the stream. The caddis, or case grub of the smaller flies, however, is very abundant; and in some of the hatch holes there are a considerable quantity of leeches.

On the Chess a trout of two pounds would be a very fine one, the fish averaging from half a pound to a pound and a quarter. On the Wick it would be an ordinary fish; indeed, they are not considered fair takeable fish under a pound and a half. They are often caught of four and five pounds, and I have known them to run up to seven or eight or even ten pounds; and this in a small stream, little more than a good-sized brook, is a most astonishing size; for not only do these fish acquire this unusual weight, but they arrive at it very rapidly indeed. I have had many opportunities of knowing how they will increase under favourable circumstances, as one of the fisheries on the stream belonging to a friend of mine was on one or two occasions almost destroyed by bleach and tar water—some forty or fifty brace of fish being all that were saved: none of them were over two pounds, and yet, in two years, many of them had grown to six and seven pounds' weight.¹

Taking the Wycombe fish as a breed, I may say that they are the heaviest and thickest fish, for their length, it has ever been my lot to see; while the colour of the flesh of a good fish, instead of the ordi-

¹ Since this was written I regret to say that again have the whole of his fish been destroyed by filth sent down from above. F. F. 1864.

nary pale pink of a really well-conditioned trout, is often of a deep red, much redder, indeed, than that of salmon. On the other hand, the Chess fish are not particularly handsome, shapely, or well coloured. Here is a point well worthy the consideration of those who wish to take up the science of pisciculture. What particular species of food can it be which not only makes up for the total absence of the may-fly and minnow, but so feeds the fish in this admirable little stream, that there is no river, large or small, which I have ever seen in all England, can for its size equal it in production? What, then, can be the particular food that fattens them so rapidly?

My own impression is, that the fresh-water gammari, or pulex, to which I have previously referred, have not a little to do with it, for these insects abound in this stream even to profusion—to a greater extent, indeed, than I have ever found them in any other brook. The trout feed upon them voraciously; and it is a very common thing to find in the trout a mass of these insects, half digested, and as large as a filbert. I have seen the trout picking them off the walls, which pen the stream in some places, as rapidly as a child would pick blackberries from a hedge; and I am induced

to think that this insect has, as I have said, much to do with the fineness of the fish ; and the more so, because, wherever I have found it to exist in any quantity, I have invariably observed that the trout are of fine size, and in unusually good condition.¹

In lakes, also, it is a very common thing to find the trout in one lake large, bright, and well fed, and

¹ These insects of course thrive better in sluggish than in rapid water, though they do well enough in either when there are weeds. They are peculiarly well-adapted for lakes ; and were I owner of a lake, I would leave no stone unturned to introduce them in large numbers. They feed upon almost anything, and are the scavengers of the water. They are very fond of the large fresh-water mussel, and destroy and eat them in large numbers. These, which are easily introduced, should be as food for the trout food. Where the streams are too rapid for the plentiful production of the gam-mari, it would be by no means a bad plan to make here and there (where the situation of the soil and the banks suited such a plan) small shallow ponds, supplied with water by means of a small pipe, and having an exit to the stream. In these the requisite kind of weeds might be planted, a stock of these little insects turned in, and some kind of offal or other food occasionally being cast to them, and the insects left to thrive and increase. They would of their own accord make their way into the stream, where they would afford excellent food for the trout. Other kinds of insects might be also placed in such food-breeding ponds, where they might propagate and multiply in safety. By such a method as this almost any amount of the food best suited to the trout might no doubt easily be produced. *For if we increase the stock of fish, we must, of course, if their size and weight is to be kept up, grow food for them somehow, and this seems not to be a very difficult plan.*

in another, very similar in appearance, and perhaps only a bare half-mile distant from the other, they will be long, black, and lean, with heads out of all proportion to the thickness of the body. In another, probably but a similar distance from the first two, the trout will be abundant, but very small, though bright and well coloured. These varieties, I have every reason to believe, are caused partly by a difference of water, produced by the absence or presence of certain plants, these of course giving a difference of food. To exemplify this: I remember some years since, while fishing in a wild part of Donegal, near the little village of Ardara, coming upon a cluster of small lakes. The trout in some of these lakes were small, bright, and very plentiful; in others, they were of a good size, but not handsome. But in one of the lakes, a small one—a mere pool, of perhaps a couple or three acres in extent—my attendant informed me that the trout, though of a dark colour, owing to the peat colour and depth of the water, were large and well-shaped, and of good flavour, often running up to five and six, and even seven or eight pounds' weight. But the lake was what is termed among anglers "a sulky lake," that is, the fish very rarely rose well at the fly, and probably it might be fished a dozen times without producing

a single fish, though there were times and days, if the angler chanced to hit upon them, when very good fishing might be had, and when the lake appeared alive with fish. I fished the pool, however, and had the good fortune, by sinking the fly, to take one of the trout, a strong well-shaped fish, though somewhat dark in colour, and of two pounds' weight. We also caught specimens of the fish in the other lakes, and the difference between the fish I have already mentioned. While fishing the small lake I accidentally allowed my fly to sink to the bottom, and on pulling it up again with some difficulty I brought up a large piece of a thick moss-like green weed, with which the bottom of the pool appeared to abound. On examining this weed more closely I found it swarming with a variety of insects, chiefly water-snails, the small crustacea that inhabit fresh water, and large quantities of the caddis of some considerable fly. The abundance of food thus found at the bottom of the lake fully accounted not only for the large size and good condition of the fish, but also for its being a sulky lake, or for the trout not paying much attention to the flies upon the surface of the water. For they had no difficulty in procuring any quantity of food they needed at the bottom, without swimming hither and thither to

seek it, or giving themselves the trouble to come to the top. Colonel Whyte also mentioned a fact somewhat of this nature, some time since, in the *Field*. He related, that wishing to improve the size and condition of his fish in a small lake, he cast into it a bushel of the small crustacea, which are often found on water-weeds. These increased rapidly, and as they did so his trout increased in size and improved in condition wonderfully; but it is also fair to say, that they became much shyer of rising to the fly. Probably the reason why the fish sometimes rise well to flies, and not at others, in lakes like those of Donegal (which are by no means few), is owing to the fact that the abundance of caddis at the bottom may be undergoing some transformation, into flies perhaps, which ascend rapidly to the top of the water, and the trout are thus led in pursuit of them to the top of the water, where the insects rest, and are easily captured. If anglers, being aware of this fact, made some little study of entomology, so far as to know about the time when these insects undergo their transformations, they might not be induced to seek such lakes so often in vain. In the instance I have noted the lake is deep, and the water dark; and the fish at the bottom, engaged with ground food, do not see the flies at the top.

In the great Irish lakes, as Lough Erne, Lough Arrow, the Westmeath lakes, and others, the large trout which inhabit these lakes never come to the surface in any number, save at the rise of the may-fly. In a good fly season they rise with great freedom, and wonderful takes are made; at other times they can only, save at rare intervals, be picked up by spinning. Of course I am not referring to the small things that get on the shallows, but to the sly old fellows who scorn a midge-fly. On the Thames, also, the large Thames trout are always more upon the rise and on the look-out for flies when the big stone-fly (which is a perfect monster on the Thames), puts in an appearance in April, or when the few green drakes that are found in it show themselves. It is not to be supposed that these large fish will take notice of anything but large flies, because it would take myriads of the smaller ones to make a meal for them; and therefore it should be the aim of the pisciculturist to increase, by every means in his power, by the importation of larvæ, &c., the larger flies, if he desires to improve the fly fishing in any lake or river.

Again, I will instance the fish in Loch Leven, which grow to a fine size, and are almost always in superb condition. The bottom of the lake, in places,

is grown over with a peculiar weed; in this is found a great variety of insects, chiefly crustacea, as small snails of various sorts: the lake also abounds in the more minute entomostraceæ. Large quantities of both are often found in the stomachs of the trout when taken. Here sport with the fly is generally good, because the lake is shallow and clear, and the fish see the fly well. In other lakes again, where these species of weeds, which form the harbour and subsistence of these insects, are wanting, it will usually be found that the trout are small, or, if large, ill-fed and meagre. I know also a small lake in Wales, where the fish never take a fly until after dark, when fish from two to three pounds weight (an unusual size for Wales) may be taken. This lake abounds in leeches, and the trout are very fine in it. A quarter of a mile off is a similar lake, in which trout do not thrive at all, and, indeed, are seldom found; while about a mile from it are one or two small lakes, in which the trout do not average three ounces. And yet the character of the lakes, and the soil in and about all of them, are apparently precisely similar.

Yet one more instance I must select, to show the changeable and contrary habits of fish. In a large mill-pool belonging to a friend at Alton, are some wonderfully fine trout, the trout running from two to

twelve pounds. To take trout of five and six pounds with the fly, and to hook them of even larger size, is not at all uncommon. Last season (the summer of '64), I took four fish in two evenings, which together weighed close upon seventeen pounds, and magnificent fish they were. Yet the fish in the stream that feeds the pool seldom get beyond two pounds, or thereabouts, in weight; of course there is a great deal of food in the pool, mainly consisting of water-snails and sticklebacks. Some years the fish run very freely at the minnow, and do not notice the fly much, but in other years the minnow is at a discount, and the fly at a premium. I have never seen any very large flies in the pool, yet the flies the fish take are usually large palmers—like nothing, I should think, which they can be in the habit of seeing. This case differs entirely from any I have remarked elsewhere, and it is to me as yet, I confess, a piscatorial puzzle. A close analysis of the contents of the pond, as concerns insects and weeds, would no doubt throw some light on this interesting fact, which I hope some day to be able to make, as it appears to combine the best sport and the largest fish—which is precisely the point we desire to arrive at.

It cannot be doubted that the condition and size of

trout, as well as other fish, depend almost wholly upon the supply of food, and I think I have shown that the particular kinds of food are also a great desideratum. Now, it being known that particular kinds of weed are favourable to the production of certain species of insects, what can be easier—when the soil is favourable to such a measure—than to transplant a sufficient quantity of these weeds, and the larvæ of the insects which will almost always be found to abound in them, from one lake and from one stream to another? For example, with respect to the gammari so often noted, what could be easier than to transplant weed? This would serve as food for the large fresh-water mussel found in almost all waters, and it would serve as food for the gammari, which in turn would serve as food for the fishes. It may be said, with regard to some lakes and streams, that they are so gravelly and rocky, that the weeds would hardly thrive in them; but it is seldom indeed that some nooks and corners do not exist, in or about the banks of lakes and streams, where there may be found sufficient soil, which, with a slight admixture of the natural soil, and a judicious planting of these weeds, may not be made to grow them to some small extent; and the weeds, once introduced, will gradually increase year by year, forming their own soil, and

naturally producing those requisites which are the most favourable to their production. Of course judgment must be exercised in carrying out such experiments, quite as much as would be exercised in the introduction or cultivation of a new food-producing plant in agriculture. We acclimatise every species of agricultural plant, and examine its qualities and capabilities, for cattle or for ourselves; we study the soil and manure suited to it, &c. &c.; we have shows and prizes for the best specimens of agricultural productions, and thousands of persons assemble to note and study them; but who ever thinks of acclimatising an apparently worthless water-weed?

All plants, even to the meanest looking weed, have their uses for man; and among the fauna of the world, there must be many which would be valuable to us in the light above indicated. We have received one from America—the *anacharis alsinastrum*. This weed has hitherto been a terrible nuisance, growing so rapidly as to fill up our smaller rivers and ponds in many instances in an incredibly short time; but it might be that this weed, so troublesome and so difficult to eradicate in the south, would be a great benefit to the hill and moor lakes of the hard north. Hardy water-plants, in which insects can thrive, are greatly wanted there; and it might be found that

the introduction of the *anacharis alsinastrum*, and its attendant insects, would have a very favourable effect on the size and flavour of the trout found in such places. It would in time become a very interesting and valuable fact, to hear that Mr. So-and-so had brought home a new water-weed, favourable to the production of certain water insects, from Lake Nyanza or elsewhere. There must also be a vast number of water insects, which would prove valuable to our fisheries if introduced, provided we knew all about them. There are hundreds—nay, thousands—of lakes in Ireland and Scotland that are now worthless, producing nothing but wretched little starved trout of ten to the pound, which might more or less be converted by these means into valuable properties.

I think I have said enough to show that there is here a very wide field for discovery. Here is, as I have said, a new world—a new science to be learnt. The modern taste for aquariums and vivariums has given us some small insight into how to cultivate those plants which we already possess, but we do not study even these to discover the natural duties and uses for which Providence designed them. We do not in a like manner work out the properties of the insects that inhabit them; and what could be more easy, or would be more interesting, to the entomo-

logist, than to watch the changes and the habits of the various insects that people the waters—to see the most delicate, beautiful, and harmless little flies in creation spring from curious and ungainly grubs, or fierce predaceous larvæ, changed in form as in nature, to a degree altogether unaccountable! What wonderful and interesting processes would not reveal themselves to the curious observer! How encouraged he would be to note each new fact, and record every phase of each transformation! How valuable, too, would be the study of the peculiarities of these beautiful and almost microscopic entomostraca! What more delightful to the student than to know that he is making new discoveries most beneficial to mankind, and which will be connected with his name in future generations! There is no part of creation uninteresting, without its uses, or which does not possess its benefits for man; and there is none, therefore, which is not worthy of his most earnest attention. Those who first study this science, and who first discover its hidden secrets and virtues, will deserve well of their country. For it is well said, that “he is one of the greatest benefactors to his country, who makes two blades of grass grow where one grew before;” and, therefore, he who makes two, twenty, or two hundred fine fish,

where one wretched starveling only grew before, will assuredly not be very far behind in his deservings.

Leaving for a time the subject of water-weeds, let us take other views of the necessities for good water cultivation. Many rivers are starved, in a great measure, for the want of a few trees and bushes along the banks, as foliage is one of the great purveyors and providers of food for trout, and therefore, in many places now destitute of it, and where the trout run small, it should if possible be encouraged. For this purpose few trees are so valuable as the pollard, when it grows old. The trunk holds and conceals myriads of grubs and beetles, which cannot fail to some extent to find their way into the stream, and so form food for fishes. Some people are very fond of introducing minnows into their rivers and lakes, to supply food for trout; but minnows, unfortunately, feed on precisely the same kinds of food as trout. They are incessant rangers in search of food, and very voracious, and before he becomes food in his turn, probably a minnow of fair size will, at a very low calculation, have devoured twenty times his own weight of food; and, consequently, instead of benefiting the trout, the minnow has deprived him of nineteen times its own weight of varied food. This quite

accounts for the fact of trout often rather falling off and deteriorating in lakes into which minnows have been largely introduced. Vegetable-feeding creatures are rather what are required than such as feed on other insects. The minnow is capital food for big trout if thrown to them in a stew, or as a change and variety where already abundance of food exists. But where food is so scarce that the trout suffer from not getting enough, to introduce minnows by way of *increasing* the food of the trout is certainly a fallacy. I know of several streams where the minnows abound to profusion, so much so as to be in parts a nuisance to the fisherman, yet are the trout wretched starvelings, seldom reaching three-quarters of a pound, and always lean and lank and out of condition.

CHAPTER VII.

ON THE CROSSING OF BREEDS OF FISH.

AND now we arrive at another valuable consideration—that of crossing of breeds. There can be no doubt much may be elicited here. In some rivers, the race of salmon and trout are naturally small, and without apparent reason. In Scotland, for example, there will be four rivers running into the same estuary, and the breed, shape, make, and size of the fish of every river will be distinct and different. In some, the fish will be long and thin in shape; in others, short and thick. In some, they will scarce ever exceed twelve or fourteen pounds in weight, and in others they will run up to twenty, thirty, and even forty pounds, if allowed to exist for a reasonable time. Now, here it is evident that the rivers themselves can have little or nothing to do with the growth of the fish, since the great feeding grounds wherein the fish grow and increase their weight, and that at a rate out of all proportion to that of any other animal,

are identical, being the broad sea; since salmon never increase their weight in the fresh water after their first trip to the sea, but rather fall off and deteriorate. Why is it, then, that, enjoying these feeding grounds in common, some thrive so much better and faster than others? It cannot be doubted, that it is in the nature of some breeds to increase more and faster than others, even as a Hereford or Norfolk steer exceeds a Welsh or Highland stot, feed him and breed him how, where, and when you will. We have discovered how, by the crossing of breeds of animals, we can get those which carry flesh best, and increase the fastest, upon a small amount of food. How easy it would be, therefore, having discovered the same thing with regard to fish, to transplant and cross the breed of salmon and other fish, until we found that which is most valuable and suitable to our various rivers. Here is another branch, then, of the science, scarcely inferior in importance to the last, but of which we know literally nothing. Is it not a surprising thing, that a people whose interests are so vast in the elucidation of such questions, should be content to remain in ignorance of them, and should make scarcely an effort to obtain enlightenment on them? It would be very difficult to compute how many millions a year are lost to this country by an

ignorance of fish culture. Indeed, it may with some reason be said that the absence of proper understanding and cultivation of our waters *may* make just the difference between wealth and poverty. Having said so much, it is needless for me to pursue this fruitful and important theme further. It is to be hoped that public attention will be awakened, and that we shall speedily begin to make up for the time we have so lamentably lost. The subject of hybrids is one which, in the present state of knowledge we have upon it, possesses an interest in a scientific point of view rather than a practical. An experiment as regards the rearing of hybrids was tried in the season of 1864, by Mr. Buckland, who, as I gathered from the *Field*, crossed the eggs of salmon and trout; but I believe the experiment did not succeed, and the eggs never hatched. It would have been interesting to have had the particulars as a guide for future experiments, but they were not published. I incline to think that hybrids between salmon and trout are much more rare than is sometimes supposed; as, if they were by any means common, the races could hardly fail to become in time strongly intermixed, owing to their occupying almost the same spawning grounds, and at about the same time.

CHAPTER VIII.

CONSIDERATIONS ON THE BEST KINDS OF FISH
FOR RIVERS.

THE next points to be considered are the wider dissemination of the best kinds of fish we at present possess, and the acclimatisation of other kinds found in foreign countries, but at present strangers to our waters.

The best fresh-water fish we have are salmon,¹ sea-trout, charr, trout, greyling, burbot, lampreys, perch, eels, flounders, and gudgeons. The tench, carp, bream, dace, roach, pike, &c., require the assistance of cookery to some extent, not exactly to make them acceptable, but to make them, let us say, palatable or agreeable. It is difficult to explain the exact estimation of these fish; but we may say,

¹ I do not enter here upon the means whereby salmon may be more widely disseminated, and why they are not more plentiful; the subject is too large for a place in the body of this chapter; it is so much a subject by itself, that I have so placed it in the Appendix.

if not very well cooked, one would not select any of them for choice at a Blackwall dinner, though they all afford wholesome food to some one. Now, there are many trout streams which are not, perhaps, capable of supporting salmon to any extent, but which might be greatly improved in value by the cultivation of the spawn of the sea trout. Of course, in speaking of sea trout, I refer to the white or salmon trout, and not to the *Eriox*, Grey, or bull trout, which is, compared with the other, almost a worthless fish, being a bad riser for the angler, and, though excellent while small, an indifferent fish for the table when of any size—two bad qualities not usually found in the salmon trout. Moreover, although a handsome fish, it is so destructive, that, wherever it appears in any quantities, its far more valuable congener, the white trout, and even the salmon, gradually disappear before it. I recommend it, therefore, to be kept down, as we keep down vermin in our shootings, or, being a very prolific and hardy fish, it is apt to increase beyond all bounds with the least encouragement. The Tweed and its tributaries suffer heavily from a mistaken preservation of it. There are many of our salmon rivers which might easily afford good sea trout, if they were duly introduced and encouraged; for the addition of sea

trout will not in any way interfere with any other fish, and they are next in value, both for the table and the sportsman, to the salmon itself; and any one who has seen the manner in which some of the western Irish rivers and lakes swarm with this delicious and game fish, will readily testify to the value of such an introduction. In some of our southern rivers, where they are called "bouge," they are little inferior in size and the estimation they are held in to the salmon proper.

At the charr I must pause. Charr at one time were far more plentiful in this country than they are now. Their principal habitat was the Lake district, when few of the lakes were without them. They are found also in many of the Irish lakes, in one or two in Wales, and perhaps some half-dozen or a dozen in Scotland. The practice, however, of taking these fish in such vast quantities in nets, when they come into the shallow water to spawn, has terribly thinned them, and in many lakes they are very much reduced in numbers. The charr, moreover, is the most delicious fish that inhabits our fresh waters, and this, too, is another incentive to its destruction. There are, according to some ichthyologists, several species of charr; according to others, they are simply varieties. It is believed by some

that the charr of Windermere, Llyn Bodlyn, Lough Melvin, and elsewhere in the British Isles, is identical with the Ombre Chevalier. I shall touch on this point when I come to the consideration of Lakes. It is tolerably certain, however, that it is not identical with the great Northern or Scandinavian charr, as it is said never to be found in rivers, save at spawning time, when one species at least, found at Windermere, runs up the river Brathay to spawn. The habits of the northern fish appear to be widely different from those of its southern congeners, since it is constantly found in abundance in rivers, not alone near their junction with lakes (whence, as it might be supposed, they had migrated for a time), but altogether away from lakes. Lloyd, in his "Scandinavian Adventures," mentions taking them with the fly again and again in rivers; and he is supported by very many other authorities. The Rev. F. Metcalf, in the "Sportsman in Norway," also speaks of catching charr in rivers. He mentions one of six pounds, which he caught with a minnow close by the falls upon the Mallanger river. Further up the river, he again speaks of catching large numbers of splendid trout, *charr*, and greyling; and to show that they are not confined to particular localities, he afterwards speaks of quantities of charr being

taken in the nets *near the river's mouth, where the water was almost brackish*. A friend of mine fishing the Salangs river, in 1863, goes even further, and says that they not only caught the charr in the river's mouth constantly, but that the fish even *had the sea louse on them*, showing that this species of charr was migratory like the salmon. Now, the consideration for us is, not that our charr are *not* found in such places, but that the Scandinavian charr *are*; and as there is no great difference in the character of many of our rivers and lakes, and many of the Scandinavian rivers and lakes, it certainly appears to me that we might easily transplant and add this very delicious fish to our fauna with considerable advantage. I have had specimens of a charr sent me from Iceland, of two and three pounds' weight. There they appear to inhabit the most rapid streams, and they take the fly and bait as freely as the trout. They were sent to me by Mr. Hogarth, the lessee of the river Sog, where they abound in profusion, as a kind of trout, a belief which I was the means of dispelling. The Scandinavian charr is constantly taken of seven and eight pounds' weight, and, according to Mr. Lloyd, of sometimes double that weight.

The Ombre Chevalier, as I have said, is supposed

to be distinctly a lake fish ; so I shall not treat of it here, but take it under the head of Lakes.

The greyling needs little description. It is a very well known fish, abounding in many of our rivers and streams. As an edible fish, it certainly comes next to trout, and even contests the palm with it when in good season in the months of October and November. Where the rivers are small, it would be advisable, if it is to live with trout, to establish a breeding apparatus to keep up the trout stock, the expense of this being but small ; for although the greyling is a very handsome addition to a trout stream, and finds fly-fishing for the angler at that period of the year when the trout does not, it is a great ground-feeder. Its habit, at times, is to grub or rout like a pig in the gravel and sand ; and hence, as they are in the best condition when trout are spawning, they are apt to destroy the spawn and to greatly reduce the supply of that valuable fish. I am compelled to own that I believe they do a good deal of mischief, and there is often a strong, and not unfounded, prejudice against them. They might possibly be made, in many of our mixed rivers, to take the place of worse fish, such as barbel, &c. They are, however, being somewhat widely spread about over the country, owing to the

popular discussions which have taken place upon them in various publications. In Scandinavia they are said to abound, not only in the streams, but in many of the lakes—a fact unknown in this country, but very worthy of note.

Much has been said of the burbot. In Switzerland and in Scandinavia, this fish is very highly esteemed, and travellers who are among “the initiated” make as great a point of having *lók* for dinner as the cockney does of whitebait at Blackwall. Having partaken of it, I can quite concur in any strong eulogy of its merits. It is a very firm, white, and delicious fish. The head somewhat resembles the fin of turbot, and the liver is not equalled as a delicacy by any other morsel of fish substance in existence. Had it been known of old, the Roman emperor would certainly have added burbots’ livers to the great dish of nightingales’ tongues. It is a shy fish, hiding in holes and under roots or stones, and is of no value to the sportsman, as it is seldom taken, save on a dead or night line. It abounds in many of our rivers, particularly in those of the midland counties, and can easily be distributed; but as it is a very voracious fish, and a great burrower in the soil, it is almost doubtful whether it would not devour more spawn than it

is worth. This, however, is, I am bound to say, but a mere conjecture on my part, which remains to be solved by further experience.¹

The Lamprey. This is unquestionably a delicate fish for the table, though, from some cause or other, its popularity, once considerable, has so far diminished that it is hardly ever seen in a bill of fare nowadays; and in many places so strong is the prejudice against it, partly, perhaps, owing to its ungainly appearance, that the inhabitants refuse to partake of the lamprey, and cast it away when they chance to capture it. The appearance of the flesh is somewhat similar to the burbot, but, with a peculiar and indescribable flavour, it is certainly inferior to the burbot as to the head and liver; indeed, the liver of the lamprey should be very carefully removed before cooking, as it is of so bitter and unpleasant a flavour that it is apt to taint the entire fish. There are various ways of cooking the lamprey; stewed, however, it presents the best dish for the gourmand, but it is also potted and made into

¹ Since this was written I received about a score of live burbots from Mr. Peach, of Derby. My object was to get them at spawning time, and to breed them in the usual way; but, unfortunately, the season passed before they could be obtained. I put a dozen of them, however, under the charge of Mr. S. Gurney, of Carshalton, his water being more suitable to them than mine, and I trust, when the next season comes, to be able to carry out my intentions.

pies. It can hardly, however, be considered a fresh-water fish, as it spends the greater part of the year in the sea, merely entering our rivers, like the salmon, in the months of April and May, to deposit its spawn; until this process is completed, it is in good condition. It is seldom taken in the sea, however, and when taken in the river is caught in any way but that of angling. It grows to a considerable size, and often weighs three or four pounds. Its power of fixing itself to stones, or wood-work, or any other substance, by means of the sucking apparatus at its mouth, enables it to surmount any fall or obstacle to other fish. It is found in almost all our larger English rivers, as the Severn, the Trent, and formerly it was common in the Thames: in the latter river, however, it is rarely met with now; the sewage and filth, probably, has driven it elsewhere. In the Usk it abounds, and in some of the Scotch rivers, but in neither case will the natives use it as food. In the Shannon it is also plentiful.

There is another species of lamprey, much smaller in size, salled the lampern, which resembles at first sight a grig, or small eel; it is of some ten or twelve inches, or even more, in length. This little fish comes into many of our rivers in vast shoals with the earliest winter floods, the water being somewhat

fresher and clearer at that time. It has not yet abandoned the Thames, but is taken in large quantities at the various locks; at Teddington and Moulsey are the chief fisheries. The fish are chiefly bought up by the Dutch long-line fishers, who cut them into short lengths to bait their spilletts with, the bait being very tough and bright and attractive to the fish. Large sums of money are often shared amongst the Teddington fishermen as the produce of their fishing. The fish are taken in wheels or basket-traps, similar in make to the eel-traps, and many thousands are often taken in a night. As a table fish they are certainly liked by some people. At Worcester they are potted and are in great request. I cannot say that I appreciate them, however, having tried them in various ways. They are rather rich and strong-flavoured. Perhaps, when marinated (baked in vinegar, bay-leaves, and spice), they are better than in any other form; and even then I do not think the operations of the Dutch fishermen deprive us of any considerable delicacy. One thing I may say in connexion with them, viz. the offal makes capital bait for barbel. Certainly it is not nearly so desirable a table-fish as its larger congener.

Perch, eels, and flounders are sufficiently well known to render any description needless. Perch

do not improve in flavour by being placed in waters having mud at the bottom ; but a good stream-perch, from a clean gravelly water, is by no means a fish to be despised.

I may perhaps here mention by far the best way to cook a perch. Take a good-sized fish and lay it on the gridiron precisely in the condition in which it comes out of the stream, merely cleansing and drying the scales. Do not cut off either the fins or the tail, or the juices exude from the cuts ; when it is sufficiently done, take it off the gridiron (do not let it cool), make a slit down the back, insert your knife under the skin and lay aside the mass of scales and skin, which will come off like a suit of armour, leaving the firm, white, juicy flesh exposed ; rub the flesh well over with a slice of butter ; pepper and salt to the taste. Flake off the flesh with your knife, leaving the skeleton and *interior* intact, and you will find the meat as delicate and delicious as that of any fish that comes to the table. The ordinary methods of cooking perch utterly destroy the firmness, juiciness, and flavour which it naturally possesses.

Perch should certainly not be introduced into waters that support trout or salmon, as they are voracious devourers of small fry, and in such places are not worth their keep.

Eels are, perhaps, better suited to muddy than gravelly rivers, though they abound in both and are better flavoured when taken from the latter. They are great spawn-eaters, and it has been questioned whether the eel pays for his keep owing to this circumstance. In some salmon rivers I have seen the lower pools in a perfect boil, when the eel fry is migrating, with the constant rising of the fish as the small eels wriggled along the top of the water; so that the salmon, if the eels be supposed to be destructive to them, exact summary vengeance. Their ravages, however, amongst salmon and trout spawn cannot be very extended, as the spawn is in the gravel during *the winter*, and eels are not active in frosty weather. They may, and no doubt do, however, take a heavy toll from the helpless fry when first developed in the spring, as the eels then begin to move. The Dutch keep eels out of their carp ponds as much as possible, as carp spawn in June and the eels would no doubt do damage to them. Eels, where they have the chance, migrate about autumn in large numbers towards the brackish water near the rivers' mouths, the water there being usually several degrees warmer than that higher up. Those which remain behind, as many do, bury themselves

in the mud or seek some hole in which to hibernate. It has been questioned whether the eels that so migrate do so *for the purpose* of spawning in the brackish water. I think it cannot be questioned that they do spawn there, or whence those countless myriads of small eels, which, under the name of "eel-fare," migrate from the brackish water up to the fresh in many of our large rivers? I have seen them in the Erne, in Ireland, pushing their way up even from the sea in countless millions, early in the month of May. I think there can be no doubt that they spawn as well in the brackish as the fresh water, but that if they have the choice they prefer the warmer or brackish water. Of late years, in the Thames, they have not had this choice, owing to the filthy water about London, in which it has been proved that eels cannot exist. The consequence has been the discontinuance of "eel-fare," once a very striking and remarkable sight, on the Thames. The eels have, it would seem, from this circumstance, greatly diminished in numbers;¹ and whether it be that the fresh-

¹ Were it not for the above conditions, the eels which might be taken during their periodical migrations at the wears on the Thames, would, owing to the vast extent of the river itself, and its large and numerous tributaries, be worth many thousands of pounds a year; whereas, now a very few hundreds—possibly not more than one or two—represent the annual value of the eels taken on the

water spawning is not so favourable to their increase as the brackish, or whether large numbers of eels still migrate and die in the foul water, or that, getting down with a flood to aid them, they *do* spawn and the fry are killed when they reach the foul water, I am quite unable to say; but I have little doubt that when the Thames is once more purified, "eel-fare" will in time again recur to it. Eel fisheries are in many places very valuable. The fishery on the Erne realizes many hundreds of pounds a year. Any eulogy as to the excellence of the sharp-nosed eel for food is needless. There are three kinds of eels known in England: the broad-nosed, the sharp-nosed, and the snig. The former is a coarse, foul-feeding, and worthless fish, but is not very plentiful; the last is a very local species, found chiefly in the Hampshire Avon.

Flounders for the most part are not taken in any very great quantity above the tide-way, and may therefore be encouraged as far as possible. They are an admirable table-fish, however they may be dressed. A Thames flounder is held a special delicacy; large quantities were formerly caught from Battersea to

Thames. Formerly many stages or "Bucks," as they are termed, existed, and were a valuable property, but most of them have been abandoned long since.

Hammersmith. Of late years, however, the sewage has affected even them, and they are scarcer. In most of our brackish and tidal waters they abound.

The Gudgeon is a most delicious fish, although a small one ; it is scarcely less delicate than the smelt. Few gravelly rivers in the midland counties are without them. They serve, too, not only to furnish an excellent dish for man, but a *pièce de résistance* for all fish of prey. The fact is not generally known, but gudgeon will thrive very well in ponds. In one of the ponds in Richmond Park—the largest of the Penn ponds—it has been the custom of the anglers fishing there, in order to save the trouble of carrying home their bait-kettles full of water, to empty their cans and turn the remainder of their live baits into the pond. Many of these baits being at times gudgeon, they have lived and thriven, and have bred so freely, the keeper has informed me, that on the gravelly part of the pond it is easy to catch four, five, or six dozen in an hour or two ; but the gudgeon thrives equally well in a muddy pond and in even stagnant water, for I once emptied my bait-kettle into a horse-pond ; there were about a score of large gudgeon in it, and they bred rapidly in the pond, so that in a year or two there were abundance of gudgeons of all sizes. I have, however, never

eaten gudgeon from a muddy pond, and therefore cannot vouch that they would retain their delicate flavour.

After the fish above noted I should place the pike or jack, the dace, tench, carp, bream, roach, and, lastly, chub and barbel, and I would take occasion to draw a strict line here. None of these fish would I admit, *if possible*, into purely trout or salmon rivers, their room being in such places far better than their company. There are many rivers, however, of a mixed character, where they are found in great abundance, and where they manage, owing to the varied character of the water of the rivers, to do well enough together, though even here the more delicate fish cannot but suffer severely from them; these are, however, usually large rivers: in small ones, if largely introduced and left to themselves, they would in time almost destroy both trout and salmon. As they *do* so exist, however, and are looked upon by many as affording a wide range of sport, they must be considered accordingly. In such cases I would recommend artificial breeding of better fish to be carried on largely as the only means of coping with the coarser species.

Many rivers, again, are merely white or coarse fish rivers, unadapted to salmon and trout; and as

such I treat of them. In rivers, however, like the Usk, Severn, and Wye, where the coarse fish have increased so much in parts as to become a positive nuisance, I would keep them down by every means in my power.

Dace and roach are very fair eating when taken in clear gravelly rivers. They may be pickled or potted or plainly broiled, salted and peppered, a slice of butter being laid on them while hot. Even chub can be eaten in this way, but any fish of above half a pound should be crimped. Barbel are liked well enough by some people, but the fish should be split down the back, and the backbone should be taken out before it is broiled. Indeed, few of these fish are really thrown away, for they form acceptable articles of food amongst the poorer classes, while the Jews at their various fasts employ them largely; so much so, that I have known sixteen shillings per hundred paid for average-sized dace. The Jews, however, as it is well known, are adepts in cooking fish, and we might take a useful lesson from them in this respect. Everything, however, depends as regards their tooth-someness upon the cooking. Perhaps jack and tench are the only two which are ever now subjected to plain boiling; but even with jack, veal stuffing is used to give flavour to the dish. Some people think

well and some highly of jack, and formerly it was in greater request than even salmon, and it was considered a great delicacy ; I cannot, of course, coincide in any such verdict. I have, however, eaten jack when it formed one of the components (scarcely an indispensable one though) of a very excellent dish, in which also were sauces and spices, wine gravy and stuffing, but the game was hardly worth the candle. The best jack I ever ate was one of four pounds from the River Till, in Northumberland, and it certainly was an enjoyable dish ; but the Till jack have a very high character, and justly. Possibly their food may have something to do with it, as no fish but the salmonidæ, minnows, and a very few perch, inhabit the Till.

Some people even yet waste port wine over carp, but sure I am that it is a mistake, at any rate, as regards our ordinary English pond carp. But I must own that we do not manage our ponds with the same care and skill as they do in Holland. Of this, however, I shall have to speak presently. In a river it cannot be denied that a carp is a far better fish than he is in a pond. Indeed, as regards its desirability both as a table and as a sporting fish, its capabilities are much increased in the river. Of late years many of them have been turned into, and have

escaped from private waters into the Thames; and it is found that the fish does well, increases rapidly, bites boldly, and plays very gamely; and that, too, not merely in dead dull eddies, but in the more rapid streams, many being taken in the Richmond preserve; and in the rough and wild waters at Teddington weir, very good sport indeed is often obtained with them, and they are caught up to ten pounds' weight. It need hardly be observed that, in such localities, the edible qualities of the carp are greatly improved; and so easy a fish is it to naturalize and transport, that the only wonder is that the Society which takes charge of the waters of the Thames has not, with these facts before it, introduced it more widely into all parts of the river.

The bream is widely distributed, many of our rivers and lakes already abounding in it. There are two kinds: the carp bream, which is the largest and best fish of the two; and the silver bream, a small indifferent fish. I shall treat it more fully when I come to ponds. In edibleness it may rank next to the carp perhaps, and before chub and barbel. I come now to one or two fish which are really rather salt than fresh-water fish, though they enter the rivers at times; and, first of all, I must notice the little Whitebait (*Clupea alba*). All sorts of suppositions

have been made concerning this most delicate little fish. It has been supposed to be the fry of some score of different fish, and it is now said to be the fry of none of them, but a fish of itself.¹ The shad at one time bore away the honour of paternity from all competitors, but it was found that whitebait existed where shad did not, and shad, on the other hand, existed where whitebait had never been met with; and as it was difficult to reconcile such ap-

¹ The whitebait disappears from the Thames by the middle or end of August. In the month of October I have taken it on the coast of Suffolk in almost any quantities. The variety of size amongst these fish is very remarkable, as they range of all sizes from an inch long up to seven inches, which is the largest size I have found it. At this size it strongly resembles a small herring. Indeed, I have compared it carefully with the young of the herring, and I confess that I find it difficult to detect any difference. The similarity is so very striking, that I am inclined to think if the whitebait is not the veritable young of the herring, that a large quantity of the young of the herring do duty for whitebait. Amongst the shoals were many sprats, but they could be recognised at a glance. The sprats died speedily, the whitebait were much more long-lived and active. I opened one of the larger ones, but could find neither spawn nor milt, and am inclined to doubt from this whether, even when seven inches long, they are a mature fish: if they are not, then the question as to whether they are really a distinct species, or whether they are the fry of a yet larger fish, and if so, what that larger fish is, becomes important. I have never heard of their being taken of larger size than I have noted, though, on comparing the larger whitebait with the smaller herrings found amongst the shoals of full-grown herrings, as I have said, it needs a better ichthyologist than I am to detect the difference.

parent incongruities, the whitebait has been left to its own affiliation, and is unmolested, save by the net-men, being declared by Yarrell to be a separate fish. Some would-be-thought gourmands assert that the fry of other fish, or even minnows, if the same amount of pains were bestowed upon them, would be equally delicious. I greatly doubt this ; nay, I utterly repudiate it, and refuse to believe it. In matters of this especial kind I am inclined to think that whatever is *is*. For example, turtle-soup *is*, and the man who says that mock-turtle is equally good *is* (not a judge, at any rate). The nearest thing as a delicacy to whitebait is a dish of a very small bleak.¹ They are delicious ; nay, the larger bleak, cooked in the way that sprats are cooked, form an excellent dish, and are scarcely inferior to gudgeon. Having accidentally passed over the bleak, I incidentally mention it here. It is a fish too well known, though of too small importance, to need any great space for description ; and, as it is very much of a surface-feeding fish, it takes little from the other fish, and it affords an admirable source of food to the more predatory fish also, as the pike, perch, and trout ; and these do feed

¹ I should have added above, that the bleak also for a time struggled for the honour of paternity to the whitebait, but was soon put out of court,

upon it largely. The movements of a shoal of bleak on the surface of the water are very interesting to watch; and the rapidity of its movements, and constant restlessness, as it darts hither and thither after a stray fly or floating substance, is very amusing.

As I have already said, although caught in rivers, the whitebait can hardly be called a fresh-water fish.

The Shad is a fish I have previously referred to. There are two kinds of shad. Yarrell adopts for them two names by which they were partly known before, namely, the Twaite shad and the Allice shad. The former, which used at one time to abound in the Thames (so much so that a portion of the Thames was even named Shad Thames), comes into the rivers to spawn in May, and is seldom met with after August. It is a very indifferent and comparatively worthless fish for food, being bony and coarse. Its size is from twelve to sixteen inches long.

The Allice shad is a much larger fish, running up to four or five pounds in weight. It is not so well or so commonly known as the Twaite shad. It is found more abundantly in the Severn than in any other of our rivers, and formerly afforded sport to numerous fly-fishers about Worcester, and even now many are caught. But of late years it has followed the salmon, and has greatly fallen off there. It was rarely met

with in the Thames. This shad comes into the rivers to spawn, before the Twaite, usually appearing in April. For the table, it is very much the best fish of the two. Shad may be taken both by the bait and with the fly. The shad may be also considered as rather more of a salt than a fresh-water fish ; and as in the case of the salmon, it is driven from the Thames by the sewage. The higher it ascends a river the better its flavour and condition becomes ; and, as it is a valuable and prolific fish, it should not be neglected in any scheme for improving our fresh-water fisheries. No doubt the Alice shad could be introduced, by artificial breeding, to other of our rivers, where it would be highly acceptable.

The Sturgeon occasionally enters our rivers, but it is such a partial visitor that little is known about it in connexion with them. The flesh is said to be excellent, resembling veal. The great fisheries for sturgeon are in the Caspian Sea and the rivers that enter it, (more particularly the Volga,) in the Danube, and the Baltic. It is possible that, by the transport of ova, we might much increase the numbers of this valuable fish in our waters, and induce it to become a more regular visitant to the larger rivers.¹

¹ The French have included the sturgeon and the sterlet in the list of fish to be acclimatised, but the difficulties and expense of

The flesh is said to be excellent. Of the swimming bladder, when dried, the best isinglass is made; of the roe, the appetizing caviare is manufactured.

There is a small member of the Crustacea which might be cultivated far more than it is in many of our waters with great advantage. I refer to the fresh-water Crayfish.

This delicate little fish forms an excellent edible, whether eaten by itself or used for the purpose of making into soup. Crayfish soup is looked upon by gourmands, and justly, as a choice and most desirable addition to a feast. In Germany, especially, the nobles pride themselves upon their crayfish. In England, it is used, in addition to the above methods, as a garnish to turbot more particularly. In many of the rivers and streams in our midland counties, it is found in large numbers; in others, it exists, but not to an extent to make fishing for it profitable. In many tributaries of the Thames, it is very plentiful; I may instance, the Windrush, the Lambourne, and Kennet, the streams about Oxford, and in the Colne. It is found, but not in abundance, in the Thames itself.

carrying out the operation has hitherto deterred even them. I wrote to Mons. Coumes, the superintendent of Huningue, who was here in 1862 on a mission, for information as to the acclimatisation of sturgeon, but he could not give me any,

The way in which it is fished for is curious. From one to two dozen small and shallow hoop nets, upon iron rings of from a foot to fifteen inches in diameter, are prepared. In the midst of each is tied a small piece of liver. The fisherman walks along the bank of the stream, and drops a net thus baited into every available spot. The iron ring carries the net to the bottom, where it remains. Having deposited all his nets, he then returns to the first one which he dropped in, and, by means of a string pegged to the bank, he suddenly hauls it up to the surface, and usually finds two or three crayfish attracted by the liver. Having taken them, he replaces the net in some equally desirable spot, and goes on to the next one; returning, after an interval, to haul them all over again. In this way, several dozens of this little fish may be taken in a short time.

There is little difficulty in transplanting this fish,¹ as they can be taken when full of spawn, in September or October, and can be carried alive to any distance, with little trouble; and if the stream they are conveyed to suits them, they will soon increase and multiply to almost any extent. Rivers which

¹ A large quantity of them have been transplanted by the Acclimatisation Society of Great Britain to the Earl of Breadalbane's streams.

are not too rapid; and with overhanging banks and marly (not muddy) bottoms, suit them best. I placed, some which were full of spawn in my river in October, 1863, and in September, 1864. While catching subjects for the aquarium I caught a small crayfish, about an inch in length, and a very amusing and interesting inmate of the aquarium he forms. Judging from this circumstance, their growth must be rapid. They may easily be kept in stews, but will then require regular feeding. Indeed, I make no doubt but in small spaces of water, properly managed, with a sufficiency of holes and hiding-places for them, and by feeding them with proper and sufficient food, they would breed and increase to any extent, and a very profitable trade be carried on in them: their food need be but of small consideration, as they will eat offal in preference even to other matters. They make good use of their nippers, when handled, and are apt to pinch somewhat sharply. One way of taking them is to thrust the hand up into the holes under old roots and banks, and letting them fasten on the fingers, to draw them out thus. I do not strongly recommend the plan; but the reader can try it if he likes, and, if he does not mind the pinch, will no doubt find amusement in it, particularly as he may, perhaps, occasionally lay hold of a water-rat,

whose sense of his attentions will, possibly, be even more strikingly expressed.

The pearl-bearing Mussel, which abounds in many of our rivers, particularly in the Teith and Tay in Scotland, and the Donegal river in Ireland,¹ might also be a subject for cultivation, as it would not only be valuable for its pearls, but form food for insects, on which the fish live in turn. These mussels have received some little attention from the Acclimatisation Society. Mussels of a somewhat similar kind are found abundantly in most of our rivers, and it is possible that some of them may even contain pearls.

The culture of Leeches is largely practised upon the Continent, and handsome profits are yearly realized by it. The best leeches come from the south of France, from Italy, and Hungary. It is doubtful whether our climate is not too cold for successful Hirudiculture. To those who wish to study this subject I recommend the work of Mons. Jourdier.

¹ The pearls in this river have been taken of large size and very pure water, as much as 60*l.* or 70*l.* having been given for one. I saw some very fine ones in the possession of Colonel Hamilton, especially some beautiful black pearls, and I brought some both black and white from the river myself.

CHAPTER IX.

ON FISH TO BE ACCLIMATISED.

WE have now to consider what fish there are which we can with advantage introduce into our rivers, that are entirely strange to them. And I shall make, perhaps, a somewhat sweeping assertion, when I aver that we have possibly too many in them already, as many of the coarser kinds being to an extent destructive to the better class of fish, we could well spare them; many of these fish are not natural to our waters, having been acclimatised by us; and beyond those I have already mentioned, there are few, if any, which it would be worth our while to introduce into our *first-class rivers*. We have already the best freshwater fish in the world in our salmonidæ; there is but one member of the salmonidæ, if we except the Coregoni, and the Northern charr, of any consequence left for us to introduce, and that is the *Salmo Hucho*. The huchen is said to be a very voracious fish, and

among the small fry of fish particularly so. It is said to be an excellent fish for the table; but when much fished for it readily becomes a very shy fish to the angler's lures. The chief objection to it is that it will only answer in our best rivers, where we have already much better fish, which its presence would hardly be advantageous to. Under these circumstances I think its introduction would be a questionable advantage, and I would advise that we improve and increase to the utmost our salmon and trout, and leave the huchen alone, lest we sacrifice the substance to the shadow.

There is, perhaps, one fish mentioned by Lloyd, in his "Scandinavian Adventures," which it might be worth while to learn something further about, viz. the Ide. This is a river fish; it grows to eight or nine pounds weight in the Scandinavian waters, though it is not often taken above five or six pounds. It is a good fish for the table, lives chiefly upon aquatic plants and insects, and affords good sport to the angler. It somewhat resembles the shad in appearance.

The Black-bass of America is another capital river-fish worth some attention. It is excellent for the table, and gives good sport to the angler, and in our *white-fish rivers* would no doubt be valuable. It is, however, very voracious, and some care and consi-

deration should be exercised in acclimatising it. It thrives well also in lakes, but does not object to a strong current. It is said to be a much better eating fish than the pike.

The Mountain-mullet of Jamaica is perhaps one of the most delicate and delicious edibles found amongst fish. In Jamaica, the estimation it is held in is so great, that a dish of mountain-mullet is the common excuse for a *recherché* dinner, and a prominent inducement to guests to partake of it; and "Dine with me, old fellow; I've a dish of mountain-mullet," seldom fails to produce the invited guests at dinner-time.

The mountain-mullet does not grow to a large size, seldom exceeding two pounds weight, and not often reaching that size. Inhabiting rapid rattling streams, similar to Highland burns, endued with great leaping and locomotive powers, it can make its way almost anywhere, and over any reasonable obstacle. An eye-witness assures me that he has seen one leap sheer over the huge trunk of a fallen cotton-tree, which lay like a bridge across the stream; and although well able to hold its own in rough streams, it does well enough when these streams are shrunk to mere water-holes by the heats of summer. But, added to its excellent and desirable edible qualities, it presents

the strong attraction of being a capital sporting fish, taking both fly and worm freely, and playing like a fresh-run sea-trout when hooked. Whether the fish would stand our winters is the question to be resolved; in other respects, some of our streams in Cornwall or South Devon, for example, might suit it well enough. Its capabilities, also, of being transported and acclimatised at any distance, have also to be tested. Of its desirableness there can be no shadow of a doubt; and it might further be worthy of consideration, whether even if our winters did not suit it, it would not be the very fish particularly suited to the fine, but fishless streams of the Cape and many of the Australian streams, both of which, like those of Jamaica, become rather water-holes in summer.

There is another fish which might do in rivers of a similar character, viz. the Murray-cod. This fish is spoken highly of in Australia, and it grows to a large size. The Acclimatisation Society of Great Britain made an attempt to introduce it, but the experiment was not well managed, and so failed. It might, perhaps, be more feasible first to try it at the Cape, and if it succeeded there, we should have a better chance of getting it thence to England by greatly shortening the sea-voyage; and if it did not succeed there, it would be useless to try it here.

CHAPTER X.

ON LAKES, POOLS, ETC.

AN immense portion of our water acreage consists of lakes. Such of these lakes as communicate with the sea by means of rivers that are passable to fish are, for the most part, capable of supporting salmon and sea-trout. In some there may be but a badly defined passage to the sea ; in these instances every art that can render such passages practicable to fish should be put into requisition, as the addition of a lake is always most valuable to a river or fishery, being to the salmon a safe resting-place and harbour of refuge. When there are impassable falls, salmon-stairs should be erected (see Appendix); a weir, with hatches at the outlet of the lake, should be placed so as to force back the water, until a sufficient quantity be collected to form a good running volume, on the first favourable rainfall. If salmon or sea-trout exist not already in them, artificial propagation should be undertaken in the small

tributary head waters; and every possible means should be adopted to render the salmon a tenant of such waters. Where communication, however, is impracticable, then the best unmigratory fish that can be introduced should be procured and encouraged.

Few lakes exist that are not favourable to the breeding or introduction of the trout, and I have already shown the best methods of proceeding with them. It will, however, be found that many small and even large lakes abound to profusion in very small trout. The smallness of these trout no doubt, in a great measure, proceeds from their being too numerous for the food found in the lakes. If the introduction of an extra amount of food, by the various means I have pointed out, be either impossible or not thought worth the trial, the only way left is to reduce the number of trout; this can be done by netting, or by putting into the lake a certain number of jack, in order to keep the small trout down. But this last is a dangerous experiment, and, if decided on, *these jack should be ALL MALES*, in order that they may not breed, so as to increase their number; for if this be not attended to they will in time get so far ahead as almost to exterminate the trout; keeping them down will be an endless task, and they can never after be got rid of. Therefore the *greatest attention*

*should be paid to this point.*¹ The way to be sure on this head is to select the fish at spawning time, when the fact can very easily be ascertained. Fish of about a pound weight or under should be chosen ; but, under these circumstances, they should be taken out by all possible means once every three or four years, and replaced by others, or instead of contenting themselves with the smaller fish they will destroy the larger trout. As I have said before, the experiment is very hazardous, and should not be entered upon without due consideration. But it is a well-known fact, that all the lakes in the south of Scotland, which produce the finest trout, have pike in them ; whether in the course of years, if the pike are not kept down, they will continue to have trout in them, is another matter. Long hang-nets, set as trammels, will be found useful in such lakes for destroying pike.

Common trout in lakes often increase to a large size ; but there is a trout peculiar to lakes, called the great lake-trout, or, *salmo ferox*. When full grown, the *ferox* is a handsome fish in appearance, but his flesh is coarse, and, as an adjunct to the table, he is

¹ I own that I do not like the plan, as I have known several lakes quite spoiled by it, though for a time the size of the trout was greatly improved.

not in very great esteem. As a matter of sport, he is one of the strongest and gamest fish that swims when you have hooked him;¹ and the killing of a 20lb. ferox is no light triumph and no easy achievement—a 30lb. salmon is a much easier conquest. But they rarely take anything but a trolling bait, and that at long and weary intervals, seldom, indeed, rising to a fly (though I have known them taken with it). Oh, that trolling for the mythic ferox, which has fabled itself to my mind as a species of fresh-water kraken! How many long hours have I spent at it bootlessly! As a destroyer of fish of his own kind he is scarcely, if at all, less destructive than the pike, though perhaps a more desirable fish. These very big trout are very apt to make wastes of the water around them. In the management of a lake, the most useful size (*if possible*), to permit the common trout to arrive at, is about four or five pounds; and with plenty of proper food in lakes, they should not be long in arriving at that weight. After this they grow more slowly; they feed upon their own species more largely; and it is a question whether they are then really worth their keep.

¹ As the excellent and cautious Mrs. Glasse would no doubt have remarked if the subject of *Feroxes* had been brought under her notice, "First hook your ferox."

I treat this point here solely in a commercial view. If I look at it as a sportsman, I should say that I prefer a fair chance among a good show of three and four-pounders, to that very rare one of the twelve or twenty-pounder—one soon wearies of always sitting in a boat, with a couple of rods stuck hopelessly over the stern, but one seldom tires of fair sport with the fly amongst fish from 1lb. to 4lbs. or 5lbs. weight.¹ I may take occasion here to point out a singular fact, which has often been noted, but not attempted to be accounted for, and that is, that many lakes have numbers of these very large trout, running from 7lbs or 8lbs. to 10lbs. or 12lbs. weight,² and sometimes even much larger, and at the same time they have only very small fish as well. I know of many lakes where this is the case; of course, there are also many lakes where this is not so. How is it that there are so very few middle-class fish, fish of 1lb. and 2lbs. or 3lbs. weight, such as the fly-fisher loves to see rising quietly and unobtrusively, just within

¹ Some who may have had better success at trolling for the *ferox* than I or any of my friends ever had, may be disposed here to differ with me. "May difference of opinion," &c.

² It is possible that these large fellows may be the *ferox*, but so little is known of the peculiarities which mark the *ferox*, that the point is left in uncertainty, particularly as the common brown trout often grow to a large size, and may be confounded with it.

the cast of his fly, sucking in the insects that play over and alight on the lake, as day begins to wane, and the purple shadows of the mountains begin to lengthen and deepen? Oh, for that quiet delicious hour when the cool evening breeze begins to spring up, and Nature to awaken from her noontide siesta, when we can wander along the lonely strand, light of heart and freed from care, casting the seductive flies over each little circlet which betokens to the angler a goodly and a hungry trout below. Now, the cast of flies falls like thistledown, and—"by the bones of the uncanonized St. Isaac, what a head and shoulders;"—with a dash curiously unlike the way he would seize the natural fly, he has it, and turns to descend with his dangerous prize. "What, ho! bully-rook—not so fast, fair sir!" and with a slight upward turn of the wrist, the fine steel wire is fixed like the tooth of the weasel in the eagle's leg, and it shall go hard, but like it, too, it shall bring its would-be captor to land. "Hoots toots, what a pother! full twenty yards of line, as I'm a living fisherman and a sinner." That is all too far away for a near acquaintance, my dainty *salmo fario*; so, with your leave, my scaly friend, we will gently persuade you to yield us back that twenty yards of silken web you have so lustily borrowed of us. So! he feels the rankling steel, and

bounds into the air like an acrobat, to see if haply he can shake it out. By this hand ! three pounds if he's an ounce. Well jumped, trouty ; well played, piscator. That dip of the rod-point saved your tackle *à merveille*. There's no fool at one end of the line, whatever there may be at the other. But the struggle is over at last, and poor trouty is consigned to the gradually-filling creel, the prize of the evening.

"Lonely," did I say? Nay, for in yonder bay stands knee-deep another fisherman, fishing for his evening meal too ; and clever as you may be at your craft, friend piscator, Goodman Gossip Heron shall show you a trick or two of fishing which you cannot equal. How spectral and like a ghost he looks as he stands upon the watch ! Ah ! now you have disturbed him ; he is off, and he flaps lazily away, like an over-gorged monster as he is, dropping his last capture as he goes home to Mrs. Heron, and all the young Herons, who are anxiously awaiting his coming far up the face of that rugged and inaccessible rock that overhangs Loch Lonely. And now the moon begins to rise. The Lodge is two miles off across the brae ; so fill thy pipe, and, with a light heart and a heavy creel, betake thee gladly and peacefully homeward, thanking God for his beautiful world and thine own happy lot in it : for *certes*, good friend, we

cannot choose but envy you that fine basket of trout, that capital evening's sport, and that delicious homeward walk.

I am writing, as the reader will see, *con amore*, and I must beg him to pardon this rhapsody as an unlooked-for digression ; for it is hard to be always commercially-minded on such subjects, nor ever to look at the more congenial part of the picture.

But to resume my argument. These middle-sized fish are almost wanting in many lakes I could name, though small ones abound. Now, how is this to be accounted for? That the trout can easily reach the middle weight if left to themselves is proved by their reaching the greater one. May it not possibly be that these big monsters prefer the half-pounders, or fish of near that size, to their trumpery little two-ounce sons and daughters, which are far more plentiful? One thing is most certain—viz. that their capacity and capabilities are quite equal to taking even much larger fish, and they may prefer one large fish to a dozen small ones. I don't say that this is the reason of the absence of the intermediate size, because I cannot prove my case, but I do think it is by no means an improbable theory. I have seen large Thames trout, of eight, ten, and twelve pounds' weight, chasing roach of half and three-quarters of a

pound, and even larger ones, scores of times ; and I have always found, on examining trout that have been caught, when they have had fish in them, that the fish they had chosen to devour were good-sized ones, much larger indeed than the Thames Anglers usually employ as a bait. (Might not these gentlemen take a hint from this fact?)

I repeat, therefore, that, commercially speaking, up to four or five pounds should be the maximum for lake trout. Still, as others may differ from me on this point, and I do not wish to advocate my opinion too strongly, I merely record it without urging it upon any one. But if the matter *could be* regulated as I have above put it, and it became a nice question of how many pounds of fish per annum will Loch Lonely produce me, I should be inclined to hold to my views upon the subject. Looking at the question again, as a sportsman, I care little for these big fish—these great unapproachables. They have my profound respect ; should one ever chance to leave his card on me, his condescension will gratify me hugely ; but the lively, free-rising two or three-pounder has my best affections, and is the object of my tenderest aspirations and hopes. Deed and truth, I'll step out in the gloaming, and scale mountains and wade bogs, like a fervent lover, to flirt with my

fair young lady trout of two or three pounds' weight, when I wouldn't wet the soles of my boots for the bare chance of *seeing* her grandmother, though I should dearly like to "take a rise" out of the old lady, too, if she happened to come in my way.

The angler will be rather a gainer than a loser by a proper management of the waters, and the sporting and commercial interests in all fishing matters are entirely identical. Their objects are—*the best fish, the best sized fish, and the greatest number of them.* Given these three unknown quantities, what are the relative proportions? How is this piscatorial *xyz* to be determined? Will any one help in trying to work up the form of the equation? What is that *xyz* to be equal to? Is it to be a *plus* quantity or a *minus* quantity? I have worked hard for many years to make a *plus* quantity of it, and hope to be successful at last. If I am, I shall not have striven in vain—I shall have done some little good for my fellows; for surely there is many a hungry belly and many an empty pouch going, that might be filled if that same equation were only properly worked out!

The charr might certainly be much more widely spread in our lakes than it is, if judiciously introduced.

The Ombre Chevalier, or charr of central Europe, by some is said to be another variety. It is a very delicious charr. Whether it really be a different species from our charr or no, I cannot decide. Dr. Günther holds that it is. Carl Voght gives it the following names: "The Knight or Rotheli, Salbling, Salmarin, Schwarzrentrel, Salmo Umbla, Salmo Salvelinus, L'Ombre Chevalier, Charr," and says that it sometimes reaches the weight of *ten pounds*; ¹ and he further says, that the fish known in the lakes of Switzerland, Bavaria, and Tyrol by the names of Salbling, Salmeling, Salmarin, Rothforelle, Schwarzreuter, Alpenforelle, *are all of the same species in their variations*. Yarrell, backed by Agassiz and Nilsson, avers the identity. The breed might, however, be introduced or crossed with our own with advantage, and this could be very easily effected. Some thousands of eggs of the ombre were sent to the Thames Society, who hatched them and

¹ With us a charr of over 11lb. weight is a rarity, and one of 2lbs. is scarcely ever known. Dr. Günther, who is, perhaps, the best ichthyologist of his day, makes a strong distinction between the Umbla and Salvelinus. He says that there are at least three species in Europe not identical with our British charrs, and the British charrs are also of three different species, the Irish again having two other distinct species, the Iceland charr, which he terms "*salmo nivalis*," being another totally different species. According to him the Ombre Chevalier is the *Salmo Umbla*.

turned them into their river. Unlike our own charr, it never leaves the lakes even to spawn, according to Dr. Günther, and, as he stated, is quite unadapted to rivers; and here is another striking point of difference, as in some of our lakes the charr certainly do enter the rivers to spawn.

I have not enjoyed opportunities of studying the Ombre Chevalier, and must perforce accept my knowledge of it from foreign sources; yet to show how, upon matters of this nature, authorities may disagree, I may here mention the fact, that when Monsieur Coumes, the superintendent at Huningue, was a short time since in London on a mission from the French Government, he certainly stated that they were actually naturalizing this fish to the French rivers. I have already mentioned the fact of some charr in the rivers of Norway which visit the sea, and in lakes which have a communication with the sea we might try this fish in our own country.

Much has been written of the Lucio Perca—the pike-perch, or Sander. This, again, is a very voracious and destructive fish. It is a very fair fish for the table. It shows no sport to the angler,¹ allowing itself

¹ I mention this point, as in acclimatising any new fish, its capabilities, whether desirable or not, should, I think, be examined in every point of view.

to be drawn from the water with scarce a struggle ; and it is said to be excessively difficult to transport, owing, apparently, to the small amount of vigorous vitality in both the fish and its eggs. M. Ekström failed in several attempts to transplant this fish from Sweden to Denmark, as the plan of artificial fecundation appears rarely to succeed, and the fish itself will not long exist when taken from the water. This is the account we have of it. How far modern science may be enabled to cope with the difficulty, I will not pretend to say. The French pisciculturists, however, who have much better opportunities of procuring it from Germany than we have, do not seem to have yet acclimatised it. The voracity of this fish need not be a bar to its introduction, as it is more of a lake than a river fish, and it might be placed in lakes, ponds, and such waters as are already tenanted by pike and perch, where it could do but little comparative harm, and yet be a better fish at any rate for the table than the pike or perch, though of much less use to the angler. Its advent could hardly fail to be regarded favourably. I was, sometime since, applied to by the Acclimatisation Society to undertake the transportation of this fish from Berlin, where it is plentiful, and has a good reputation ; and, from what was stated at the time, it would

have appeared that the fish there in favour was of a hardier nature than other authorities have given it credit for. I gather, however, from Herr Carl Voght's work, that there are two species of Sanders, and possibly the other, which I have not noticed, may be the fish referred to. It was not convenient to me to undertake the journey at the time, and the project was for a period laid aside.

I must now refer briefly to a class of fish found in some of our lakes, and concerning which comparatively little is known. Nevertheless, without doubt, some of them are excellent for the table. These fish are many of them but very partially distributed amongst our waters, and we have no reliable records as to how they became naturalized so partially, whether they are indigenous, or who introduced them. I refer to the class known as the Coregoni. Under this title there are some valuable members of the Salmonidæ already in some of our lakes. The Coregoni appear, for the most part, to be of little or no use to the angler, and it is therefore as regards their value for the table only that they must be altogether considered. Of those which already inhabit our own waters, there are the Powan of Loch Lomond, the Pollan of Lough Neagh, the Vendace of Loch-Maben, and the Gwyniad of Bala Lake, Llyn Tegid,

and elsewhere, also called the Schelly of Uls-water.

Of all these fish, probably the Powan is the most valuable, since it grows to a fine size, from twelve to sixteen inches in length. It is called the fresh-water herring, and is by some authorities stated to be excellent food, though I have heard others deny that it is so. It is abundant in Loch Lomond, and is taken in nets there in large numbers. Although it dies very soon after its removal from the water, and would thus present a difficulty towards transporting it to other lakes, artificial breeding, no doubt, would easily succeed with it.

The Pollan has sometimes been confounded with the Powan, but they are distinct fish, although their habits are very similar. It is found chiefly in Lough Neagh, where it is in great abundance. It requires, however, to be eaten soon after its removal from the water, or it soon deteriorates. It is not quite of so large size as the Powan.

The Vendace, though found chiefly in Loch-Maben, is said not to be confined to it, as it has been stated that it is found also in other small lochs in the neighbourhood, though in smaller numbers. It seldom exceeds seven or eight inches in length. Yarrell, speaking of this fish, is satisfied that its introduction

must have been effected *by means of the spawn*, as it could not be transported even a few miles alive, being of so delicate a nature. It is a very delicious fish, somewhat in flavour like to the smelt. Dr. Knox, however, speaks of it as a *moderately good fish to eat* : Dr. Knox may have eaten it under unfavourable circumstances. Of course, it is desirable that a fish so much in request as this appears to be should be more widely diffused ; and I should think that, by means of artificial breeding, it might not be difficult to extend its range. But a judicious choice of the lake to be stocked should be made, and I imagine that those lakes which support its coarser and less desirable congener, the Gwyniad, might well be tried with the Vendace. Unfortunately, it grows every year scarcer in Loch-Maben, and it is only with difficulty that sufficient can now be captured for the club-feasts which are periodically held in its honour ; while casual visitors find it a great favour to obtain a dish of them.

The Gwyniad is said to be insipid and of poor flavour, if not eaten immediately after it is caught, and it already exists in several lakes ; so that it is a question whether it would, without some stronger evidence of its desirability, be worth while expending any further trouble on it. It runs to a fair size, how-

ever, nearly approaching the Powan in that respect. There is an excellent fish of this class, called the Fera, found in Lake Geneva. This delicious fish has engaged the attention of French pisciculturists, who have been largely occupied in stocking many of the most convenient and contiguous waters of France with it. The French Government are very liberal in transmitting fecundated eggs of the Fera upon application; and there can be little doubt but, in a few years, we shall number this fish amongst our Fauna. There is another fish of this class, called the Lavaret, found in the Swiss lakes, which is highly spoken of for the table. It has been asserted by some that it is identical with the Fera—by others that it is also identical with the Gwyniad; but it is, I believe, now decided that it is a separate variety. Carl Voght distinguishes it from the Fera: (his description of both these fish will be found in the Appendix.)

Unfortunately, the whole tribe of Coregoni are but imperfectly known, and there has hitherto existed considerable difficulty in the way of comparison. One point with regard to them is indisputable—viz. that many of them are very desirable fish to cultivate, as the food they consume is composed of insects, such as the smaller Coleoptera and the Entomostracæ. The Coregoni are said to abound in many

of the American lakes, and among the most valuable is the Lake Shad, White Fish, or *Coregonus Albus*. The following is a description of this fish, from Mr. Hunter's work on the Scenery, &c. of the Eastern Townships of Canada:—"Form oval, slightly tapering towards the tail; body deep and thick; head pointed, and with the *mouth very small*; average weight about four pounds. Colour silvery, bluish-grey on the back; lighter on the sides, and pearly-white on the belly. This is a most excellent fish, and nearly all are disposed to acquiesce in this opinion. It is taken in considerable numbers in Lake Massawippi, and in the other lakes of the Eastern Townships." This would evidently be a very desirable fish for our waters, and, no doubt, would suit most of our lakes.

There is another American fish which it would be very desirable to obtain, if we could manage to obtain it—the Otsego Bass. Though called a bass in reality it belongs to the Coregoni. The generic name being *Coregonus Otsego*. It strongly resembles the White Fish in appearance, and grows to a good size—five or six pounds. It is found only in Otsego Lake. It is esteemed one of the greatest delicacies in the United States, and is in very great request—so much so that the breed is rapidly diminishing. A friend who has been for some time located near

this lake, gave the fish so very high a character that I induced him to try and send over some of the ova. He endeavoured to do so, and obtained nearly 50,000 ova—but unfortunately placed them in some zinc trays which were of rather impure metal, and the whole of the ova died, as we concluded poisoned, before he could send it away.¹ No doubt if the plan of packing it in wet moss and ice had been adopted, we should have succeeded in getting it safely over.

There are many other American fish recommended strongly by various authorities as useful for our waters. I have already alluded to the Black Bass in treating of rivers. This fish is also suitable for lakes, where it might be really useful, and there could not be much difficulty in obtaining it.

The great Maskinongé rather resembles the pike in appearance. It inhabits the large lakes in Western Canada chiefly. This fish has been known to reach 70lbs. and even 80lbs. in weight. That which I have said concerning the voracity of the black bass,

¹ My friend came to this conclusion, because after a few days a white powder exuded from the zinc and lay thickly over the inner surface, and wherever this was the ova died. It so happened, however, that some half-dozen pellets rested upon a cork which stopped a hole in the zinc, and *these alone did not die*. A curious and very confirmatory circumstance of the opinion he expressed.

applies more forcibly here ; and I may remark that it is a question if we do not already possess, in the pike and the perch, two fish equally good with the above-named fish ; and it would be worth while to consider, whether it be advisable to increase the number of destructive and voracious fish which inhabit our waters, and which might by any accident become naturalized in our more valuable fisheries, where their introduction would be but a nuisance and a misfortune. If, however, variety be thought desirable, *where it can do no harm*, I have nothing further to urge against it.

Before closing this chapter I may add a few words to the account already given of the transport to this country of the *Silurus Glanis*.¹ Dr. Günther gives it as his opinion that it is the only fish we could get from Central Europe which would be of any use to us. In a conversation I had with the Doctor lately, he advised that lakes which have more or less peat banks or beds should be stocked with silurus, as more appropriate to the fish. If such a condition be requisite, we have an abundance of lakes, now all but useless, which may be made available. The tiger eel, referred to below, Dr. Günther supposed to have been the burbot, as he stated

¹ See page 103.

that no eel existed in the system of the Danube. I here add a letter which I sent to the *Times*, and which was published in that journal on Monday, September 26th :—

“ The arrival of that remarkable and valuable fish, the *Silurus Glanis*, in England, is a fact worthy of being made known to the public. It is more than a hundred years since any new fish has been acclimatized in England, and a very much longer period since any fish of equal value has been brought into this country to be acclimatized ; indeed, it is a question whether any animal since, perhaps, the introduction of the turkey, has been brought here likely to equal the *Silurus* in importance. One of the greatest wants hitherto felt in this country has been a good pond or lake fish, that might be turned to actual account, in order that the huge wastes of water with which our islands abound might be profitably stocked and employed. This want the silurus seems likely to meet ; indeed, it is almost the only fish we could have procured which could meet it. Growing to an enormous size, even to 200lb. or 300lb in weight, where space and food are plentiful, it nevertheless in ponds preserves its fine flavour. It feeds ravenously upon the coarser kinds

of fish, but of all food prefers frogs. We have undoubtedly vast quantities of frogs in this country, which at present are not used by us in any way as a medium either of food or of producing food; and so rapid is the growth of the silurus, that it has been known to reach the enormous weight of 54lb. in four years.

“ Its flesh somewhat resembles veal in appearance, and partakes of the rich flavour of the eel. All Englishmen who have partaken of it unite in averring that it is superior even to our own noble salmon. The above facts I have from Sir Stephen Lakeman, to whose enterprise, energy, and determination the introduction of the silurus is due. It need not be pointed out that, if we can replace the worthless carp and roach with which our large sheets of water are infested with a fish of this character, the gain to us will be very great. Sir Stephen Lakeman brought these fish from Kopacheni, where he has an estate on the banks of the Argisch, which is a tributary of the Danube, and is about ten miles from Bucharest—a distance of 1,800 miles. The labour of transporting them hither was enormous. He started from Kopacheni on the 23d of August, and brought these fish by Bucharest to Giurgevo, a distance of fifty miles, thence by steamer to Basias (in Transylvania), and

by rail to Pesth, Vienna, Nüremberg, Cologne, Brussels, Boulogne to London, and thence to Twickenham. Many times his charge was upon the point of being shipwrecked, but was saved by his indomitable energy and perseverance. To combat the carelessness, and in some places even the positive disfavour of railway officials, incessant attention was required. He started with thirty-six siluruses and some tiger eels—a remarkable and valuable fish, peculiar to the Danube. Some of the siluruses were of large size, up to 6lb. They were conveyed in casks, about the size of quarter-casks, placed upon rockers; these, by keeping the casks constantly in motion, plashed and aërated the water. The larger fish were suspected, and no doubt with justice, of having eaten the smaller ones, and with them the tiger eels. They all died, however, but fourteen, which arrived here safely on the night of Thursday, the 15th, in the charge of Sir Stephen and my friend Mr. Lowe, one of the secretaries of the Acclimatisation Society. The little strangers varied from one to two ounces in weight; they were perfectly healthy and lively, and after their long fast of twenty-three days, they made good use of their time when enlarged, as on the next day, when I examined them, their stomachs were distended with food.

“They have now been in my charge a week, and are exceedingly healthy and vigorous. They are a peculiar fish, resembling in their habits the burbot, which I have also had charge of here. They hide themselves by day, and roam about for food at night. I have no doubt that the attempt to introduce them will be thoroughly successful.

“FRANCIS FRANCIS,

“Piscicultural Director to the

“Acclimatisation Society.

“FIRS, TWICKENHAM.”

CHAPTER XI.

ON SMALLER PONDS.

I NOW come to ponds ; and here, perhaps, we display our very worst management. The Dutch, by judicious treatment of their resources in this respect, realize large revenues, and produce fish which are really said to be palatable, and even excellent. But what is the English pond-fish worth ? In ninety cases out of a hundred, the flavour of mud is so painfully evident, that for any table-purposes the fish is worthless. In fact, by putting fish into our ponds, we spoil them. Take a carp, for example, from a river, and he is, as I have said, perhaps, an eatable fish. Take him from one of our ponds, and few will encounter him. Why is this ? It is because we do not study how best to keep our ponds in good order—clean, sweet, and wholesome.

In the first place, for the sake of picturesqueness, and to add to the beauty of the landscape, we plant trees all round our ponds, or to a certain

extent round them. These trees yearly shed their leaves : the surface of the ponds may, in the autumn, be seen covered with them. The leaves become saturated with water and sink to the bottom of the pond, where they accumulate into a perfect bed, or thick layers of leaves. These, acted on by the water, slowly decompose, the action continuing for months, until they gradually turn into thick, black, and stinking mud. During the decomposition of these leaves, and also after their decomposition, they continue to send forth noisome gases and exhalations, which penetrate and pervade the water, from which an unwholesome mist and smell ascends, more or less, at all times, and particularly in hot moist weather. Under these circumstances, how is it possible that the fish inhabiting these waters so affected should be otherwise than receptacles for a species of concentrated essence of mud? To add to the effect we leave our ponds year after year without cleaning them out, and the weeds grow and rot, and grow and rot year after year, and, combined with the leaves from above, the pond literally grows mud, until at length the ponds either so fill up or become such a nuisance that they generate deadly diseases, and necessitate a heavy and expensive operation for the carting away of the almost liquid filth thus formed.

Ponds cannot be kept too clean, and no more weed should be permitted to accumulate in them than is just sufficient for shelter and the production of food for the fish. The monks, from the necessity for fish diet caused by their fasts, understood the management of fisheries, particularly of inland fisheries, ponds, and stews, &c., infinitely better than we do. Indeed, many of the old fish-ponds, particularly where they are found in succession, communicating with each other, are due to their skill and intelligence, and in the majority of instances where these existed, hard by stood formerly some monastic institution. The best specimen of this arrangement for fish culture which I have ever chanced to see, is at Stanton Harcourt, near Witney, in Oxon. There the ponds are constructed in two separate series, crossing each other at right angles. There is one large stock pond several acres in extent, communicating with two other ponds in succession, and across these run about seven or eight other ponds of smaller size, each discharging into the other. One of them is, curiously enough, fashioned like a rude cross, having, possibly, some significance with respect to the religious purposes they were contrived in aid of. The large pond I suppose to be the stock pond, and these smaller ponds were no doubt succession ponds . .

or stews, maintaining fish of various sizes, in which, probably, the fish were nursed and fed until fit for the table; and no doubt many a noble tench, fat carp, and luscious eel, made rich and savoury by all the varied receipts of monastic cookery, humbled the bereaved stomachs, and mortified the flesh of abbot, and friar, and reverend prior at Stanton Harcourt, in the days gone by. Alas! what a spectacle greets us now: choked with weeds and mud, green with slime and filth, fetid with corruption, used as a farm-yard adjunct to wash sheep in, they stand an evidence of knowledge that has departed, an industry destroyed, and a need that is stupidly and wastefully ignored.

More or less, this is too much the state of nine-tenths of our fish-ponds; from supplying our needs liberally they have become rather dangerous nuisances. In Holland, where, as I have stated, this subject is properly studied and understood,¹ the ponds are *usually* made in series of two, three, or more, communicating by hatches with one another; so that when one is drained, the others may remain full, and each or all of them can be raised or let down at pleasure. One or the other of them is usually drained down and left dry yearly, or every year or two, for some months,

¹ And whence we, with almost boundless resources for the culture of eels, export more than half of our supply of eels.

in order to allow the soil to exhale and purify, and the weeds to die down. Some weeds are indispensable, as they harbour food, serve to aërate and keep pure the water, and are needed for the fish to spawn amongst. Indeed, the fish cannot spawn without them; and, added to this, the spawn is said to require the aëration afforded by the weeds for its proper vivification. The little gold fish often die off in great numbers, from no other cause than that of being placed in tanks or reservoirs where there are no weeds for it to rub itself against, in order to free itself from the spawn. The Water Crowsfoot is one of the most useful weeds for ponds, but the *Anacharis Alsinastrum*, or American weed, as it is commonly termed, should be avoided, or it will soon choke up the pond.

Ponds should be fished once in every three or four years; they do not pay if left for longer intervals. A few pairs of the larger fish should be left as breeders, with whatever fry may exist; but the middle-sized fish should be taken out—that is, the fish from two to four or five pounds. Carp, for example, grow slowly up to about three-quarters of a pound weight, when they seem to strike out and grow very rapidly up to five or six pounds, if food be plentiful and the water of good temperature. From

this onwards they grow again much more slowly, and the fish take up, when large, more space than they are worth ; for these large carp are also unmarketable, the fish from two to five pounds being best for the table, the large ones being apt to get woolly and tasteless.

Mr. Simeon, in his most able and interesting work, "Stray Notes on Fishing, &c.," gives a very good account of the operations of Mr. Maltby, our Vice-Consul at Brussels, who has several ponds in that locality for the rearing of fish. From this account valuable data may be derived. Mr. Maltby, it seems, does not rely altogether upon his own breed of fish, but buys others of the best and most approved breeds, to introduce from time to time into his waters, thus crossing the breeds. According to Mr. Simeon, Mr. Maltby finds the Tench perhaps the most valuable pond-fish of any, being the most delicate and free from any muddy flavour ; and in this estimate I think my own experience verifies his, as I have eaten Dr. Tench, as he is sometimes called, even from *our* ponds with a reasonable amount of satisfaction.

After the formation of a pond, it is often found that the fish do not thrive nor increase. There may be various reasons for this : one is that, possibly, the soil of the pond does not suit the fish nor encourage food for them ; a soft, warm, marly

bottom being the best. Gravel, (often impregnated with iron) does not do well, nor does a hard clay, which is too cold and unproductive. Again, steep banks with deep water all around the sides are objectionable, as the fish like to push on to the shallows, and lie with their backs almost above water, both for spawning and for warmth; and besides this, the small fry, when just hatched and capable of moving about, cannot exist in the deep water, but require shallows as an absolute necessity. This will be recognised either in rivers or ponds, if the reader will remember, when he has been walking along the banks at certain seasons, how often he has seen the small fry start off from the margin, where they have been sunning and disporting themselves in myriads, and how seldom, on the other hand, he has ever noticed them in deep water. Ponds that have rookeries beside them have been found not to answer. The reason of this is that the droppings of the rooks, which are very considerable, contain a large percentage of lime, which is very prejudicial to fish.

The best fish for ponds are Carp, Tench, Jack, and Bream. It is always well, even in carp and tench ponds, to have a few brace of jack among the carp and tench, for the purpose of keeping the fry down, so that they may not devour too much of the

food from the larger fish. The proportions recommended by Mr. Boccius, who is an authority upon this subject, having written a work upon it, are 200 brood carp, twenty brood tench, and twenty brood jack to the acre, the best time of stocking being the end of October; and this, as he points out, is a matter of some importance.

With regard to the growth of Pike, I have been much astonished, in looking over Mr. Simeon's work, to find the following remarkable statement, which I give *literatim*. It will be seen that a good and constant supply of fresh water, and that of as warm a temperature as may be reasonably gained, are very favourable matters to the growth of fish. He is speaking of Mr. Maltby's undertaking:—

“Although both lakes, La Hulpe and Boilsfut, are fairly well supplied by springs and natural streams, yet he believes the qualities of the waters flowing through them to be different, the sources from which they are derived being distinct.

“With a view, therefore, of promoting the growth of his fish—a change of water being in his opinion the means which, more than any other, conduce to improve both their size and quality—he every other year transports the smaller fish from Boilsfut to La Hulpe, and *vice versa*. This he effects by carting

them across in barrels, the proportion of water to fish in each being one-third water and two-thirds fish. In order to insure them a due supply of air during the transit, the hole in the side of each barrel is bunged up with a wisp of straw. By the jolting of the cart the fish are kept in continual motion, and, while the water is prevented from escaping, it becomes, by being shaken against the straw, sufficiently charged with external air for the purpose of respiration. By adopting this mode of carriage, he never loses five pounds' weight out of three thousand pounds transported.

"The effect which such a change has upon jack appears to be most remarkable, the increase in their weight, after removal, being, in some cases, at the rate of not less than from *eight to ten pounds a year*. In the year 1856, for instance, Mr. Maltby marked and transferred from the large lake of Boilsfut to that of La Hulpe, forty-five jack, averaging one with another two pounds each; none of them weighing more than three pounds. In eighteen months from the time when they had been thus transferred, many of these same fish were caught by trolling, having attained the weight of from fifteen to twenty pounds, being at the extraordinary rate above mentioned.

"This increase in the size of the jack was so

sudden and unexpected, that nearly all the smaller fish were destroyed by them, before any steps could be taken for their removal. It was, however, then effected by letting out the water, when the jack were placed in one of the smaller ponds above mentioned. In this, however, although it contained a good supply of white fish, they rather lost than gained weight, probably, as Mr. Maltby imagines, in consequence of there being a smaller body of water running through it, and that colder, from being nearer the source.

“At the commencement of the year 1857, he had purchased and turned into the lake at Boilsfut nine hundred carp of a particularly good breed, weighing, one with another, a pound each; but of these, when the water was let out in the month of October, not a single one was to be found, the jack not having suffered a solitary individual to escape them. Since that time Mr. Maltby has allowed no jack to be put into his water, as stock, above a pound in weight, which (as younger fish do not gain weight so fast,) will not increase in a year to more than about three or four pounds. It is only after attaining that weight that their growth becomes so astonishingly rapid.

“In the lake at Boilsfut, jack, perch, and white fish breed fast, but the fish born in that lake do not increase so fast by two-thirds as those born in

La Hulpe ; so that, although their transport from the one to the other is expensive, yet it is made up for by the increase of weight in the fish transported."

These facts are both interesting and astonishing, and are well worthy the attention of pisciculturists. We have no record of jack growing at such a rate in this country, and I believe the case is rather exceptional.

Roach, save as food for the jack, are worse than useless in ponds, and should never be introduced where there are carp, or they will in time exterminate the carp: the roach increase so rapidly, and are so much more active than the carp, that they will in time literally starve the carp. I have noticed this on more than one occasion. I will, however, instance one. In Brownwich Pond, near Titchfield, in Hampshire (a pond formerly belonging to a monastic institution), there were, when I was a boy, a great abundance of very fair sized carp; there were also a quantity of roach, running up to a quarter and half a pound in weight: there were plenty of eels, and a tolerable proportion of trout. Of the latter I usually got from two to half a dozen in the course of my day's fishing; they rarely, however, exceeded half a pound in weight. The carp did not run large, owing, as I believe, to the numerous roach, four or

five pounds being the largest I ever saw there. Fish of from one to two or two-and-a-half pounds were plentiful, and I could usually, with a float and worm, take from twenty to thirty or forty pounds' weight in a day.

I had not visited this pond for many years, when, happening to be in the neighbourhood some time since, I resolved again to fish it with a friend. The trout, I was informed, had entirely disappeared for some time. The pond was literally alive with small roach. Any person standing in one spot could easily, with one fragment of worm, and without ever changing his bait, take three or four dozen of them, provided, and as long as, any worm was left on the hook, and it mattered very little what spot he selected. Our whole day's fishing produced us hundreds (I cannot say how many) of these wretched little roach, some half-dozen small eels (much smaller than formerly), and three carp, the largest about three-quarters of a pound, and all three of them so starved and so wretchedly thin that, as my friend remarked, one might almost shave oneself with their backbones—the length and head being those of two-pound fish if in fair condition. I should think that one or two more years would certainly, if no remedial measures were adopted, see

the last of the carp. The roach themselves, too, had diminished to the smallest size, being not larger than bleak, say fifteen or twenty to the pound.

Eels, again, are bad things to have in a pond, as the destruction they work among the spawn is very great; and if the reader cares for his fish, let him by no means be tempted to indulge in the picturesque, by placing swans or ducks or fancy waterfowl of any kind on his pond: if he does, he will certainly maintain them at the expense of the fish. I do not believe at all in their keeping the weeds down, for the reason that I have never seen their presence produce that effect. If the pond proprietor must have a pair of swans to look pretty, let him get a skilful taxidermist to stuff him a pair as life-like as possible; he may even, to render the illusion more real, put some clockwork into them, to make them nod their heads every five minutes; let him then anchor them far out in the middle of his pond, and for all picturesque purposes his end will be answered. Knowing the mischief they do, I detest swans, and wish every swan was, like his sable brother, a "*rara avis in terris*," or rather *aquis*. One had better throw open his pond or river to all the poachers in the district than indulge in a taste for swans. If any one doubts this, let him take a row up the Thames from

Weybridge to Chertsey, or on to Laleham, during the latter end of the month of April or early in May, and take particular and especial notice of what the swans are doing. If he has still any doubt, and likes to kill one or two and cut them open, he will solve his doubts and do a service at the same time; he may be fined for it, but he will certainly suffer for a good action and in a good cause. A swan can and will devour a gallon of fish-spawn every day while the spawn remains unhatched, if he can get it, and it is easily found. I leave the reader to calculate what the few hundreds (I might almost say thousands) on the Thames devour in the course of two or three months. Their greediness and voracity for fish-spawn must be witnessed to be believed. If this were not so, the Thames ought to swarm to excess with fish, whereas it is but poorly supplied.¹

¹ Here is a little calculation. Suppose each swan only to take a quart of spawn per diem, which is a very low average indeed; suppose each quart to contain 50,000 eggs (not a tithe of what it does contain)—I am not speaking of salmon or trout here, their ova being much larger; suppose only 200 swans (about a fourth, perhaps of the number really employed) are at work at the spawn, and give them only a fortnight for the period of their ravages. Now what is the result we get? Why, a little total of 140,000,000. One hundred and forty millions of eggs! Suppose only half of those eggs to become fish, and we have a loss of seventy millions of fish every year to the River Thames—a heavy price to pay for the picturesque, particularly when the reality may perhaps be doubled, or trebled, or even quadrupled.

To these facts some will probably demur, and use a common argument, that "*They* never saw the swans eat fish-spawn, although they have seen swans at feed hundreds of times." This is very probable. Gentlemen usually go on the water, and take particular note of things appertaining to the water, during the pleasant warm months of the year, when fish do not spawn, and therefore, of course, they see nothing of this. Besides, such an argument, if it be argument, is nothing in the face of facts. I *have* seen them, and I know very many other people who have. The late Mr. Arthur Smith and Mr. Frank Buckland were appointed, by the Thames Society, to try and mitigate the swans. They went up the river some miles, for the sole purpose of assuring themselves of the facts first, never having previously actually noticed them; and they came back thoroughly convinced of all that I have stated, from ocular demonstration. Many, many times I have striven to drive the swans away from their disgusting meal, and with very little success. They will suffer you when thus engaged to come near enough to strike them with a stick—nay, they will almost fight for the spawn, and the moment your back is turned they commence anew. I dwell upon this point with special force, because all poaching and all other

means of destruction sink into utter insignificance beside the ravages of swans, particularly on the Thames.

I once, when at Marlow early in the month of May, saw the long shallow some distance below the river covered with large fish (barbel, chub, roach, &c.) engaged in depositing their spawn. I watched them for some days; how long they had been there before I came I know not. The shallow, for nearly a hundred square yards, was black with shoals of fish; so thick were they in places that I, who happened one day to be fly-fishing, could not throw the fly on the water in many parts without foul-hooking either a large roach or a chub. At length the fish ceased spawning, and dropped off the shallows, exhausted, into the deeper, stiller water below. As soon as the fish left, I saw a troop of swans, about five-and-twenty in number, come sailing up the river, led by a patriarchal old villain with a huge knob over his beak. He appeared perfectly aware of what he was going about, for he led his band direct to the shallow, and immediately the whole troop commenced ripping up the spawning beds, and devouring the spawn. In spite of all my efforts to drive them away, I could never manage to keep them off the beds for more than two or three

minutes at a time. By hook or by crook, they would manage to get upon some part of the bed, and repeat the ripping-up and gorging process. For ten days those twenty-five swans gorged themselves to repletion, night and day, upon the spawning beds; and I believe they must have devoured in that time a small barge-load of spawn. Two men, engaged night and day, could hardly have kept them off the bed. I pointed this out again and again to the fishermen about there, but they seemed not to care about it. How much longer these devouring brutes stayed on the beds I know not, for I was obliged to leave the place before they had finished their feast; but that almost the whole yearly produce of the river for miles below was then and there devoured by the swans, I have not a particle of doubt, as there are no shallows fit for spawning for a considerable distance below that spot.

But to return to Pond-fish. Perch thrive fairly in some ponds, but not in others, as they rapidly get the muddy flavour so common to English pond-fish. Many of the small lakes in the south of Scotland abound with them, and in some of the lakes they seem to do well, often being taken of three and four pounds in weight. For marketable and table purposes a perch of from half a pound

to a pound is to be preferred. If a pond is fit for trout, having a good stream running through it, I would put no other fish but trout into it. I have seen some ponds produce trout of magnificent size, and very fine flavour, and am inclined to think that very many ponds condemned to baser tenants, would produce fine trout if they were allowed to. "

Mr. Boccius, in his work upon Pond-fish, recommends a species of carp found in Holland, called the Spiegel, or Mirror carp. He avers that it is as far superior to the ordinary carp for table purposes, as it excels it in beauty of appearance. A curious feature noticeable in this Spiegel carp is a row of very large scales of various sizes, along the side, which are of a mottled blue colour. It appears at times to grow to a very large size.

Gudgeon, as I have before stated, will do well in ponds, and may advantageously be introduced into them.

I now come to the Pike, and little more can be said of him, as already he is in many instances an intruder and almost too widely spread, as he monopolises waters which formerly were full of fine trout. In some lakes, as I have before said, he is for a time useful, and the trout increase in size; but the breed of pike in these lakes, if they have managed

to establish a breed, should be kept down by every possible means, and the larger fish, particularly, sought out and killed by any device that can be employed, or in a few years the nice trout-lake will become a pike-pond. The best time to thin them out is at spawning time, when a net, placed quietly round the shallow parts of the lake, where weed and reed beds are, will secure any quantity of the stock of the lake. The big ones can then be taken out, and killed if not wanted, or sent off to regular pike waters, where they will be welcome, and the remaining stock regulated. For this purpose the fisherman should commence his operations in the early part or middle of April.

In many of the lakes which salmon frequent, the pike is a most destructive pest, as the time when the salmon-smolts are passing down to the sea is a regular jubilee with them, and myriads of fish ten times more valuable than themselves are devoured by them. Here they should be exterminated: it should be "*Guerra al Trimmer-o!*"—"War to the Trimmer" even.¹ In many of the ponds, canals, and reservoirs of the midland counties, on the other hand, his presence is most welcome; and as he already inhabits most of these localities, little can

¹ Not excepting spear, spade, spud, or anything else whatever.

be done for him but to treat him fairly, and fish with moderation. The best pike I ever saw, if I except the Till fish already mentioned, are, without question, the Trent pike, both for shape and make, and for the table. They are short, thick, well-fed, handsome fish, with firm white flesh, and every other good quality which can belong to a pike. In ponds pike are less liable to contract the muddy flavour than the other fish : how this is I know not. I have tasted carp from a pond of very muddy flavour, and jack from the same pond almost destitute of it ; so that is a point in his favour. A jack, of from one to three or four pounds' weight, may be *made* very fair eating, as I have before stated. To the sportsman he is welcome, as coming at a time when salmon and trout are out of season, and altogether the pike is not a bad fish *in his place* : out of it he is a perfect pest.

Of Bream, there are two kinds, the white and the carp bream. The white bream is comparatively worthless, both for the table and the sportsman, as it is of small size and bad flavour. The carp bream grows at times to a very large size in the Irish lakes, where a bream fisherman would be satiated with the sport, as cartloads are often caught at one

drag of the net.¹ They are sometimes taken up to ten and twelve pounds' weight. They will do well in a pond with carp and tench, particularly if there are any deep holes in it, and they will afford variety for the sportsman; but they are of no great value for the table, as I think; probably, split and dried like haddocks is the best way of preparing them. They are salted and eaten largely by the poor in Ireland. The French have an old motto, to the effect that "he who hath bream in his pond may bid his friends welcome." There is no accounting for taste.

¹ In Lough Erne vast shoals of bream may occasionally be seen swimming at the surface and rippling the water, so as to resemble the effects of a sudden puff from a breeze of wind.

CHAPTER XII,

DOES THE ABSTRACTION OF OVA FROM A FISHERY
INJURE IT ?

BEFORE closing our consideration of the fresh-water fisheries, I find it necessary to add a short chapter for the purpose of combatting an erroneous notion which is likely to interfere with the working of artificial fish-breeding if it be not removed. On applying to many gentlemen for permission to take spawn from their waters, there is often a prevailing belief in their minds, and still more so in those of their keepers, that the abstraction of the ova is a serious loss to their fishery, and that the disturbance of the fish at spawning time is injurious to their interests ; whereas I am fully convinced that nothing can be further from the actual facts than these conclusions. First, I will supply instances to show that the process is not at all injurious, but the reverse ; and then I will endeavour to explain the reasons why this is so. Mr. Samuel Gurney, M.P., has for many years been following up the subject of pisciculture. He

has always been most liberal in his gifts of trout ova to aid all general and public purposes, and, to my own knowledge, very many thousands of trout ova have been taken yearly away from his fishery at Carshalton, which altogether comprises, perhaps, half or three-quarters of a mile, or so, of the Wandle. Yet the fish have scarce ever been so abundant in Mr. Gurney's water as during the past two seasons, and the last one in particular was especially productive, and this too, in spite of the very large number of fishermen who are permitted to fish in his water. Again, M. T. Smith, Esq., M.P., had command over a very nice stretch of water upon the Test. For three years, to my knowledge, he has allowed any quantity of ova we could get, to be taken from the stream, and his liberality was freely made use of, and large quantities of ova *were* taken ; yet was Mr. Smith able to send some 200 brace of fish away to stock other water during the earlier part of last season ; and, in spite of this, so great still was the quantity of trout left, that when we were netting it we often had forty or fifty trout in the net at the same time. In fact, there was no stretch of water on the Test that had such a large supply as this, although it was always assiduously fished by many skilful rods. I could cite several other instances of a similar

nature to show that no harm whatever, but rather benefit, occurs from the netting out of some of the fish, and the abstracting of their spawn at spawning time.

I account for this fact thus. A trout of about two pounds will yield some 2,000 or 3,000 ova. Now, in such waters as those I have quoted, in all probability there would not be much more than about double that quantity of fry produced altogether. Consequently, if there be, let us suppose, a thousand brace of fish in either of these waters, the nine hundred and ninety odd remaining brace of fish may be looked upon as utterly unproductive. Now, surely it can be no great loss to the stream to permit a portion of this huge waste to be turned to a profitable account? There is scarcely an egg in a thousand that comes from the trout which is hatched. What do we deprive the water of by taking away a part of this unproductive material? Suppose that we take 10,000 eggs from a river—it will represent about ten small fry. This is not a very heavy abstraction. Now, in the action of the Acclimatisation Society, we endeavour to make the taking of the spawn a very profitable affair to the persons who give us permission, as we agree to return them, if they require it, from ten to fifteen per cent. of the pro-

ceeds; and as, if the ova had been left in their streams, they would not get one per cent. nor even one quarter per cent. of fry from it, the advantage of our method of dealing must be manifest.

Now, where trout are engaged in the act of spawning, other trout, and many other fish and vermin of all kinds, find out where a pair of fish are spawning, and take up a favourable position for devouring the spawn, which position, unless much disturbed, they never leave while the process is going on, but remain feeding on the ova to the last pellet. If, however, these destroyers are swept out by the net and violently disturbed, it will be some days before they will settle down to the same work as before, so greatly will the netting have disturbed them. Meanwhile the beds are left unmolested, and are covered and hidden, and the trout are compelled by nature to continue their process; so that large quantities of ova are deposited, or made secure during and through this disturbance, which would not otherwise have been deposited at all, but would be devoured. Indeed, if either of the above-named gentlemen were to rear some 5,000 or 10,000 of fry, I believe they might give away every other ova their fisheries produced without missing it.

CHAPTER XIII.

OUR SEA FISHERIES.

IF our ignorance of the value of our inland fisheries is to be deplored, assuredly the ignorance which exists upon a matter so vital to us as our sea fisheries is ten times more deplorable. Situated as England is, where would she so naturally turn for a constant and unfailing supply of hardy sailors, in case of a great naval war, as to our fisheries? The importance of these aids to our naval power has always been clearly recognised until of late years. Formerly, so great a store was set by this source of supply, that the Government granted bounties in respect to the fish taken in our herring fisheries; and there can be no question that the system, in a national point of view, was a wise one, and worked well, and that the withdrawal of it has had an injurious effect upon this source of manning the navy.¹ Even as a matter of

¹ Strangely enough, just as we have given up the system of bounties, America and France—who is straining every nerve to create a great navy—has taken it up.

pounds, shillings, and pence, I cannot but think the country was a great gainer by it. In the first place, it induced a very large number of families to follow the business, and so fostered an important branch of industry. It threw a much larger supply of fish into the markets, and created exports instead of imports, as I shall take occasion to point out presently. It caused large numbers of our fishermen to occupy grounds now occupied for the most part by foreign fishermen, who thus improve their naval resources at the expense of ours. And lastly, but not leastly, it caused a great number of lads to be trained to the sea, and to become the best and hardiest of sailors, at no further expense to the country; whereas we have now to keep training-ships and training-schools, and naval reserves at a vast expense to the country, and propositions have been made for a naval militia; the lads thus trained being, for the most part, landsmen, instead of used to the sea from their cradles, while in such a fair-water, smooth-sailing way of making sailors, it is impossible but that an inferior article, to the handy, hard-a-weather set of men, who keep the sea in all weathers, for eight or nine months in the year, in small craft, by dint of sheer seamanship, must be turned out. Formerly Jack had a hard life of it; he roughed it

emphatically from youth up. He was a rough oak knob, that grew the harder the more he was knocked about ; and if he lived hard, he certainly died hard—harder, perhaps, than any mariner afloat, and that was his *specialité*. Now Jack has become an exotic. He is hand-reared and frame-reared, and has succession and forcing ships allotted to him ; is carefully manured and tenderly watered, instead of profusely grogged and backied, and there he stands in beautiful white ducks and blue shirts, all in a row, like pots of geraniums at a nurseryman's. Now, put training ships and schools in the one scale, and the bounty in the other ; consider carefully the materials produced by the two, and I think I may venture to reassert, that the system of bounties was a wise and, for us, a necessary one.¹

So little is the subject of our sea fisheries thought of or understood, that, save the persons actually engaged in them, no one knows or cares anything about it. Where the haddock comes from, which the modern Briton eats for his breakfast ; or whence the cod, that

¹ A commission is even now (August, 1864) inquiring into the state of our coast fisheries, and has been at work for several months. But from the proceedings of the commission hitherto, and the fact that the action of the Government for many years has not been favourable to our sea fisheries wherever it has interfered, I do not anticipate much benefit from its labours.

aids his Christmas dinner; or how the salt-fish is taken, which he keeps fast on in Lent: he knows and cares no more than he does to know whether there be fish or no in the rivers of the moon—possibly not so much. Yet is fish an article, not only of daily consumption, but almost hourly consumption: we eat it at every meal. For are not shrimps and prawns, and even at times the domestic bloater, comestible ornaments of the tea-table?—while who has not eaten pickled salmon for supper, yea, though the penalty be nightmare? This indifference can proceed from nothing but very general ignorance, and this ignorance makes the subject a difficult one to handle. Authorities, whence one may draw inspiration and wisdom, are fully as scarce as our knowledge. Fortunately, there are one or two gentlemen of knowledge and scientific attainments whom I can quote upon this subject; for the knowledge of the fishermen themselves is so beset with prejudice and inconclusiveness, that it would be worse than useless for my purpose. Mr. William Andrews, the President of the Natural History Society of Dublin, has written a good deal upon this subject, and has written it well, and with much and valuable experience.

Formerly, one of our most valuable fisheries was the Newfoundland Fishery. The quantities of cod

and ling which we got thence were enormous, while the Banks formed the best school for sailors we had. Let us see what Mr. Andrews has to say about Newfoundland. Quoting from a paper read by him before the Royal Society of Dublin, I find the following. Speaking to the same effect that I have, of the importance of our fisheries, as a school and training-ground for sailors, he says :—

“ In 1663, a document was issued by Charles the First, and directed to the Lord Treasurer and others, desiring them ‘to erect a common fishery for the nursery of seamen,’ which contained the first regulations for the governing of his Majesty’s subjects ‘inhabiting in Newfoundland, and trafficking in bays ;’ but from the earliest periods the policies pursued by the Government, especially the Board of Trade, tended much to weaken the position of the original settlers there, and to damp their energy and perseverance in extending the fisheries. The Act, however, of 10th and 11th of William and Mary, declares the fisheries of Newfoundland a beneficial trade to the kingdom, in the employment of a great number of seamen and ships, by the increase of her Majesty’s revenue, and the encouragement of trade and navigation. The same parliament came to a resolution, ‘That the fisheries and trade of Newfoundland do very much

promote navigation, increase seamen, and are of great profit to the nation.'

"In the reign of Elizabeth, there were 260 ships employed in the Newfoundland fisheries, and the seamen nursed in these fisheries mainly assisted in manning her fleets. Act 15th, George III. 'declares the fisheries the best nurseries for able and experienced seamen, always ready to man the royal navy when occasion may require; and it is of the greatest national importance to give all due encouragement to said fisheries.' In fact, from the British fisheries, Britain derived the principal means of defending herself; for it had been remarked that neglect and want of proper encouragement to our fisheries would much affect our commercial marine, and consequently our naval ascendancy.

The French saw these advantages to the naval power of Great Britain, and therefore, by every influence and exertion, endeavoured to obtain equal position and benefit. The French, therefore, spared no encouragement to stimulate their fisheries, gave bounties on the fish exported from Newfoundland, or from France to the French colonies. Bounties were also allowed on all men and boys sailing annually from France, and that were employed in the shore and bank fisheries of Newfoundland. On the other

hand, so discouraging had been the countenance of the Government to the British fisheries, that the capitals embarked in them were by degrees withdrawn, and the nurseries of seamen, so justly valued, almost entirely lost. They still more rapidly declined after the treaties of 1814 and 1818, when the greater and the most valuable parts of the Newfoundland fisheries were ceded to the French. The Americans zealously followed the example of France, supported their fisheries by bounties and other encouragements, and thus, concurrently with the French, sapped the foundation of the British fishery. The British fishermen, being unable to contend with the unequal competition, were left to languish and to deteriorate, being chiefly employed in the in-shore fisheries in small craft; while the French and the Americans prosecuted with vigour the deep-sea fishing on the great banks of Newfoundland—these Powers, it is stated, employing at least 1,000 vessels of considerable burthen, and manned with not less than 30,000 seamen.

“The valuable report, dated 2d October, 1848, addressed to the Vice-Admiral, the Earl of Dundonald, by Captain Granville G. Loch, R.N., upon the fisheries of Newfoundland and Labrador, when in command of her Majesty’s ship *Alarm* (an ominous name)

conveys most forcibly the state of the British fisheries, in comparison with the advantages possessed and maintained by the French. Captain Loch heard the French speak with pride of the sailors their bankers produced, and of the hardships and dangers they were exposed to in fishing on the banks, and that to deprive their country of these fisheries would be to lop off the right arm of her maritime strength."

A short article from the *Field* of the 14th of September, 1864, containing a paragraph cut from the *Times*, will give confirmatory evidence on this subject.

"FRANCE AND THE DEEP-SEA FISHERIES.

"We have frequently noticed the efforts which France has been making and is making to extend and increase her maritime power by industriously prosecuting and developing her fisheries. We have asserted again and again, that her activity in this respect is solely for the purpose of creating and maintaining a great navy. We have even told the tale of the Newfoundland treaty, showing how a British minister did, without scruple or hesitation, sign a treaty handing over to France the most valuable portion of these fisheries—fisheries, upon the discovery and working of which our navy first became formidable. In fact, it is to the fisheries of New-

foundland, lately so recklessly sought to be sacrificed, that we owe the fact of our having a great navy at all. We append an extract from the *Toronto Leader*, considered of sufficient interest by the *Times* for insertion, and certainly worthy of the consideration of all classes of Englishmen. It is also to be noticed that whereas the whole yearly produce obtained by our countrymen *now* from this source amounts to \$8,500,000, as far back as 1814 we realized something like \$15,000,000 per annum, or nearly double the amount realized now. France and America both pay heavy bounties for the prosecution of these fisheries. We pay our bounties, too, but in a different form; for we pay at least five times as much for manning ships, &c. in order to produce an inferior article.

“ ‘ There is no part of the British American coast where the fishery cannot be prosecuted with success; at Labrador, Newfoundland, Cape Breton, on the eastern shores of New Brunswick and Nova Scotia; at Prince Edward Island, the Magdalen Islands, Anticosti—everywhere it is the same. Though these fisheries thus surround the British American coast, they are extensively prosecuted by subjects of France and citizens of the United States. By Canada they are almost entirely neglected; a few years ago we

had not a solitary sail on these rich fishing-grounds. It is worthy of note that Canada is the only one of the provinces that offers a bounty for the encouragement of deep-sea fisheries, and that she is the only province that does not pursue this branch of industry to an extent worth mentioning. Distance has probably much to do with this anomalous state of things. Gaspé is the principal part of the province that borders directly on the fishery, and is for the most part unsettled. France and the United States both pursue the policy of giving bounties to encourage these fisheries. France pays 530,000f. to 540,000f. a year, averaging about \$68 to each man engaged in the fishery. This is an expensive process, *but it is alleged that it would cost twice as much to train an equal number of men for the navy in any other way.* In 1861 a French commission appointed to inquire into the deep sea-fisheries said in their report:—"It is on fisheries that at this day repose all the most serious hopes of our maritime enlistments," and it was added that "no other school can compare with this in preparing them so well, and in numbers so important, for the service of the navy." These bounties are also defended on the ground that the French pursue this fishery at a great disadvantage of distance, and from having no pos-

sessions in the neighbourhood except two rocky islets. The number of French seamen engaged in this fishery is under 12,000. From 1820 to 1851, the Americans paid \$8,000,000 in bounties on fish, and the same policy is still pursued. Without the aid of bounties the maritime provinces export beyond their own consumption of fish, the value of about eight millions and a half a year: Newfoundland (1862), \$3,760,010; Nova Scotia (1860), \$3,094,499; New Brunswick, \$750,000; Prince Edward Island, \$900,000; total, \$8,504,509. The figures for the two provinces which export the great bulk of the fish taken from the sea by British Americans, are from actual returns; those for New Brunswick are given, as an average estimate, in a prize essay published in that province in 1860; and for Prince Edward Island, are estimated from a return of 1857. The product of the French fisheries in our waters ought to be, according to the number of men they employ, about \$3,000,000 a year. If we add for the Americans an equal amount—for we cannot at this moment lay our hands on the figures—we shall have as the whole produce of those fisheries, over and above what is consumed in the maritime provinces, \$14,500,000 a year, of which, in spite of the adverse bounties against which she has to contend,

British America, without the aid of Canada, obtains \$8,500,000.' ”

I will add a few facts to show the value of this fishery. In 1517, the first English vessel that visited the coast of Newfoundland, found French, Spanish, and Portuguese engaged in the traffic. In 1615, England had 200 ships there, while the French, Biscayans, and Portuguese had 400. Many of these ships carried twenty guns, eighteen boats, and from ninety to a hundred men. In the early part of last century, the inhabitants of New England had about 1,200 tons of shipping employed in the whale-fishery ; and, with their vessels engaged in the cod-fishery, they caught upwards of 23,000 quintals of fish, worth 12s. per quintal, which they exported to Spain and the Mediterranean, and remitted the proceeds in payment for English manufactures. In 1745, the annual value of the North American fisheries was stated to be 982,000*l.*, or close upon a million a year; and this, of course, represents a far larger value in the present time than it did a hundred years ago. In 1787, the number of British vessels engaged was 402, employing 16,856 men, while, besides large quantities of fish, there were nearly 2,400 tons of oil exported. In 1814, the exports of fish and oil amounted to nearly 3,000,000*l.* The advantage to

this country, nationally, may be summed up in the words of De Witt: "That the English navy became formidable by the discovery of the inexpressibly rich fishery-ground of Newfoundland."¹

Now let us see what our paternal Government has been doing with this most valuable possession—3,000,000*l.* a year, and the maintenance of men enough for a couple of fleets. All the gold-mines in our possession cannot equal this, for they are exhaustible: properly worked, Newfoundland is inexhaustible. In 1857, a treaty was concluded between our Government and France, in which the British Government literally handed over the most valuable part of the Newfoundland fisheries to the French, granting to them the *exclusive right* of occupying large tracts on the coast, for the purpose of cleaning, packing, &c., with other rights of a judicial and

¹ The question of our fisheries in connexion with the question of manning our navy, is of far greater importance to us now than ever it was, since the alteration of maritime law by the Declaration of Paris places us in the position, that should we engage in a first-class naval war with France or with any other Powers, the whole of our shipping trade would and must pass over into the hands of neutrals, since who that could send their goods safely by neutrals would risk it in belligerents? If the trade goes of course the ships must go, for who will keep ships when there is nothing for them to do? The men also must of course follow, so that we cannot rely on our merchant seamen to supply the ravages of war made in our navy.

imperial nature. Now this treaty was at first a secret treaty, entered on without even the knowledge of the parties most concerned—the Nova Scotians themselves; and to give the treaty an air of fairness, a proviso was inserted in it to the effect, that if the treaty were refused by the Government of Nova Scotia, it should be void and of no effect. When the treaty became known to the inhabitants of Newfoundland, meetings were held, and great indignation expressed, as a matter of course. The treaty was indignantly repudiated by the Government, and delegates were appointed to proceed to England, and bring their case before Parliament. Upon hearing this, *Mr. Labouchere assured them, that as they repudiated the treaty it could not take place, and was therefore at an end.* The deputies consequently, relying upon the word of a member of the Government, did not prosecute their intention, but remained at home. Nevertheless, in spite of this, the French fishermen and authorities proceeded to act upon it, and riots and serious outbreaks occurred at St. John's; and when our Government was applied to for information, either the information was refused, or it was asserted that as the Nova Scotians refused the treaty, it did not exist. Still the French proceeded to act upon it, and gave a threatening notice to the inhabitants of

St. George's Bay to quit their rights, and to cease to use the shores as they had always been accustomed to—a notice equivalent to confiscating their property. The President of the Chamber of Commerce then wrote to the British Commandant on that station, Sir Houston Stewart, complaining of these encroachments, and he replied, that “The interpretation of treaties must be left to the Imperial Government;” and thus the matter stands,—the treaty not being definitely declared void, but being left to create bad blood upon all sides, a cause of quarrel at a future day, and a status on which to claim the whole of this valuable property, whenever a favourable opportunity may occur for doing so.

It may be urged that a work of this nature is hardly the right place to rake up treaties and matters of Government; but if these things affect the well-being or cause the depression of our fisheries, I would ask—how is it possible to consider in what way our fisheries may be improved, and yet to ignore the chief causes of their failure? I know that these subjects are not popular studies, and that the merest *ad captandum* account is too often accepted by Englishmen, instead of a searching inquiry into the facts being exercised; and it is owing to such carelessness that bad laws, or treaties injurious to our

interests, are made and suffered to pass unquestioned, or, at least, unaltered when they are made; consequently, as I have said, it is very much from the bad laws made by Government, or the want of that protection which they should receive from the Government, that the unsatisfactory state of our fisheries for the most part proceeds. We may be told that like other disastrous matters which have occurred to us of late years, this treaty was a mistake, an oversight, a want of judgment; but people who make mistakes equal to 3,000,000*l.* a year are rather dangerous people to be allowed to negotiate treaties; and why should we, for no equivalent, give away our own countrymen's property to the French, particularly a property which alone can enable them to become our rivals in the mastery of the sea?

In speaking further of the depression of the Irish fisheries, Mr. Andrews says that the quantity of salt-fish imported into Ireland yearly amounts to 1,200 tons, valued at 27,000*l.*; the annual import of herrings to about 80,000 barrels, valued at 128,000*l.*; and this, too, at a time when the fisheries around the Irish coasts are not only far more than equal to any demand that can be made upon them, but, properly worked, would also be inexhaustible. Mr. Andrews, in his voyages from port to port and place to place in

pursuit of knowledge on fishery matters, frequently mentions the fact of seeing immense shoals of pilchards and herrings weeks before they could be attempted to be taken by the fishermen, owing to the fact of the smallness of their boats, and insufficiency of their gear. He mentions other cases of foreign craft loading with fine fish off the coast in a few days, and sailing for their respective ports; while there was not a craft on the coast that could come into competition with them, and the natives could but look on while the foreigner filled his pockets with what should have been their wealth, if they only possessed the means to take it. This, as Mr. Andrews points out, is from the poverty of the inhabitants and *the absence of encouragement*.¹ I will again quote from his excellent paper:—

“The men of Skerries and of Rush, who once followed annually the deep-sea fishery (and when the bounty was given, large quantities of ling and cod were brought home and cured at Rush), still inherit the desire to make their north-west cruises. In 1853 this spirit stimulated them to fit out four vessels for Iceland; but not having good information when on

¹ With our existence depending on our resources as a naval power, and, if possible, upon our exclusive possession of those resources, it is but reasonable to ask that some means of encouraging the prosecution of these valuable fisheries should be found.

the grounds, and being late in arriving there, they were not successful. French vessels had made good their fishing before the Skerries boats were prepared. In 1855, three vessels were again fitted at Skerries, averaging fifty tons each, with a crew of eight men and a boy. The vessels had equal success. The first that returned had 21,000 cod, with a large quantity of oil. The weather on the fishing-grounds was changeable and foggy, with heavy swells. They left in April, and were twenty-one days going out; and returned in August, nine days coming home. If the weather had been favourable in the commencement, they might have completed their cargoes in two months. This is the way to make fishermen, and to form seamen. The poverty of the men at Dingle and other places on the west and south-west coasts make them able only to fit out canoes, to the almost extinction of the sprit-boat and the hooker. The consequence is that the herring-fishery is much on the decline. And what can this wretched system avail, with their few hundred fathoms of spilliard line and the sceltane of hooks, on those abundant fishing-grounds? It is not that they are unequal as seamen and fishermen, but it is their poverty, *and the absence of all encouragement to fisheries*. Compare this with the vessels that fish the coast of Iceland,

Norway, the Orkneys, and the Well-bank, the Dogger-bank, and the Broad Forties—vessels ably manned, well found, and with twelve miles of lines, who fish the Dogger-bank in the North Sea, 150 miles from land, remaining months on the ground at anchor or hove-to, weathering heavy seas and heavy gales. A fine vessel I saw at Greenwich, of sixty-six tons, had eleven miles of long lines, with hand-lines and nets, had ample stowage between decks for salt and curing fish, and could bring alive in her well 2,000 cod-fish.

“ When Government aid and protection were given to our Newfoundland and Labrador fisheries, we had vessels of from 250 to 400 tons working throughout four months of the year on the great banks, in dense fogs, and a perpetual and heavy swell. These employed a large number of seamen—they remained at anchor on the banks, veering out 120 fathoms of cable, and sometimes in heavy weather having 200 fathoms of cable on end. In gales they weighed and hove-to. Since the withdrawal of all encouragement, the trade is principally carried on, in the in-shore fisheries, by boats of from nine to fifteen tons. The encouragement given by the French Government of several millions of francs a year to the Newfoundland fishery, enables the French to keep on the banks vessels of

300 tons, manned by at least forty men in each, and found with seven to nine heavy anchors, and upwards of 800 fathoms of hemp cables. These vessels have each four to five large boats, that can stand heavy weather, lines that cover a great extent of ground, and numerous nets and fishing tackle; 17,000 to 20,000 of these men return to France every winter, and are ready to serve the imperial marine. *The bounties given by France are not for the advancement of trade, but to create a navy!*

“In October, 1857, it was stated that Sir G. B. Pechell, M.P., intended to bring under the consideration of Parliament, in the approaching session, the whole question of the fisheries of France. Within a few days of that month, twenty-one vessels had arrived at Marseilles with 2,357,000 kilogrammes of cod-fish.”

Companies have been tried at times, but being in bad and non-practical hands, they have proved failures, and this has greatly discouraged any others from making the attempt.

The most valuable fish which visits our coasts is, unquestionably, the Herring. In Scotland, where the fishery is very extensive, there are said to be something like 70,000 persons engaged in fishing and curing, and 11,000 vessels of all sizes.

To show further the magnitude of the interests involved in our fisheries, I may state that, according to the report of the Commissioners, in spite of the great depression existing in Ireland in 1860, there were no less than 53,714 men, 3,384 boys, and 14,182 vessels of all sizes, more or less engaged in fishing of various kinds. The boats of course, as has been previously pointed out, are, for the most part, small craft, and far from as efficient as they might be, while the number of boys engaged appears to have fallen off from the year previous, which cannot but be looked on as a bad sign. I have no means of estimating the number of men and vessels engaged in England, but they must be considerable, as the fisheries on our north-west and south-east coasts are of great extent and importance. But one firm alone, the Messrs. Hewett, of Barking, maintain at sea a fleet of fishing vessels averaging 80 or 90 tons each in burthen, manned by splendid crews; with a supplementary fleet of cutters to attend on them and carry the fish, of 115 tons each. To give some idea of the extent of their operations, they employ 10,000 tons of ice annually. The firm having been in existence within a year or two of a century, is now about to be merged into a Joint Stock Company, in order largely to increase its operations and efficiency.

These figures will serve to show the reader the magnitude of the interests already involved, and it cannot be doubted but, by judicious management, they might be vastly increased.

Now, whether the management the fisheries meet with be judicious or no, I leave the reader to judge. In Scotland a Board exists for the protection of the herring-fishery. Let us see what the fishmongers of Scotland, whose living is, to an extent, dependent on the breath of this Board, have to say to it. The following extract is taken from the speech of the chairman at the Glasgow fish-merchants' annual dinner:—

“But, while I speak of herrings, I cannot allow this opportunity to pass without condemning a Board which has for its object the protection of the herrings. The Fishery Board was instituted at the beginning of this century, when all Europe was at war, and when the difficulty of manning the navy was much felt. A bounty of four shillings a barrel was paid the fishermen for every barrel of herrings cured; and in 1821 the board disbursed 72,000*l.* for that object, which, with expenses, (12,000*l.*), make 84,000*l.* as a bounty, or rather, I should say, as a bribe, for men to become sailors. Since 1830, the Government bounty has been withdrawn, and the operations of the

Board have virtually ceased ; but in courtesy to the Honorary Commissioners, it has been allowed to exist. So great has been the demand for fresh fish, and so inactive has become the Board of Fisheries, that the fishermen openly violate the laws by the use of illegal nets, at the risk of all consequences. You are all aware that last summer a bill for the better protection of the herring fisheries was brought into Parliament by the Lord Advocate and the Board of Fisheries, without any one practically connected with the trade being consulted on the subject. The then existing law, which was never enforced, prohibited trawling, and the use of any other net than the regular inch mesh. The present bill was nothing more than a thirty years' bill of indemnity to the Fishery Board for the improper violation of all Acts, and handing them over the full control of the fisheries to do with as they pleased. In fact, the Lord Advocate and the Fishery Board did not object to the system of trawling, while the trade and public were strongly against it. Upon this point a committee in Glasgow was appointed to oppose the bill in Parliament ; and thanks to the able advocacy of our Scotch members for making the present bill what it is, the title only of which is due to the Lord Advocate. The new bill, prohibiting trawling and enacting a close-time

from the 1st of January to the 31st of May, has now been in operation several months, *and you all well know with what perfect indifference the Fishery Board has put the law in force. Trawling has gone on to a greater extent than ever.* Two of her Majesty's war-steamers are said to be continually in Loch Fyne and the Lochs, but we seldom hear of these vessels being far from Rothesay. The Fishery Board is either unable or unwilling to put the Act in force; for I cannot believe but that the two steamers now stationed on the west coast could have put down trawling in a week's time if they had had the commands to do so."

Such is the evidence publicly offered by practical men, whose living depends upon the fishery. As regards the Board, I should by no means wish to see it done away with, as some of its functions are of a most useful and valuable nature. For example, before a cask of herrings is finally closed, an officer is appointed to examine it, to see that no unfit fish are packed away in it. Having ascertained this, he sees the cask headed, and affixes the Government brand to it; and so excellent has been the effect of this system, and so great is the reliance placed in that Government brand, that barrels of English herrings, thus marked, are taken without question or hesitation by merchants, even in the uttermost parts

of Siberia, as readily as though they were hard cash. It is needless to say that the doing away with the brand, and abolition of this supervision, which has existed for so long a series of years beneficially, would not only open the way to frauds of all kinds, but the very change of system would shake the faith of these distant merchants, and would create suspicion, and would in a short time destroy both our position and our trade. I mention these points, as it has been proposed to abolish the brand.

Very *à propos* to this subject we have a review from the pen of Mr. Lowe, in the *Field* of September 24th, which gives further insight into the "brand" question, and, singularly enough, shows the exceeding value of it in the many attempts made to remove it. The work under review is "*The Herring; its Natural History and National Importance.* By John M. Mitchell. With Illustrations. Edinburgh: Edmonston and Douglass. London: Longman, Green, Roberts and Green." The origin of the work was a medal offered by the Royal Scottish Society of Arts for the best essay "On the Natural History of the Herring, considered in connexion with its Visits on the Scottish Coasts." And admirably indeed has Mr. Mitchell fulfilled his task. I extract the following passages from the review referred to:—

“The Fishery Board was established in 1808 for the inspection and protection of the herring fishery; and there can be no doubt that the most beneficial results have been produced by its labours. In that year the total amount of the fishery was expressed by 90,185 barrels; in 1855 it amounted to 897,462 barrels. Mr. Mitchell gives the particulars of this extraordinary development in detail, and he attributes it mainly to the protection which the Legislature has afforded to the fishery, and the security which the affixing of Government brands gives to the export trade. ‘That there was an abundance of herrings on the Scottish coasts was known for centuries past; but when considerable quantities of them appeared, they were of little remunerative value when caught, because the demand was limited to the mere local consumption. Before the specific and legalized size and quality of the manufactured article—the barrel of well-cured herrings—could be obtained as goods for commercial purposes, a merchant abroad could not buy herrings in Scotland, there having been no legal distinct specific form and quality. The curer might say, “My barrels are of every size and various in quality and price;” but the foreigner could not order or buy such goods, and he therefore bought herrings which were of

legalized size and good quality, elsewhere ; and, although he paid a high price, he obtained what he wished in Holland and other countries, and these countries are ready to supply any quantity if Scotland should be unable to do so.'

"The practice of affixing the Government brand is one about which there has been an enormous amount of controversy. The opponents of the practice maintain that it prevents the free exercise of the law of competition by reducing the manufactured article to a dead-level of value, and that, as the Government brand is affixed to all cured fish which can be shown to have reached a certain level of excellence, there is no room left for the introduction of improved processes of preparation. On the other hand, the supporters of the brand allege that its imposition secures that uniform quality and price which render the article marketable all over the world ; that the maxim '*Caveat emptor*' may be a very sound one to apply in all branches of commerce where the purchaser has an opportunity of using his judgment as to the quality of the goods ; but cannot apply in the case of preserved provisions, where bulk cannot be broken, and the dishonest curer has such immense opportunities of practising his rogueries for a long time undetected and with such fatal

effect. Our readers will scarcely need to be reminded of the disastrous results which this particular form of swindling brought about in the Crimea.

“For many years past there has been a constant endeavour in the House of Commons to upset this branding system, and various members (prompted thereto, no doubt, by individual curers) have returned to the charge, sometimes not only in hope of discontinuing the brand, but of abolishing all superintendence whatever. Greatly as we dislike Government interference with individual industries, we heartily hope that these attempts, if repeated in the future, will be as unsuccessful as they have hitherto been. In 1849, the Right Hon. J. G. S. Lefevre,¹ having been commissioned to inquire into the matter, presented a very elaborate and interesting report, in which he seems to have exhausted the whole question. Mr. Lefevre went into the matter thoroughly, and after expressing a strong opinion that ‘the system of authenticating the quality of goods by the agency of a Government officer is objectionable in principle,’ he goes on to declare that, ‘as respects the foreign trade, which is sufficiently large to be an

¹ Mr. Lefevre is one of the members of the present commission, and it is to be hoped he will not see fit to recant opinions so ably and clearly expressed.

object of the highest importance to Scotland, the branding system formed so essential a part of its arrangements, its abandonment might cause such a derangement and contraction of that trade, and consequent loss and inconvenience to those engaged in it, and to the large bodies of the working classes employed, not only in fishing, but in the various operations of curing for the European market, *that he felt compelled*, notwithstanding the objection in principle to which it is liable, to recommend that it should still be maintained, and, as a necessary consequence, that the establishment of the East Coast fishery officers should be continued.'

"In spite of this strong expression of opinion by this able commissioner, the question was once more mooted in 1856, and a fresh commission of inquiry was appointed by the House of Commons, this time consisting of Bonamy Price, Esq., F. St. John, Esq. and Capt. Sullivan. The first-named two commissioners gave their opinion strongly in favour of the branding system, adducing reasons which appear to us to be of unanswerable cogency ; the third commissioner dissented, his reasons being, mainly, that it prevented a better system of cure, and that every trade should be 'allowed to stand on its own merits alone.' No attempt, however, was made to show

that any better system of cure was either desirable or practicable, and the general proposition was left in that form of indefinite vagueness which such propositions always assume. Considering the course of modern legislature with regard to our fisheries, the disposition of those individual members of the House of Commons who ride hobbies of this kind, and the practice which the superior members of the Government have adopted of purchasing the support of such members by allowing them their own way in these matters (erroneously supposed to be *minor* matters); remembering what has been done in Scotland by over-legislating the salmon-rivers, and the disposition which was evinced last session to allow the foolish cry for cheap oysters to be made a pretext for destroying our most important coast fisheries, we must admit that we look upon these attempts to interfere with the prosperity of the Scottish herring-fishery with the greatest alarm. We have no need of the testimony of Baron Cuvier to assure us that in the herring-fishery will be found the best nursery of 'robust sailors, intrepid mariners, and experienced navigators.' Indeed, we will go the extent of saying, that the abolition of the branding system, added to a few legislative measures like the Herne Bay Oyster Bill, must have the inevitable

effect of drying up the sources of supply to that navy which has hitherto kept the trident of England unconquered upon the seas."

Yet, in the teeth of such overwhelming evidence as this, it is greatly to be feared that the present commission bodes no good to the brand or the herring fisheries.

During the last session but one of Parliament,¹ the Board obtained the power from the Government to suspend any of the clauses in the Act at its own pleasure. In January, 1861, the clause prohibiting trawling with small-meshed nets was suspended, under the pretence of allowing the fishermen to catch sprats or garvies, and the result was that, on the first morning on which this wholesome restriction was thus openly removed by the Board, four fishing-boats brought in, and sold as sprats, above 400,000 herring-fry. Had these fry been permitted to live a few months, they would have become herrings, and have been worth (setting the herrings at the rate of two a penny), between 800*l.* and 900*l.*—as sprats they would not, probably, fetch as many farthings; but if this be the destruction of one night, what must be the havoc in a whole season? Will it

¹ Written in 1863.

not be a marvel of marvels if there be any herrings left in a few years' time?

A commission was appointed to inquire into this special subject. The conclusions come to by this commission were singular. It recommended that close-time should be abolished, in order that fishermen might supply themselves with bait, and that trawling¹ should be legalized, because it benefited the public. Now, a very moderate supply of herrings would answer for all bait purposes, and some measure very far short of the actual abolition of close-time might surely have been recommended. Again, trawling is carried on in small in-shore row-boats, and can be followed by tinkers and tailors, and anything, indeed, but sailors. It throws large gluts upon the markets at times, but to counter-balance this, if trawling were the only means of supply, we should either be overdone with herrings or have none. If trawling be legalized, the drift-fishing, which always ensures a steady, regular, and ample supply, must die out before it, because during one-half of their season they must fish at a loss.

¹ This kind of trawling should be called "seining," to distinguish it from trawling proper, or beam-trawling, as it is now termed. There is no similarity whatever in the two processes. The net used is not a trawl, but a sein.

The result will be, that the small capitalist who owns large smacks and is the backbone of our fishing system, will be ruined; the fishermen themselves, will find their trade invaded by a lot of 'long-shore men, who are not sailors, and who follow other occupations when the herrings are not about, and instead of the fine smacks which make good sailors and the steady markets we have now, we shall have great rises and great falls, gluts alternating with scarcity, and the trade carried on by small in-shore boats, which do not make sailors. To sum up the recommendations: the one will destroy the herrings, and the other will, at the same time, ruin the home trade; while the abolition of the brand will, as before shown, ruin the foreign trade. This will be a fitting pendant to our Newfoundland policy.

There is an old motto which says "Let well enough alone;" but it seems impossible for us to "Let well enough alone," for we have a mania for trying our hands at tinkering. We are wretchedly unskilful, or *exceedingly skilful* tinkers; for, either by accident or design, we always contrive in stopping one small crack to make a dozen large holes.

It has been stated by able ichthyologists that sprats are not the young of the herring, some difference existing in the position of the fins, and the

belly of the one being serrated while the other is smooth; even Yarrell places much weight upon this point, but the fact is, that the bellies of both are strongly serrated. A writer of an article in the *Cornhill Magazine*, some time since, stated that, from experiments he had made, he found that this latter peculiarity left the fish as it grew older, or towards herringhood, and he asserted that the sprat was neither more nor less than the herring-fry. But it is clear to me that the writer of the article in question could never have seen the two fish together so as to compare them, or he would certainly never have advanced such a theory. That the serrated belly leaves the fish as it grows older, is perfectly true, for the herring does not sensibly possess it; but it requires only the most cursory examination to decide that the sprat and the herring-fry are totally distinct. A child might easily distinguish them, so different are the two fish in shape and general appearance. The sprat is more ovate and less elongated than the herring, and is altogether a more delicately shaped fish. The herring is more elongated, and has a larger, more awkward, and angular head. The head of the herring, and particularly in the fry state, always appears full large for it, which the head of the sprat does not. Nevertheless, I have no doubt

that the fry of herring, as well as of pilchard, are largely taken and sold as sprats; the latter fish, being also taken in vast quantities by the French, and packed and sold as sardines. The sardines being but young pilchards, this must of course seriously affect the pilchard supply. But a further damage is done; for the only bait that will tempt the sardines appears to be cod roe, of which immense quantities are bought from Norwegian fishermen, who carry on a large trade in it, and prolific as the cod is, the destruction must be considerable.

Other nations by no means share in our apathy as regards the interests of *their* fisheries. Witness the three nights' discussion in the French Parliament of matters affecting their fishings, and the expensive missions sent out by the French *Société d'Acclimation* to Norway and elsewhere, as well as that of Monsieur Coumes to England, to collect facts concerning the fisheries. Witness the astuteness and attention of the Dutch towards them; and it certainly seems anomalous to find such little care taken by us of interests of a tenfold larger extent.

One of the worst evils which our fisheries all around the coast suffer from is from small-meshed trawl-nets which are allowed to trawl close inshore, where the fry of all kinds of fish betake themselves for safety.

Worked in such places, the small trawls destroy the fry of all the fish that inhabit our coasts to an extent which cannot be calculated, and, if it could, would be so incredible that few would be found who would believe it. But to give a slight notion of what can be done, I may state that from the small poke-net of a common shrimper on the Sussex coast I have seen, at almost every emptying of the net, as many as from ten or a dozen to forty or fifty of the fry of soles, turbot, plaice, or flounders, of from an inch and a half to two inches in length. There would be, perhaps, a score of these nets at work within sight at the same time, and at the lowest computation they would be emptied two score of times a day. Some of them gather their shrimps while standing in the water, and allow the rubbish and fry to fall back into it; but many more empty their nets on the shore, and cast the fry on the beach.

It is not easy to compute the mischief which even these fishers in a small way do. But the small-meshed trawl-nets are wholesale destroyers, and should not be allowed to be worked under a set depth of water; as they cannot save the fry, which are smothered in the mass of weed which the net collects, while the good fish they take are inconsiderable, and the prawns, for which they are chiefly

worked, can be taken in the pots constructed for the purpose, and which do no mischief.¹ The remedy here is plainly to prohibit trawling in shallow water, to place a penalty upon the destruction of fry, to appoint a fence-time, and to empower the coast-guard to enforce it. There is no other method, and the coastguard, as regards smuggling, have now really very little to do which is worth their employment ; whereas in the protecting of our fisheries, and seeing that the proper regulations as regards the machinery, fence-times, &c. be enforced, they would render most valuable assistance, and they are to a small extent

¹ I will instance further one case which has lately come under my notice. On the coast of Suffolk, about the town of Aldeburgh, there were formerly large quantities of codling, whiting, flounders, and many other fish. These were so abundant, that it was only necessary to cast a line into the sea from off the beach, when a good take of these and other fish could be made ; while a long line, with a hundred or two of hooks, set at some distance from the shore, would well repay the fisherman for his trouble. Visitors came to the spot as a convenient watering-place, and the fishermen in the summer-time found that, by using their small trawls for shrimps, they could earn a trifling remuneration with very little trouble. These trawls were accordingly used, in two or three fathoms of water, on the banks where the fish naturally came to spawn ; and the result of the persistence in this species of fishing has been, that the fish have in a great measure been driven from the spot, and line-fishing there is now not worth the trouble of prosecuting. There are many other places along the coast where the same result has ensued from a similar practice.

already occupied in this matter. The size of all fish which it is permissible to take is laid down in the Act of the 1st of Geo. I.; and under the sizes there determined it should not be permissible either to take fish, or to sell them, or have them in possession.

In looking further into the papers written by Mr. Andrews upon the Irish fisheries, I find a vast deal of valuable information in respect to trawling. This information, I regret to say, is too extended and diffuse to be given here; but I gather from it that, owing to the want of proper boats and gear, and the ignorance of the proper soundings and localities, vast ranges of most valuable trawling-ground upon the Irish coasts are utterly unproductive. And another cause has contributed to render some of them comparatively so—viz. that boundaries were set by the Fishery Board, where trawling was prohibited, upon some of the very best and most productive spots, owing to the ignorant and jealous prejudice evinced by some of the small-boat fishermen, who could not prosecute anything but the most meagre form of line and net fishing.

In some places, as at Dingle for example, Mr. Andrews had succeeded in establishing very remunerative fisheries, in which hundreds of men and

boys obtained an excellent livelihood. The mode of fishing was greatly improved; craft of a superior size and better gear introduced; and the number of fishermen and boys was increasing rapidly, when jealous clamour was raised by some ten or a dozen half-fishermen — half-farmers, and the consequence was, that they got the trawling prohibited on the best grounds, leaving only the rocky and foul ground, where it could not be prosecuted. I believe, however, that very lately some modification of this state of things was introduced by the Board; but a serious blow had been dealt to the prosperity of the fisheries and the fishermen, which they will take years to recover from. In Galway Bay, the same outcry was raised by the Claddagh men but lately, because better and larger boats than they possessed were trawling in the bay. In such cases, it is requisite that the Board should use the utmost discrimination in the rules and boundaries which they lay down, as well as in taking evidence upon all such matters.

It cannot be doubted, from the evidence afforded in the able papers so often referred to, that the Irish fisheries are capable of improvement to an extent now hardly dreamt of, and that a mine of wealth, sufficient to maintain the peasantry in afflu-

ence all round the coasts of Ireland, lies almost at their doors, now, comparatively speaking, unworked and unproductive.

A great outcry has of late years been raised against the system of beam-trawling, pursued around our coasts. It is stated that it destroys line-fishing, and ought, therefore, to be prohibited altogether. There is some little truth in this, mixed up with a great deal of error. To show how indiscriminate error is in this matter, one of the chief assertions has been that the lead lines of the trawl-net sweeping over the bottom destroy the spawn of fish by detaching it from the ground. That some spawn is destroyed by such trawlers I have no doubt, but that the spawn is destroyed by being detached is untrue, because during some experiments tried for the Scotch Commission, it was proved by demonstration that spawn thus detached could be hatched without any difficulty, and consequently, if the spawn thus brought up were returned to the water, comparatively little harm would be done. Still harm is done, and this might be easily avoided by the prohibition of trawling during the time when spawn is deposited on the banks, or it might be prohibited under a certain depth of water; for fish always seek the shallow banks on which to deposit

their spawn. These banks are seldom in water of more than ten or twelve fathoms' depth, and might, therefore, be protected ; whereas, the majority of the trawling which supplies our markets with their constant and unfailing supply of splendid fish, is carried on in water of twice or three times that depth, where no harm whatever can be done, as fish are only caught at such depths when in the highest season and condition. To prohibit trawling in these places, would be to destroy an immense branch of most profitable industry, and to hand the supply of our fish-markets over to foreigners, Frenchmen and Dutchmen, whose operations we should be entirely powerless to check, as this branch of fishing is, for the most part, carried on far beyond three miles from our coasts, and consequently where, over foreigners, we should have no jurisdiction. Any such enactment would not stop trawling for one moment. It would simply extinguish our own trawling fleets, which employ very many thousands of the best sailors in the world, who keep the sea in the finest fishing-boats that float, for five or six months at a time without ever seeing the land. That trawling should be prohibited in shallow water, or, if it be thought necessary, within, let us say, the three miles of the shore over which we have jurisdiction, might

possibly be beneficial in the long run, though in many places it would be a very great and needless hardship. It would be far better if we strove to arrive at something like a definite idea of the spawning grounds, and the times when they were used by the fish, and to prohibit any interference with them. This, I think, is all that is really desirable, and all that any one has a right to require of us.

But there is another circumstance, besides the wasteful destruction of small fish, which is gradually but surely affecting our coast fisheries. Wherever mining operations are carried on, the rivers and brooks are first poisoned by them and all the fish killed; and the poisoned water in turn, emptying itself into the sea, carries down very strong deposits, which in time, being driven about and dispersed by the waves, has the effect of driving the fish off the coast. One instance of this, out of many, I will particularize. At Aberystwith, two rivers carry down from the lead mines strong poisonous deposits. Twenty or thirty years ago, before the mines were opened, the rivers abounded in fish, and the sea-coast adjacent was abundantly supplied with many kinds of sea-fish. Within the time specified, however, they have almost entirely disappeared for some miles above and below this place, though plentiful enough

beyond this limit. At times, it is true that mackerel, dog-fish, &c. are caught there; but these are principally *mid-water fish*, and it is the ground-feeding fish that are mainly affected by these poisonous deposits.

There is one other fact in connexion with our sea fisheries that I must touch upon, and that is, the permitted infringement of our lawful boundaries, secured to us by treaty, on the part of French and Dutch fishing-boats. I have previously noted the action of the Government upon our fisheries in Newfoundland, but here we have a specimen of its inaction upon our own coasts. To such lengths has the supineness of our cruisers and the boundless impertinence of these fishermen carried them, that they have landed at our fishing villages by hundreds at a time and caused serious riots; while as regards the fishing upon our grounds, it has been practised to a very great extent indeed—fleets of French and Dutch boats taking the living out of the mouths of our poor fishermen, and often sailing through their nets and destroying their gear, regardless of the consequences, or the destruction they caused.

I was not satisfied with reports of these matters; but being in Northumberland during the herring season of 1861, I went to Bamburgh and North Sunderland, where these occurrences were taking

place, and saw and inquired for myself, and consequently am able to give tolerably correct evidence of the facts. The French boats were in the habit of coming in and fishing within a mile of the shore, though the treaty limits are three miles. The French boats had occasioned a good deal of damage and mischief to our boats, and it was not until a great outcry had been made by the press that active measures were taken against the foreigners, when a few of them were summoned and fined in small amounts.¹

Now, it cannot for a moment be doubted but that the slightest hint from the Admiralty, or the department of the government under which the cruisers are placed, as to the necessity of a little activity in putting down these irregularities, would result in their instant suppression. It avails nothing to say that the cruiser was away on other duty—here, or there, or anywhere—when these things occurred, and therefore did not see them. If one cruiser is not

¹ One or two of the French boats were summoned and fined trifling amounts during the past season, but the fines are far too light to arrest the practice. The natural consequence has been that affrays have taken place between the French and English fishing-boats, and life has been sacrificed; and we can hardly wonder at the men, if they are thus left to themselves, taking the law into their own hands.

equal to the work, surely we are rich enough to support two or three, or half-a-dozen if it be necessary ! These things should cease, or, rather, should never have occurred : it is an affront put upon us, and a robbery upon our citizens—for a fisherman, like any one else, pays his taxes that he may be protected and enjoy the rights of a British subject ; and for foreign fishing-boats to venture upon such an impertinence on our own shores, again and again, may well cause us to doubt whether Britannia really does rule the waves.

Some years since, my father, the late Captain John Morgan, R.N., had charge of the interests of our oyster fisheries at Jersey for a period of nine years ; and I have often heard him say, that if any of our boats happened to infringe the boundary, which would occur at times, the French cutters used to come down upon them and fire a shot at the boats, and on one or two occasions they killed some of our fishermen by so doing. What the practice has been lately will be shown by the following letter, extracted from the *Field* :—

“ FRENCH ENCROACHMENTS ON ENGLISH FISHING-
GROUNDS.

“ SIR,—I was glad to see the observations on this subject in your impression of the 13th ult. The

depredations committed on our fisheries on the north-east coast, by the powerful and strongly-manned luggers of the French fishermen, have become so systematic and extensive of late years, and have been so habitually winked at by the naval authorities, whose duty it is to repress them, that our own fishermen have suffered severely in consequence.

“It is not, however, by the infliction of paltry penalties of 5*l.* each that they are to be deterred from such malpractices : one night’s successful fishing on our banks would more than amply reimburse them in that amount, to say nothing of the chance—which is fifty to one in their favour—of escaping unmolested. I was at Dieppe during the spring of last year, when the avisos *Corse* and *Pelican*, charged with the protection of the fisheries on that station, were daily bringing in English fishing-craft which they had captured ; and there were at one time lying in the harbour no less than seventeen Colchester trawling-smacks, which had been seized for trespassing on the French oyster-beds. They lay in a line along the whole of one side of the inner harbour, and their clean lines and taut smart rig presented a striking contrast to the ugly, lumbering luggers and sloops of the Poletais fishermen.

“These poor fellows were kept there in custody for

ten days or a fortnight, and then only dismissed after taking from them their trawl-ropes, trawls, and all superfluous lines and rigging, to the value of 30% or 40% from each boat—leaving them, in fact, just what was necessary for them to find their way home with, and no more. I don't mean to defend them: they admitted that they were acting illegally, and with a full knowledge of the penalty they incurred; but one of them said to me, 'It's hard enough work for us to earn our grub, sir, with only three men and a boy on board, while a French craft the same size carries eight men and four boys, with half their wages paid by their government, and a bounty on all the fish they bring in besides, and fishes in our grounds when and where they likes;' and hard enough I thought it. At all events, what is sauce for English is sauce for French fishermen.

"I presume the usage of confiscating tackle and implements is warranted by the international fishery-treaties, or the French authorities would not practise or our Consul at Dieppe permit it. Our fisheries are very inadequately protected, and these regulations are not enforced by the officers in charge of them with the same strictness as on the other side of the Channel. Surely, our gunboats would be better employed in this duty than lying in the Medway until their

bottoms are so encrusted with oysters that they have to be dubbed off with shipwrights' adzes! (*Vide* the *Times* of the 24th.) If, however, on the rare occasions when French craft are caught in the fact, our north-country magistrates would mete out the same justice to them, by impounding all their nets and spare tackle, it would necessitate their going home to refit, and prevent their trespassing on our grounds, for that season's fishing at all events.

“ J. WICKEY.”

I need not comment upon the above letter further than to say, that I believe that such treatment of our fishermen is entirely illegal and not justified by any treaty whatever, and is an arbitrary exercise of power which, were such a thing attempted towards a French boat, would produce correspondence and diplomatic uproar. To show how productive of mischief the laxity and supineness of our cruisers is, I may mention that, a short time since, an affray ensued between one of our Ramsgate fishing-boats and a French boat, in which one of the Frenchmen lost his life; and the case is, I believe, still pending for inquiry.

In considering our sea fisheries, the formation and protection of oyster-beds is a subject which ought to receive the special attention which so delicious and

valuable an edible deserves. In England, in certain favoured localities, as the eastern coast, companies have had the cultivation of oysters in hand, and are making very handsome revenues from supplying the markets ; but they are few, compared with the wide fields which are open to such cultivation. In Ireland, the attention of many gentlemen has been particularly turned to this product ; and during the year 1860, seventeen gentlemen had obtained licences for the planting of artificial oyster-beds on various parts of the coasts. A suitable locality having been chosen and obtained, the cost of planting and preserving an oyster-bed is small when contrasted with the enormous profits reaped from it, and the subject is well worth the more general attention of proprietors by estuaries, sea lochs, and such localities as are favourable for the planting of oyster-beds. The French are largely engaged in ostreaculture. The only bit of legislation which has been perpetrated by our Government in respect to this practice here, has been a very unjust and undesirable one. The case of the Herne Bay Oyster Company has been so well and fully placed before the public, that I need scarcely enter on it at length here. The facts are simple : a private company, whose prospectus was a very remarkable and unusual one, applied to Par-

liament to grant them, without any payment or consideration whatever, about nine square miles of the estuary of the Thames near Herne Bay, in which to breed oysters—a bill having been previously applied for *to convert Herne Bay into a port*, and refused. The bill next applied for contained all the powers necessary for converting Herne Bay into a port; but a flavour of oysters was imparted to the scheme to render it palatable to Parliament. Before the committee, however, it was shown that an industry equal to more than it was proposed to expend *as actual oyster capital* on the fishing ground was already *yearly* reaped from it by hundreds of poor fishermen. It was demonstrated from specimens that the ground was useless for the purpose it was intended for, as it would not grow oysters. The oysters were wretched things, very small, about an inch thick, and nearly spherical in form, containing the smallest possible modicum of flesh. The thickness of the shell evidenced great age. I should incline to the idea that the strong tides which run over the banks have much to do with this unfavourable development, by keeping the oysters constantly on the move. Beyond this, it was shown that hundreds of families would be ruined if the flats were granted away, and this without any possible benefit

to the *public*. Nevertheless, the Legislature was so decided on the point, that it granted away a common law right in the high-way of the Thames—a privilege which it was an usurpation of power to grant—to a private company for its own sole use and benefit. That Herne Bay will be a port eventually, and the London and Dover railway will profit thereby, I do not doubt; but that the public will ever rejoice in cheap oysters from Herne Bay, I very much doubt. Yet not a single voice was raised in Parliament against this job.

The very best oysters we get are the Natives, as the oysters of Whitstable, Milton, and Colchester chiefly are denominated. The small oysters or spawn, called in the trade “spat,” is collected all round the coast, and deposited in the oyster-beds, in localities most favourable to its development, where the greatest care is taken of the beds, star-fish and other vermin destructive to the oyster being carefully kept away from them, until the fish are fit for sale, when the oysters are dredged up, and any spat which may be adhering to them is removed and returned to the water. Vast quantities of oysters were brought from Jersey, where the oyster-beds were unusually large and fertile. The coarsest and worst oysters we obtain are the Channel and deep-sea oysters.

The close-season, at any rate as regards the better kinds of oysters, is well kept. In some places, however, the coarser oysters, such as one sees about the bridges of London retailed at a penny a lot, are dredged for all the year round : of course the practice is a ruinous one. Some valuable papers upon the subject of oyster culture as practised in France were lately published by my friend, Mr. James Lowe, in the *Field*. Mr. Lowe enjoyed peculiar advantages, having much assistance rendered him by the French Government in collecting his facts. From these we gather that oyster culture, more particularly in respect to their propagation, is a much more recondite and difficult point to arrive at a thorough knowledge of than is generally imagined ; for spat will often fail utterly for many years in succession, without our being able to determine the cause, or arrive at any satisfactory means of prevention. Indeed those who are best acquainted with the subject pronounce it still a mystery, but to those who know very little about it, it is of course no mystery at all.

There is a species of oyster in America, which is said to be unusually delicious. There could not be any great difficulty in acclimatizing this shellfish in England, if it were thought desirable and found to be suitable. There is also another bivalve held in

great estimation in America, which we might possibly cultivate to advantage—viz. the Clam, of which there are several varieties : a few of these are found on our coasts, especially on the western Irish coast. Indeed, there are many members of the Crustacea, besides those which we already have, which doubtless might be used by us with advantage ; and considering the hundreds of small rivers and harbours we have all around our coasts, where such cultivation might easily and advantageously be carried out to any extent, it is perfectly wonderful that such facilities are not made available for the production of food. With butcher's meat at 10*d.* a pound, anything which will serve to relieve the pressure should be taken advantage of.

Of anything like the cultivation of lobsters, crabs, and such members of the Crustacea we have so little knowledge, that it may be said to be still an occult or unknown science, though there cannot be a doubt but that artificial means of rearing and feeding them might easily be employed with success. To my knowledge it has never even been tried.

On many parts of the Continent, and particularly in Italy, large salt-water lakes have been made, or are utilised, for the purposes of pisciculture. These works are, for the most part, the remains and the result of

ancient industry. The singular lagune at Commachio, on the Adriatic, is a peculiar instance of what art can do to assist nature in this respect. Originally, the spot was a marsh, intersected by rivulets ; at the outlet of these rivulets small islands, half submerged, lay close upon the coast. These rivulets were collected into a canal ; the shallow pools made into one large lagune ; the islands connected and raised by means of wickerwork, &c. which made a labyrinth, at every outlet of which certain traps were set. The waters of the canal were turned into this lagune. The fish from the sea enter through the traps into the brackish water to spawn, but cannot return ; and vast quantities of eels, mullets, and other fish are thus captured, a large stock always being kept up in the lagune.

The Lucrine Lake is another specimen of what can be done with oysters ; but the salt lake of Fusaro, which I have previously referred to, is a more singular instance still. This lake, which is situated between the Lucrine Lake, the ruins of Cumæ, and the Point of Missene, was originally an extinct volcano, and at times, even now, the sulphureous exhalations penetrate the waters. About forty years ago, the entire stock of oysters in the lake was killed from this cause, and the lake had to be restocked. It is about a league

in circumference, and from three to six feet deep in the middle. The bottom is muddy, and is dotted over with large stones or fragments of rocks, to which the oysters may attach themselves ; and round about these stones large stakes, which project above the water, are stuck into the soil—not so tightly, however, but what they can be withdrawn. From these stakes to others extend lines or cords, and from these cords at intervals are suspended faggots, to and within which the spawn of the oyster, when first hatched, can attach and ensconce itself until safe from any outward danger. The use of these faggots and stakes is important, as when the young of the oyster is first hatched, it scatters in all directions, until it finds something to which it can safely attach itself. Meantime it is the prey of every fish or marine creature that can take it, while vast numbers perish from other circumstances ; and were it not for the fact that each female oyster is said to give forth yearly from one to two millions of young, the stock, under the calls that are made upon it by man, must rapidly diminish. When about three years old, under favourable circumstances, the oyster becomes edible.

When they wish to obtain oysters at Lake Fusaro, they either break them off the stones with hooks, or pull up the stakes or faggots, and detach such as they

require with their hands. This method of fishing, instituted by the ancients, is in practice to the present day ; and the hint has not been lost upon the French, who have imported the plan to Marennes, while a system very similar to that at Commachio has been instituted at the Basin d'Arachon.¹ We have few

¹ The following account of what is being done by the French at the Ile de Ré was lately published in the columns of *Galignani* :—

“ M. Coste has just communicated a paper to the Academy of Sciences on the progress of his artificial oyster-beds on the western coast of France. Several thousands of the inhabitants of the island of Ré have been for the last four years engaged in cleansing their muddy coast of the sediments which prevented oysters from congregating there ; and as the work advances, the seed wafted over from Nieulle and other oyster localities settles in the new beds, and, added to that transplanted, peoples the coast, so that 72,000,000 of oysters, from one to four years old, and nearly all marketable, is the lowest average per annum registered by the local administration—representing, at the rate of from twenty-five to thirty francs per thousand, which is the current price in the locality, a sum of about two millions of francs, the produce of an extremely limited surface. That the waves or currents carry the seed of oysters is a well-known fact, since the walls of sluices newly erected are often covered with them. In the island of Ré the existence of the oyster-beds, however, no longer depends upon this contingency, they being now in a state of permanent self-reproduction. The distinction of oyster-beds into those of collection and those of reproduction is quite unnecessary, since the property of reproduction belongs to them all. In some localities it is sufficient to prepare the emerging banks for collection to see them soon covered with seed ; but in other places nothing would be obtained without transplanting proper subjects, an operation which by no means impairs their reproductive qualities. The concession of emerging banks is

salt-water nurseries and ponds in England used for the rearing of fish, though there is in existence a company, which has, under the able superintendence of Dr. Mitchell, turned its attention to this subject in common with oyster culture, and they are in possession of several small ponds near Southend, which are suitable for the above purposes; and it is, I believe, their intention to try what can be done with them in the way of experiment. In France the practice is followed out to some extent; and at Concanneau, on the coast of Brittany, there are a series of ponds or viviers hollowed out of the rock in which large quantities of crawfish and other fish are raised and nursed for the markets, under the excellent management of Mons Guillot. Mr. Lowe speaks in the highest terms of the efficiency and value of these viviers. Such ponds abound around our coasts, and there

anxiously applied for by the inhabitants of the coast, the more so as improvements in the working of this branch of trade are of daily occurrence. Thus Dr. Kemmerer, of Ré, covers a number of tiles with a coating of a kind of mastick, brittle enough to enable him to detach the small oysters from it. When this coating is well covered with seed, he gets it off all in one piece, which he carries to the place where the seed is to grow. The same tile he coats a second time, and so on, as long as the seed will deposit upon it. In short, wherever the violence of the currents and the stability of the bottom do not present irresistible obstacles, the cultivation of oysters has become a lucrative business."

is scarcely a harbour or a river's mouth where something of the kind might not with the utmost ease be carried out. I know of one small pool, near Titchfield, at the mouth of Southampton Water, where lobsters are placed; and this is a mere stew, in which they are kept for a few days until required. There are, however, as I have said, numberless places where fortunes could be realised, and vast stores of food provided for the people.

There are few shell fish of any kind found upon our coasts, from lobsters to limpets, which are not more or less valuable to some part of our population. Mussels, cockles, shrimps, whelks, and winkles are all articles of food or commerce, many forming indispensable baits in our more valuable fisheries. Due attention should therefore be paid to their cultivation and supply, as, owing to reckless fishing, some of them have been seriously diminished. A slight notion of their actual value can be formed from the fact that the supply of whelks alone obtained off the Herne Bay flats (now handed over to a private company) and sold either to the North Sea cod fishers or the London market for food, realised something like from 15,000*l.* to 20,000*l.* a year, while in many places the sums realized from the sale of mussels would seem incredible.

CHAPTER XIV.

ON THE COOKING OF FISH.

I WILL now touch briefly on a branch of my subject which appears to me to be one of no little importance : I allude to the cooking of fish generally. Upon our methods of cooking the better sort of fish, save as regards the waste committed when cooking them, I need not touch. A Blackwall dinner is, of itself, evidence sufficient that our great cooks know the art to some extent ; but it is our little cooks that fall so terribly off from that which they should be.

Take the subject in its broad sense, what can be worse than the cookery of the great mass of the poor ? Literally, they know nothing about cooking ; and the producing of simple, palatable, wholesome, and inexpensive dishes is a profound mystery to them. Many points of distinction have been set forward between savage life and what is termed civilization. Perhaps none is so characteristic and striking as the preparing of food, or "cookery," in the

two states ; and taking it as a test, the great bulk of our lower classes have little to be proud of. The veriest savage that roams the North or South American wildernesses, the most uncivilized and unknown among the amphibious islanders of the Pacific, know better what they put into their stomachs and how to prepare it than our poorer countrymen do. It is a question if there is any human being on the face of the globe, barely excepting the Bosjesman of Australia or the Earthman of the Andes, who is so badly off in cookery knowledge as the English labourer. It may be that excess of civilization has completed our cycle in this respect, and brought us again to the bottom round of the ladder. It appears to me that there is no greater evidence of the decline of character in England than the state of cookery knowledge amongst the lower classes. A knowledge of economical cookery, and the habitual practice of it by the wives, sisters, and mothers of labouring men, argues domestic duties properly fulfilled—industry, intelligence, and home ties and relationships drawn closer and purified by the conscientious and careful fulfilment of those duties. *It is the distinction between the human being and the brute, for man is the only cooking animal.* It makes up, in fact, the

sum of all that is worth living for in life. It is of importance to the rich, but it is life and death to the poor!

What ensues from that dirty, drabbish practice, begot by unions and pauperism, of putting a pinch of sloe leaves into a pot and serving the debilitating wash out to the labourer, instead of a good, wholesome, cheap, and strengthening *bouilli* for his dinner?¹ Why, as it saves trouble and aids gossip, it saves the woman the only opportunity of a healthful use of the small amount of brains she does possess, in the study of how she can best provide something answering the above description for her husband's, son's, or brother's dinner: it results in the ignoring of the art of cookery, and the necessity of practising or performing any duties at all: it causes a fearful waste of our resources; it drives the husband to the beer-shop, and often the wife too, to supply, by an artificial, unsustaining, and poisonous stimulus, the absence of what should be

¹ Even supposing that, by way of strengthening himself, he takes beer—what is *that* beer? Granting, at the very best, that it be made from malt and hops, it is a very bad substitute; but granting it to be what public-house beer in the country usually is, it is practically gout, gravel, stone, dropsy, or any other disease which poisons are most likely to generate. But it may beget worse than this, for drunkenness, ruin, and crime may be and often are added to the list.

supplied by food judiciously prepared. It must proceed eventually to the destruction of all social womanly respect and functions, and of manly gratitude for pains bestowed—to the breaking up of all home feelings, ties, and virtues. It must debase mankind to something below the beasts (who *do* fulfil their duties)—to a creation without a purpose—human, but without human aims. It is not easy to conceive what a being can be which has lost the great type of its race—which belongs neither to savage life nor civilization—which cultivates the virtues of neither but the vices of both. Intelligence, understanding, and self-respect must all be gone before these things can go; What a fine satire it is upon civilization to hear a talk of plans for “Moral Cottages,” and to find our Legislature actually busy with a “Labourers’ Cottages Bill:” as if legislation could be expected to supply the loss of habits of housewifery, cleanliness, order, sobriety, decency, and morality—as if character can be manufactured by Act of Parliament as easily as it can be unmanufactured!

But while we deplore the loss of this knowledge among the *labouring* class, we must not think that it does not affect the middle and even the upper classes. It must be remembered that it is from these lower classes that we draw our servants; and

it is now so much the fashion to make such very fine ladies of the daughters of the middle and upper classes, that the slightest knowledge of domestic matters—particularly of anything so very low as cooking—is scouted indignantly. How can a young lady who murders Mendelssohn or Beethoven five or six hours per diem—who flirts the night and her health too away in heated ball-rooms and theatres, who destroys crayons by the fascies, or the nose upon Aunt Sally, or even longsuffering Time in The Park, for sundry other hours, and who lives but to indulge a Tantalus craving after the pettiest novelties and the strongest excitements—be expected to bestow a thought upon anything so utterly useless, degrading, and out of her sphere? And thus this most vital matter, which has so much to do with the health and peace of families in detail, and the well-being even of nations in the aggregate, is left to the ignorant stupidity of the modern English servant, whose habits in respect to cookery are, for the most part, of so wasteful a nature as to be criminal. It is not too much to say that, of all the food cooked in England, one-third, at the lowest estimate, is wasted, utterly wasted—thrown to the dust-hole and the dogs. Well might we quote the adage, so familiar to our fathers, but so little thought of in the present day,

“Waste not, want not ;” for it is absolutely certain that, if we did not waste, we should not want ; and if we knew how to avoid wasting, and practised it, there would be no such things as paupers ; for pauperism is, alas, a self-entailed curse, that we have only ourselves to thank for. I could devote whole pages to the useful consideration of this subject at large, but I am compelled to confine my attention here to fish only.

There are many fish which inhabit both salt and fresh water, which we now in our ignorance reject as worthless ; whereas nothing which an All-wise Providence has sent for our use is worthless. The reason that we reject these fish is because we do not know how to cook them, or what particular use to put them to. The very worst fish that swims, the most bony and apparently inedible of fish, contains nourishing properties to a very large extent : for example, they may be made into most excellent and palatable soup, if flavoured according to taste, with very, very little trouble or expense indeed. Having boiled a huge mass of cod’s head, or a turbot, we, as soon as possible, throw the liquor down the sink ; but if that liquor were used again, when cool the second time it would be a strong jelly. The skins and membranes of fish, for the most part, contain the

strongest of gelatine. Isinglass, which produces even a stronger jelly and more nourishment than gelatine, is but a preparation of the sound of the sturgeon and other fish ; and isinglass is given, much as cod-liver oil is, not only as a nourishing, but as a strengthening food.

We do not throw away any portion of beef and mutton because it is coarse, tough, and flavourless ; it is too expensive for that. We call it gravy or stock-meat, and we extract its juices by boiling ; and why should we condemn any fish, when the coarsest and most flavourless of them can be turned to the best account also, by being used in a similar manner ? A little pepper, a little salt, some vinegar, and a sprig of herbs, is all that is required to turn barbel and chub into very good and enjoyable soup—not that barbel or chub are by any means inedible of themselves, as I have often experienced ; for, well cleaned, with the backbone cut out, with pepper, salt, butter, a slice of lemon, or a few drops of vinegar, they are very palatable if they are properly grilled. These fish, and many others, are constantly and chiefly used by the Jews, who are infinitely better cooks than we are, but from whom we nevertheless make no attempt to learn the art of cooking the fresh-water fish which are so excellent on their tables.

With regard to fish-soups, these are not generally in favour in this country, for the reason that they are not generally known. If they were, there can be no question that careful people would prefer materials which cost but a tithe of the price of those they at present employ, and contain, at least, as much if not more nourishment, and which are also to the full as pleasant to the palate; while it must always be borne in mind that the increased use of the one would tend to cheapen the other, and bring it more readily within reach.

There is another way of preparing fish common in Norway, whereby the worst and most bony of fish may be made excellent food of. The flesh of the fish is partially boiled and then taken from the bones, and the whole compressed, with some few common herbs and spices, into a cake, which is baked, and is by no means to be despised.

We have a vast variety of most admirable fish included in our Fauna, and it is doubtful if any country in the world can equal us in this respect. We have waters unlimited in extent, both salt and fresh: rivers by thousands and thousands of miles, and lakes, ponds, canals, and other waters, even unto hundreds of thousands of acres; and a great question is now beginning to dawn upon the minds of the

workaday world of scientific naturalists and others—viz. what do we do with them? what do they yield? and what ought they to yield?

Is the land more naturally prolific than the water? Assuredly not. Two, or twenty, or two hundred acres of water will produce double the weight of animal food that two, twenty, or two hundred acres of land will, if as carefully tilled, and with this striking difference—that in the case of the production, as regards land, there are very heavy working and other expenses; in the case of water there are comparatively few. Fish, even if left to themselves, will eat and grow, and nature will provide the means of sustenance, without either barns or stables, teams or fences, seeds or farming implements, or even draining: nay, in this instance, draining (if one felt inclined to make a grim joke) might be held decidedly injurious, as indeed is another rather large item in farming, viz. manures. Nor will fish property be subject to panics and convulsions. No one will speculate for a rise in carp, turbot, or trout; no treaties of reciprocity can well give away our inland fisheries; and those of commerce will not put all sorts of internal or external *ad valorem*, or prohibitory, or any other duties upon them—at least I hope not. They are our own produce, and worth so much per pound in

the market on any day we like to sell them; and if we do not sell them, why, we shall not lose by keeping them, for they cost us no money to feed, as do bullocks or sheep. If we have enough to export, they are a source of exchange and wealth, and will relieve our overtaxed industry: or, at least, the effect of a large introduction of fish into our home provision-markets would speedily influence the price of every other production.

I have, in the foregoing pages, briefly reviewed the subject of our fisheries, and pointed out the various means which may be employed, and the best kind of investigations to make, and of experiments to conduct, in order that they may become a great mine of wealth to us; and I trust that the explanations and advice I have here offered may be found useful to those who are studying this question with the same views and wishes as myself.

APPENDIX.

APPENDIX.

I.

REASONS FOR THE DECREASE OF SALMON.

THE decrease of salmon is not a matter of yesterday, but may be traced back during a period of more than a quarter of a century, though undoubtedly that decrease has of late years progressed with alarming rapidity. If we take our average of the fishings over a reasonable period, we shall find that the mode of fishing lately adopted in Scotland and Ireland, but now, happily, for the most part abolished in England, and seriously checked in both Scotland and Ireland, sadly depreciated those fisheries. When I speak of a reasonable period, I do not mean to confine it to any five, ten, or fifteen years, but to take it, as we only fairly can do, by the changes that have taken place in the methods of fishing.

For example, some twenty years ago, the Irish fisheries, by poaching, &c., were in a very reduced state. Laws were passed, and the rivers put under the management of officers appointed to see to them. In a very few

years the fisheries improved wonderfully ; but as they began to improve, and the style of fishing began to pay well, fixed nets, hitherto but little known on the Irish coasts, began to make their appearance. The more the fisheries improved the more these nets increased, and to such a degree that the rivers again began to suffer very severely. Small rivers were entirely extinguished by them, larger ones did not pay the up-stream proprietors for looking after them ; *and poaching can never be suppressed, if the up-stream proprietors do not strenuously set their faces against it.*

The system was manifestly ruinous, unfair, and illegal. Suppose I own a river fifty miles long, I incur a great expense and a vast amount of trouble to get up a stock of salmon. The salmon go down to the sea, and some fellow who has hired fifty yards of seabeach runs out a fixed net half-a-mile long, and catches nearly every one of my fish. I have spent money and trouble for nothing ; the stranger has ruined my river and destroyed all the salmon ; and finding that it does not pay to fish his net longer, he takes it up and goes elsewhere to repeat his destruction. This was, actually and literally, what has been until lately occurring in Ireland. Happily new laws have, if not entirely yet largely, abolished these destructive engines, and we trust to the future to show the wisdom of these enactments.

If a sufficient quantity of fish are not allowed to run up a river to stock it, the river must decrease rapidly in production ; for vast as is the natural fecundity of the salmon, yet so numerous are its enemies, and so large a

part of the watery creation prey upon its spawn and fry, that barely one solitary ova in every thousand deposited produces a full-grown salmon. Were this not the case, of course a dozen pairs of fish would stock a river ; as it is, hundreds are required.

Salmon run up at all periods of the year : even in December, clean fish are often found running into unobstructed rivers. Every salmon in the sea would enter some river or other if not prevented, and when once in the river, he becomes an easy, nay a certain, prey to the nets or cruives. The earlier fish, usually called spring-fish, or those which run into the rivers in January, February, and March, are by far the most valuable to the rivers, and for the following reasons : Being early spawners, their progeny in turn become early fish, and in the early months of the year salmon is scarce, and fetches a very high price. They are, too, usually large fish : added to this, the weather being cold, salmon will travel farther, and will keep longer, and remain altogether in better condition. These facts show that particular attention should be shown to these fish, and that their breed should be encouraged as much as possible. This can only be done by allowing the earliest fish to run up free, by opening the fishing at the mouths of rivers somewhat later than usual. But the very facts above detailed afford also the cause of these fish being much more keenly sought after ; and the result of this keenness is that in many rivers where they formerly abounded they are become extinct, while in others they struggle up few and far between, and hold but a doubtful existence at the best.

If it were possible to say how many fish are sufficient to stock a river well, and to let so many run up to fulfil that office; nay, if it were possible to deal with and count our shoals of salmon, as a farmer does his flocks of sheep and his oxen, and if we could be sure that the spawn beds would not run dry or be otherwise destroyed, we might reduce this point to a matter of calculation and figures, and become extremely practical and arithmetical over it. But it is *not* possible, and therefore the best and only way is to give the fish a reasonable and fair—*indeed, a favourable chance rather than the reverse*—of getting up to the head-streams without let or hindrance in good time. But have we done so? Nay, we have rather waged a war of utter extermination against the salmon. Any one who has seen the ingenious variety and the multitude of engines formerly set up on our coasts, estuaries, and rivers to bar the progress of and capture our salmon, must have been filled with wonder that a single salmon ever escaped them.

To commence with the rivers. In every favourable pool and stream we have draught-nets of immense capacity, worked one over the other incessantly at all hours, to intercept and sweep on shore the fish that are running up; we had nets which were half fixed—that is, fixed at one end, and extended across the stream: against these the salmon would strike, and the end of the net was immediately brought round, so that the salmon were enclosed and dragged on shore; we had nets of a somewhat similar nature, which were lifted up from below; we have nets of every variety and construction, worked

at weirs (by which the fish are stopped and gathered together in shoals) and elsewhere, much too numerous to mention, for the ingenuity of man has been racked to discover and adapt them to the work in the most murderous fashions. We had, and have even now in very many places, also fixed erections, some of brush faggots, wattled stakes, and other materials, extending across the stream as far as may be practicable, against which the salmon in its upward progress strikes; and when seeking to pass beyond the obstruction on the outside, they become entangled in a bag, or in a maze of chambers, ending in a species of trap similar to an eel or a funnel-mouthed mouse-trap, from which there is practically no escape. We have stages and ranges of baskets, like large wicker eel-pots, into which the fish readily passes, and from which, when they are perfectly adapted, nothing even of shrimp size can escape alive.¹ We have cruives; and here I must explain, for the benefit of the general reader, what cruives are.

A weir is first erected, either entirely across the river or such portion as may be fishable, and over this the salmon cannot pass. In this weir are left certain gaps, through which the stream flows: in these gaps are fixed the cruives or traps. The cruives are composed of wooden bars in frames: these are called hecks or haicks. The

¹ Models of all these machines belonging to the Association for the Preservation of the Fisheries of Great Britain and Ireland can be seen at the South Kensington Museum. These models were exhibited at the International Exhibition, where they formed a very attractive and instructive spectacle.

up-stream face of this cage is simply a vertical row of bars, so close together that they are impassable, save to the smallest griles. Formerly the Scotch law insisted that they should be set three inches apart, so that any fish under 8lbs. or 10lbs. in weight could pass through. The old law of England also made fish of 6lbs. or 7lbs. in many of the rivers undersized fish, which it was illegal to take. The down-stream face of the cruive, through which the salmon must pass first in its upward progress, is made of two frames of bars, which are set so as to slant inwards until they meet ; one of these frames works loosely upon an upright spindle, so that when the salmon presses against it, it opens and lets him through, but closes behind him by the mere pressure of the stream. The ground-plan of this trap will represent a square or rather oblong figure, with a triangle cut out of the lower face or base of it.

Once in these traps, there is no escape for the poor salmon : the landing-net and a knock on the head, with a place on the icehouse floor, are his portion. The traps are visited every morning and evening by men with large landing-nets, with which they are swept, and every fish is lifted out. I have seen from a dozen to thirty fish constantly taken in one of these cages at ordinary seasons, and when there is a great run of salmon on, of course the take is proportionably larger.

The old laws of Scotland required that a certain portion of the weir in the centre of the river should always be left open to the free passage of the fish. This was called "the king's gap or share." They also enforced

what is called "the Saturday slop," when for a certain period, embracing the Sunday, the whole of the traps were thrown open, so that a perfectly free passage should be left. These arrangements, being properly and fairly enforced, always permitted a sufficient number of fish to run up to stock the river. It might, however, be necessary in the present day, as our fisheries are so much reduced, and the nets have much increased, and the drainage has so much altered the duration of floods, to enlarge the gap somewhat, and to lengthen the duration of the "Saturday slop" (at any rate for a time¹), in order that a larger number of fish might be permitted to run up, that the rivers might be the quicker and better restocked, as has been done in the English Salmon Law.

Lastly, we had and have in far too many places still those most destructive engines of all, called stake and bag-nets. The first of these is a net of a certain depth, extending vertically upon stakes, and ending like the brush-weir, in a maze of chambers. These stakes are carried out as far as the shore and depth of water will permit; and if the stake-nets be not destructive enough, beyond this, a net is often carried out a great distance farther by means of floating leaders and anchors, and is called a bag-net. These nets are set at right angles, or at a more suitable angle to the shore, and all fish seeking the rivers along the coast must strike against them. A great many fish are thus taken, and others are driven out to sea; and as these

¹ This has since been done. By the new Scotch Law, the "Saturday slop" is extended to thirty-six hours. The English, however, is forty-two hours, and the Irish forty-eight hours.

implements are usually employed near the mouths of rivers, the few fish which are not taken are driven from the river which they are seeking, and are, in all probability, put past the mouth of the river altogether ; and when they again draw in to the shore for the purpose of entering the river, probably heavy in spawn, they come against some other net on the other side of their river, and if they have again the good luck to escape the maze of chambers, they are driven out to sea again ; and thus they are kept in the sea for weeks and weeks over their natural time, a prey to the seals, sharks, and other predaceous animals, which always swarm near stake-nets, and during the residence of the salmon in the salt-water, take heavy and incessant toll of them. Such is the voracity and determination of the seal in pursuit of salmon, that they will rob the nets in the very face of the fishermen ; and the destruction thus caused, and the number of salmon yearly lost to the consumer, from the fish being kept in the salt-water for an undue length of time, is something enormous in the total ; and if they spawn it is in the tidal part of the river, probably in brackish or deep water, or in some other spot quite unsuited to the development of the ova, and thus the spawning is lost.

Some of these nets have seven or eight heads or sets of chambers, and extend out from the shore for nearly a mile. One of the most destructive species of mischief caused by them, where they are set near the mouths of rivers, is the enormous number of salmon-fry or smolts which they kill. Jammed together in masses of wrack and sea-weed, thousands on thousands are sacrificed in a

tide ; and I have heard it stated on good authority, that on an occasion when one of the fishermen in the Beulay Firth waded out to attend to the net, that by the net in many places *he waded knee-deep in dead smolts, while the ground for a considerable distance about the net was literally silvered with their scales !* After this, can any one wonder that salmon have hitherto decreased ? The wear-and-tear of gear in this mode of fishing is very great ; indeed, it is the most expensive as well as the most destructive of all the modes of fishing. These nets, too, cannot well be made to observe close-time, even if one be appointed, as in very rough weather it may be impossible to remove any portion of them for weeks and weeks together ; and if stress of weather be permitted as an excuse for not opening them, every breeze will be so construed. It is not too much to say, that fixed nets have been the chief cause of the damage done to our salmon fisheries.

They are a comparatively modern invention, and the failure of our salmon fisheries may clearly and distinctly be traced, step by step, from the time of their first introduction ;¹ and they ought, as a matter of justice to the other proprietors of fisheries, *to be done away with utterly.*

The close-time, during which salmon should be allowed to deposit their spawn unmolested, is also a matter of great importance. In the great majority of instances, this

¹ A singular proof of this is in the last report of the Irish Fishery Board. During the last three years, in consequence of the increase in the value of salmon, there has been a regular and steady increase of bag and stake-nets, amounting altogether to some 200. Just as these nets increased, so in exact proportion the take of salmon steadily and regularly decreased. (1863.)

is put off until it is far too late. Fish are seldom as a rule in good condition after the middle or end of August. The ova begins to become large, and the fish is not in good order for the table.

The other matters detrimental to salmon are mine and mill refuse. These have been dealt with mildly in the English Act, to which I refer the reader for regulations as regards weirs and fry-killing, &c., which upon the whole are reasonably good, save that netting should not be allowed to be carried on in the immediate proximity of fish-passes, or fish-passes will be rendered useless.

II.

THE STOCKING OF THE CLYDE WITH GREYLING.

IN 1858, Mr. J. J. Briggs sent the account of which the accompanying extract is a small part to the *Field*. He is quoting from Mr. Eyre's Journal, kept to note down any facts that might be interesting. The Clyde is now thoroughly stocked with greyling, which are even of finer size than the trout which are found in it. Three or four dozen a day is an ordinary day's sport.

“Mr. Eyre says :—

“On the 13th of April, 1857, the temperature of the air being 40° Fahr., we netted about 200 greyling near Bakewell, and expressed the spawn and milt from about fifty of them. Of the rest some had spawned, and many were too young. The spawn was put into common wine-bottles, about half-filled with water, and sent off the same night to Abington, on the Clyde, about fifty miles above Glasgow. The West of Scotland Angling Club had already prepared a rill for its reception. About 10,000 ova were sent, and I retained some hundreds for experiments. They were about one-eighth of an inch in diameter. The following remarks are extracted from my diary, the progress of the greyling from the ovum state to

that of the perfect fish being observed daily with a microscope :—

“ ‘*4th day*.—They seem a little larger, and consist of an outer vesicle of elastic membrane, filled with a semi-transparent fluid, and of an inner vesicle or yolk filled with a yellow granular substance, and on the inner vesicle is a spot indicating the germ of the future fish.

“ ‘*6th day*.—The form is slightly altered. The fluid appears flocculent.

“ ‘*8th day*.—The live foetus is visible. It is of a semi-transparent yellow-amber colour ; the head in three lobes. The fish lashes its tail violently at regular intervals, eight or ten times a minute. The granules partially absorbed.

“ ‘*10th day*.—Temperature of the room, 55° ; river (Derwent), 52° . Foetus less active.

“ ‘*30th day*.—The foetus made its first partial detachment from the enveloping membrane by freeing its tail. About half-an-hour afterwards it entirely and suddenly disconnected itself from the chorion, which sank to the bottom of the glass. Temperature, 60° . The eyes well developed, the mouth seems still closed. The umbilical sac filled with granular matter attached to the thorax. Pulsation regular. Above the place of the hinder part of the gill-cover a constant and rapid motion is apparent, above 160 per minute. This may be from the vibrating edge of a fine membrane, which at present forms a substitute for the true gills, or it may be from the rapid circulation of the blood in loops coming to the water to be aerated, or it may be from cilia on the edge of the membrane. The membrane, or whatever looks like it, is so

transparent that it is difficult to decide. The markings of the vertebræ are apparent. The place of the vent is indicated by a scarlet spot.

“ ‘33d day.—The mouth is now in constant but slow motion ; the yolk-sac much lessened in size.

“ ‘41st day.—The young fish are now perfect, and are about nine-tenths of an inch in length, and the umbilical sac is absorbed.

“ ‘These ova were daily examined by being placed under the microscope or other magnifier, and part continually destroyed, probably from the concentrated light of the lenses. On one occasion Mr. Eyre and Mr. Peach were examining a rather forward-looking ovum *under the microscope*, when the fish, by an instantaneous effort, burst the membrane or *chorion*, and in a few minutes after they saw him, by another effort, free himself entirely from it. This was a piece of wonderful good fortune, as that particular operation might have been watched for for years fruitlessly.

“ ‘In the natural rill falling into the Clyde, the *first fish* appeared on the *seventeenth* day, and the average was twenty days. In some ova placed in boxes through which the same rill ran, the average time was forty days.

“ ‘In June, 1857, these fish were about the size of minnows, healthy, and in the evening rose freely at small flies. I estimated their number at 3,000 or 4,000.

“ ‘In March, 1858, they were on the average five inches in length (some reached $6\frac{1}{4}$), and were doing well.’ ”

III.

STORMONTFIELD.

THE experiments, or rather operations, in the breeding of young salmon at Stormontfield, on the Tay, were commenced in 1853, at the instance of Dr. Esdaile and Mr. Ashworth. A gentle slope from a mill-lade, running parallel with and sixteen feet above the Tay, was chosen, whence a sufficient supply of water could be obtained. Three hundred boxes were laid down in twenty-five parallel rows, each box being partly filled with clean gravel and pebbles, and protected at each end by perforated zinc. Filtering-beds were formed at the head and foot of the rows, and the boxes were charged with 300,000 ova by the 23d of December.

On the 31st of March, 1854, the first ova were hatched. A pond had been provided for the fry ; this pond was 223 feet long, by 112 feet in the broadest part. It was subsequently found to be far too small. By June the greater part of the fry were admitted into the pond, being then about an inch and a half long. There they were fed with boiled liver daily, and on the 24th of May, or nearly twelve months after their being hatched, a large portion of them, having assumed the smolt scale, left the pond

and commenced their descent to the sea ; an equally large number remaining behind, and showing no disposition to assume the migratory dress of the smolt. Many of the smolts which then migrated were marked by the cutting off of the adipose fin,¹ *and a large number of them were retaken, ascending the river again, at various periods up to August, in the form of grilse*, and varying in weight from 6lbs. to 9lbs., according to the time they had remained in the salt-water—thus distinctly proving the disputed question as to the rate of growth of salmon. It was thought that the singular case of some fry remaining in the river for two or three, and others only for one year, might be the result of some carelessness in conducting the experiment, by using grilse and salmon indiscriminately ; but subsequent attempts have shown that it was not so, as during the last season the spawn was taken only from the best and healthiest full-grown salmon, no grilse being used ; and the result has been precisely the same as formerly—so that this curious problem in the natural history of the salmon still remains to be solved.

From 1853 to 1862 the boxes were stocked five several times. One of these, that of 1854, proved a failure. It was found impossible to stock the boxes oftener than every other year, owing to the limited accommodation for the fry. Great benefits must have accrued to the Tay

¹ Many plans of a different kind were tried subsequently for marking the smolts by rings, wires, &c. ; but none of them were found to answer, save the cutting off of the adipose or small soft fin, which is peculiar to the Salmonidæ.

from these operations, but it was rendered impossible to estimate them, by reason of the prejudice and ignorance of the fishermen, who failed to send notice to Mr. Buist of the marked fish recaptured, so that the proportion of fry that returned to the river as grilse and salmon could not be computed. Thus, one of the most valuable statistical results of the experiments was altogether lost; a fact very much to be regretted. Many most interesting and hitherto debatable points in the natural history of the salmon were also cleared up in the course of the experiments, and science owes a debt of gratitude to the conductors of them. To those who desire a compendious and circumstantial history of these operations, I recommend strongly Mr. Brown's little work upon the Stormontfield Experiments, which is a valuable contribution to the natural history of the salmon.

IV.

MR. ASHWORTH'S UNDERTAKINGS.

SEVERAL successful undertakings in pisciculture have been carried out in Ireland. The first of any note, perhaps, was at Outerard, near Galway, in 1852. The Galway River is the channel through which Loughs Mask and Corrib, two enormous lakes containing a vast area of water, discharge themselves into the sea. The fishery of this river belongs to Mr. Ashworth. In 1852, finding the stock had been terribly reduced from a variety of causes, he established a breeding-place at Outerard, in a small tributary stream. Here twenty boxes were laid down, after the same fashion as the plan, already explained, adopted at Stormontfield. This plan, carried out by Mr. Ramsbottom, was the model whence Stormontfield was taken. These boxes were stocked with about 40,000 ova, which in due time came to perfection. Subsequently, owing partly to the opening of a wide Queen's-gap in the weir, Mr. Ashworth's fishery multiplied itself in value manifold, and he cast about, adding a still larger area to the field of his operations.

Lough Mask, which discharges into Lough Corrib, is separated from it by a very rugged channel and a lofty,

impassable fall ; consequently, although Lough Corrib abounded in salmon, none had ever been seen in Lough Mask. Moreover, the many gravelly tributaries which salmon love to spawn in rather discharged themselves into the upper part of Lough Mask, which again receives the waters of one or two smaller lakes, than into Lough Corrib ; and as the capabilities of production of a fishery are bounded by the area of its spawning-beds, this proved a serious check to the further increase of productiveness in the fishery. Undaunted by difficulties, however, Mr. Ashworth set to work, ameliorated the stream, put salmon-stairs to the impassable fall, and stocked the head waters of Lough Mask with half a million of salmon ova. These operations have been so lately completed, that we hardly know as yet what measure of success will attend them ; but I see no reason for doubting their success, and, if so, a capable area of about thirty square miles will be added to Mr. Ashworth's already valuable fishery, and in a few years' time the fishery will realize a handsome fortune. This shows what can be done by pisciculture, in its broad sense, and a little practical common sense combined.

V.

MR. COOPER'S EXPERIMENTS AT BALLISODARE.

THIS undertaking, which was really an experiment, shows how great difficulties can be overcome by perseverance, and how a fishery can be created where none has previously existed. Mr. Cooper owns two rivers, the Owenmore and the Arrow, which unite some two and a half miles from the sea and from the Ballisodare River. On these rivers are three falls : the lowest, which is a succession of falls over high ledges of rock, is within a short distance of the sea ; the next, which is a short distance above it, is called the Upper Ballisodare Fall. This fall is impracticable to fish, though fish had been known to surmount the lower one occasionally, but not often. The entire height of the two falls is about seventy feet. The highest, which is on the Owenmore, near the village of Collooney, has but one fall ; but this one is higher than either of the falls which comprise the lower one and the Upper Ballisodare Fall, and is entirely impracticable.

The ladder applied to the Upper Ballisodare Fall was at first brought out into the lower water too far down the stream from the fall, so that the fish in running up missed it. It was therefore found necessary to turn it,

so as to bring the embouchure of the ladder close to the foot of the falls. A few pairs of fish had always been in the habit of entering the river and running up to the lower falls, and the plan adopted to stock the river was that of catching the fish and placing them in the river above the falls, so that they might spawn in the river. After sundry failures, the ladders being completed and several fish being put up above the falls, and some fecundated ova deposited in the river, a large quantity of salmon-fry was observed to be in the river. These, at the usual time, became smolts and disappeared. This was about April, 1857. On June 26th the first grilse was observed at the fall; by July they were plentiful, and so continued till the end of the season. The river was not fished in 1857.

I had much more and interesting particulars from Mr. Cooper in reference to this fishery, but cannot find space for it here. The account was fully given in the *Field* in December, 1858, and from that paper I extract the following table, showing how completely the experiment succeeded. The table was kept by an agent whom Mr. Cooper appointed :—

“ ‘ 1857. August 24. Saw several salmon in the hole under the fall of Collooney.

“ ‘ September 24. The river between Ballisodare and Collooney is now well stocked, salmon being visible in almost every deep hole, and a number being congregated between Collooney Bridge and the hole under the fall.

“ ‘ October 3. A flood being in the Owenmore, I shut the water off the Collooney ladder to see if there were any

fish passing up, and found seven salmon and one white trout in the pond. Of these seven, five were males.

“ ‘ October 13. Examined Collooney ladder, and reported to Mr. Leech that there were salmon in it. Twenty-seven salmon were found in it, the great majority of them being females.

“ ‘ October 15. Lowered the sluice of Collooney ladder again, but got no fish.

“ ‘ October 28. Again examined the ladder, and got three male fish.

“ ‘ October 30. Four male and two female fish taken out of ladder and put up.

“ ‘ November 3. Sixteen male and eight female.

“ ‘ November 4. There were ten fish in the ladder, which were not removed, as Mr. Leech was not present.

“ ‘ November 5. Nine fish, not removed.

“ ‘ November 6. Seven ditto, ditto.

“ ‘ November 7. Eleven ditto, ditto. I went to Ballisodare on this day, and saw several large fish leaping at the upper ladder.

“ ‘ November 9. We put up from the ladder twenty-four male and fifteen female fish.

“ ‘ November 23. Lowered the sluice again; twenty-five male and twenty female fish found in the pond. A few of these were large fish, say 14 lbs. or 15 lbs. weight.

“ ‘ November 30. The fish are now beginning to spawn in great numbers in the Owenbeg River.

“ ‘ December 3. Thirty-six male and forty-five female fish found in the ladder.

“ ‘1858. January 5. Saw a few spawning-beds in Owenmore.

“ ‘January 9. In River Arrow and tributaries found twenty-nine salmon redds.

“ ‘February 14. Walked the Kilmorgan River (a tributary to the Arrow), and counted twenty-one redds.’

“ In the early part of this year, 1858, we seldom fished. In the month of February we took five fish; in March three; in April two; in May ten; in June thirty-nine. We did not, in fact, begin to fish regularly till the 1st July. During this month we took 868 salmon, and up to the 20th August (the close of our season) 530 more—the year’s take averaging very little more than 4 lbs. each. Mr. Culbertson’s notes on this year are: ‘Spring-fish showing in February. One of 9lbs., taken in the net, was a fry marked by Brown in 1856. In March got another about the same weight. Only a few fish through this month. Fry coming down in April, and more plentifully in May: but I do not think so many in the river as last year. On 13th May saw nearly one hundred jumps from six to eight o’clock in the evening; they were from 8lbs. to 12lbs. weight. On 9th June was first grilse at lower fall; about the end of the month they were very plentiful. Among the fish taken by the nets on 6th July, seven were fry marked by me last year, and they weighed $5\frac{1}{2}$ lbs. to 6lbs. each.’

“ Since the end of the close-season, many reports have been sent me relative to the numbers running up. From my inspector’s book I take the following: ‘Aug. 28. At Ballisodare numbers of salmon in every part of the river

between bridge and lowest fall. Sept. 1. Collooney ladder literally full of fish. They did not run in such numbers last year until November, being over two months earlier this year. Sept. 6. Plenty of fish immediately above Collooney Bridge. Sept. 25. Collooney ladder swarming, and plenty showing in every place between bridge and fall. October 3 to 6. Heavy floods. Collooney ladder resembles a steeplechase, as we see them clearing the steps in pairs, and some very good fish. Oct. 8 and 9. Plenty of fish still on the run. Oct. 16. I have been watching the salmon jumping and playing at Collooney fall and ladder. I have visited the ladder daily this week, and from the numbers in it, am convinced that they could be removed from top of ladder with the hand.

• Nov. 27. Great numbers of fish in Collooney ladder.' In addition to these notes of my inspector, one of my water-keepers reported having counted 267 salmon in one hour ascending the Collooney ladder; and Mr. Culbertson has written to me to say that he reckoned 100 in less than half an hour making up the rapids at Ballisodare. On yesterday, Dec. 2, there were so many fish in the pond at Collooney, that Mr. Leech took up no less than six at once in a common landing-net.

“ EDWARD J. COOPER.

“ Markree Castle, December 3.

“ P.S.—Since my letter was written, the Earl of Enniskillen has visited my fishery; and I extract the following from his notes, entered in inspector's book :—

“ ‘ On the 9th (Dec.) I visited Collooney ladder, and

saw immense quantities of fish running up. Frequently saw four fish at the upper step jumping together. On the 10th again at Collooney. Not nearly so many fish moving this day; counted at upper step nineteen in five minutes. Turned off the water, and put up 256 fish. This day (11th) counted 102 fish jump at the upper step in five minutes. Turned off the water; the pond actually alive with fish, in general larger and fresher from the sea than those of yesterday. Put up 246 fish, and then stopped, as the fish were getting sick in the pond. I am confident that we did not take half the number out, and that we left from three to four hundred in the pond.' "

VI.

CREATION OF A SALMON FISHERY AT DOOHULLA.

THIS is another and a most interesting instance of the manner in which unproductive waters can be made of great value. The Doohulla lakes in their natural state contained nothing but a few worthless brown trout. By means described below, they were first made into a valuable white trout fishery, and have now been further converted into a very valuable salmon fishery. There are so many instructive facts connected with this experiment, that I cannot do better than publish the letters in which the whole case is contained, and which I gave in the *Field* about the end of 1863. It will be seen that they afford very strong evidence against the growth of the salmon being so rapid as has been generally supposed, at any rate in many instances. Mr. Ramsbottom being at my house with Mr. Youll, inspecting the acclimatization fish hatchery, in the course of conversation recalled the following facts, which I sent to the *Field*. To that letter he replied, and explained some facts which I had misapprehended, as also did Mr. Ffennell.

“Mr. Ramsbottom, among other operations, has had under his charge the stocking of the Doohulla lakes, in Connemara

with salmon. These lakes, which are but a few miles from the far-famed Ballinahinch lakes, are some sixteen in number, connected by a number of small channels and rivulets. Many of these channels were cut by a former proprietor, who made some ineffectual attempts to introduce salmon into the lakes. They have, I may mention, for years abounded in very fine white trout, but up to the last year or so salmon had not taken to them. Two years since Mr. Ramsbottom induced the present proprietors to try their luck at artificial breeding, and so far succeeded that 18,000 fry were hatched out the year before last under his superintendence, a large proportion of which became smolts. In the first year 700 of these smolts were marked, a large number went to the sea, but many remained behind for another year. May, June, July, went over, August came, and, in spite of the most careful watching, not a fish reappeared. Mr. Ramsbottom has hecks and a grating in the river, so that he must *see* all that goes up. August, September, and indeed the whole year, went over, and not a single salmon showed itself in the river. Mr. Ramsbottom was almost in despair, thinking the experiment an utter failure. Nevertheless, they determined not to give it up, but decided upon hatching on a larger scale, and 200,000 ova were laid down and duly hatched. Not a fish of them was marked, be it remembered. As for the fish of the previous year, Mr. Ramsbottom had almost given them up, when one morning early in the ensuing season (the one just completed) he received a note from his son, who is in charge of the fishery, to say that he had either seen a shoal of salmon in the bay or some very large

white trout. Two days after came a note to say that three salmon had been seen rising in the lakes. Then came one to say that a grilse of 4lb. or 5lb. had been caught in the trap. Then one or two more, and amongst them one of the marked fish of the year but one previous; and so the tally went steadily on, one, two, and three fish coming in daily, until before the end of the season no less than 106 grilse had made their appearance in a water where salmon had never been seen before, and amongst them were no less than *eighty-three* of the fish they had marked. The whole of the fish were grilse, averaging 4lb. to 5lb. weight.

A curious fact occurred also, which is worth noting, showing that big smolts make big fish. Among the smolts marked were thirteen which had far outstripped the rest in size; and among the grilse were some which had also considerably outstripped the rest. Most of these smolts were marked. Among the rest was one very fine fellow, which Mr. Ramsbottom had to hold in both hands while he was marked. They were cutting off the adipose or soft fin, and the operator, who held the scissors, remarked, as they came to this fish, "What a pity to mutilate such a fine fellow! We will only cut off a piece of his fin;" and the fin was cut in halves, leaving a small triangular piece. This very fish was caught, and as he was the largest smolt, so he was the largest grilse, and weighed $7\frac{1}{2}$ lb. The whole of the fish of course were returned to the water, and allowed to run up to their spawning beds without further interference. Now here is a strong and indisputable fact, in the whole of these fish, without exception, taking the entire year in the sea. There

can be no mistake or doubt whatever in this case. Here are the grilse, all making their appearance at the same time, not one of them coming in at the expected time, viz. in two, three, or four months, but without exception taking fifteen and sixteen months, all evidently guided by the same rule and the same instinct. The facts are very clear, and there can be no confusion of seasons or dates in the matter, because there were no salmon in the lakes previously. I will not comment upon this singular fact. It does not prove that all salmon stop in the sea fifteen or sixteen months, but it proves that which I have often asserted, viz. that some do.

FRANCIS FRANCIS.

SIR,—The accompanying note from Mr. Ramsbottom, correcting some little misapprehension of mine as to the operations at Doohulla, has been sent to me. It will be seen that the result of Mr. Ramsbottom's experiments in this instance give a widely different result from most of those we have hitherto had under our consideration. Here we have grilse that take nearly four years to come to maturity, whereas in former instances it has been proved, apparently to satisfaction, that grilse of a larger size have been produced in about eighteen months—a variation, I need scarcely point out, of a very astonishing kind.

FRANCIS FRANCIS.

“DEAR SIR,—I feel it to be my duty to drop you a line, for two causes :—First, I beg to tender my thanks for the very able manner in which you laid before the public, on Saturday last, the 5th inst. our piscicultural doings at Doohulla. Secondly, I also beg respectfully to call your

attention to a little mistake there is in reference to the *time*, &c. I induced the present proprietors of the Doohulla fishery to try artificial breeding.

“You will find that you have said, ‘Two years since Mr. Ramsbottom induced the present proprietors to try,’ &c. Of course, as many of your readers must conclude, that there has only two years elapsed from the taking of the river to the return of the grilse: however, I must inform you this is not the case. It is four years this month since the first lot of ova were deposited, viz. 18,000. These, when hatched, were kept in the nursery beds and ponds for about two years and three months, and then turned out into the river as smolts, perfectly ready for sea. It was from the above lot of smolts we marked the 700 in March, 1862, and which have during the just past season returned as grilse, being now a little over three and a half years old.

“I am also very happy to inform you that I have just received a note from my son to say that he has for the first time seen grilse on the spawning beds of the river at Doohulla.

“That your readers may more clearly understand the circumstances, I append a table of the dates, &c.

“18,000 ova deposited at Doohulla, 1859.

“Ova hatched Feb. 1860.

“Fry kept in nursery ponds until May, 1862, being nursed for two years and three months; but I would here remark that a few of the fry, but only a few, appeared to be ready for sea when about thirteen months old.

“Turned out of nursery ponds ready for sea May, 1862.

“Returned as grilse (after being at sea from thirteen to fifteen months) in June, July, and August, 1863.

“You will here see that when the first grilse returned (in June) it must have been three years and four months old.

“R. RAMSBOTTOM, Clitheroe.”

“SIR,—The letter published in your last number from Mr. Francis Francis, referring to the successful result of the artificial production of salmon in the river Doohulla in Ireland, is not only interesting, but highly instructive. It is in this instance demonstrated that the smolts remained twelve or fourteen months in the sea before they returned as grilse. The same fact was indubitably established at Ballisodare when Mr. Cooper opened the river there to salmon by means of the ladders which he erected over the natural barriers at its mouth, and that at Collooney higher up. These were maiden rivers, and there could be no mistake regarding marking the smolts. The first smolts produced were seen going down, and not a grilse returned for a year after. The same result was evidenced by Mr. Mitchell's markings of smolts in the Tweed, as stated by him to the Parliamentary Committees on the Tweed Bills of 1857 and 1859.

“I shall abstain, as does Mr. Francis, from comment on this question at present. I am anxious, however, to add something further relating to the Doohulla river—I should rather say the Doohulla waters, because there is nothing which can be well dignified by the name of river connected with the concern. There are several small loughs, or lakes, which now discharge through two artificial cuts, one con-

necting the upper lakes with a lower one, the other connecting all with the sea, and much more in the character of mere ditches than of rivers. The whole catchment area (as engineers call it) of those small loughs is very inconsiderable ; they always contained some white trout, which ascended through a tortuous brook or stream when heavy rains created occasionally sufficient water in its rugged bed ; those favourable opportunities, however, were few and very far between. The place was purchased some few years ago by Mr. John Knight Boswell, of Monkstown, near Dublin. He requested me to assist him in directing such measures as might be adopted for the improvement of the fishery, and I had great pleasure in accomplishing my part of the task, as I found him a person who did not hesitate to invest his money freely in giving the experiment a fair chance of success, and who applied himself with zeal and great intelligence of mind to the undertaking.

“The main principle carried out was that of connecting the waters of the several loughs, and causing them to discharge through one channel. Cuts were made to effect this—the old stream was dammed out—the water was run through an additional lake before unconnected with the others. The speculation was a complete success, though a valuable white-trout fishery only was created when Mr. Boswell sold it, realizing a large profit for his outlay. The present owners have followed up the enterprise, as Mr. Francis states, by the able assistance of Mr. Ramsbottom’s skill in pisciculture, and a salmon fishery is now established.

“I have been induced to communicate this imperfect detail of the operations at Doochulla, for the purpose of

endeavouring to induce others to 'go and do likewise.' There are ample opportunities afforded in the highland districts both in Ireland and Scotland for artificial river making and artificial propagation of salmon ; and I would recommend any one disposed to speculate in this direction to visit Doochulla and see for himself.

“ W. J. FENNELL.”

VII.

THE THAMES ANGLING PRESERVATION SOCIETY'S EXPERIMENTS.

FORMERLY the Thames was perhaps one of the most productive rivers in the kingdom. But poaching, over-fishing, unfair and unsportsmanlike fishing, its conversion into a sewer and into a canal, the abstraction of a very large quantity of its water by Water Companies, and the superabundance of swans, which a mistaken and extravagant appetite for the picturesque has crowded it with, have all contributed to render fishing on it for a very considerable portion of the year, and, save under very favourable circumstances, a very bootless occupation. I can remember the fishing of the Thames for twenty-five years, and I do not hesitate to say, that it has been steadily growing worse and worse. It is certainly very praiseworthy of the Society to do what they can to arrest the progress of the evil, but they cannot do impossibilities.

Unfair fishing and poaching they can do something to check, but these are the least of the evils the river suffers

from. The other matters are almost beyond their reach. It takes a long, long time, where the fish have fair play, to fish a river out; and I believe that, if the Thames had fair play, no amount of fishing would do so: but with the swans to eat the spawn by barge-loads, the sewage to cut off the most valuable part of its fishery from the sea, to the extinction of salmon, sea-trout, shad, lamprey, sturgeon, &c., the immense diminution of the eel and other valuable fish, and the yearly slaughter of myriads of such fish as are left to us; with the canalization of the river,¹ which has for a long series of years been going on under the management of the Navigation authorities, so that

¹ That I am not writing without being able to give instances of the exceedingly destructive effects of canalizing rivers, I will cite two instances on the Thames, both of which came immediately under my notice. Many years since one of the best fishing places on the Thames was Hampton Court, or rather Moulsey. At that time opposite the lock, on the other side of the river, was a very deep hole, with a strong eddy; the bottom of this hole was covered with all sorts of rubbish, old punts, old trees, &c. &c., amongst which any quantity of fish could always, in all waters and weathers, find a secure and quiet harbour. Barbel of almost (now) fabulous size used to tenant it, while the bream and chub found in it seemed inexhaustible. Many and many a hundredweight of fish have I, with poor old Bill Wisdom's assistance, coaxed out of that hole into my punt—well. When the new lock was made, this hole was partially filled up. It was thought that the eddy exercised a malign influence on something or other, although, as an engineer, I never could make out what or how: it was, however, thought necessary to mitigate the hole, and mitigated it was accordingly; and the fishing has never recovered the blow it then received. Again, Hampton deeps were, perhaps, with the exception of Shepperton, the most famous on the river. There were many excellent swims in them. Barbel of huge size were constantly taken there. Bream abounded, and other fish were found there in proportion. Some

the haunts of the fish are destroyed wholesale, the only wonder is that there are any fish at all in it. I may say here that the latter process is one of the very worst blows which can be dealt to the fisheries of any river ; it is one which has destroyed the fishing in half the rivers in France. Fish like natural rivers, alternate deep holes and shallows, sharp elbows, and rapid streams : navigation likes a straight cut of uniform depth and uniform strength of stream ; but when a heavy flood comes in such a straight cut, where are the fish to go ? In this case, down into the London sewage. It could only be expected that these things would in time produce the effect which they have produced, and in seeking to provide sport for its supporters by doing their best to increase the best kind of fish found in the river, viz. the trout, and introducing a valuable sporting fish like the greyling, the Society have certainly done all that they could do under the circumstances. They do well to breed trout, and there can be no harm either in their hatching and turning a few thousand of salmon into their river yearly in expectation of its eventual purification by means of the main drainage scheme. Some years ago I suggested in the *Field*, the introduction of the greyling into the Thames by means

years ago something was found to be requisite at the tumbling bay below, and in the interests of navigation a solid bay was made, which was very much higher than the old one. This checked the stream which used to run through the deeps, and forced it all round on the other and more shallow side of the ait. Hampton deeps are now very little better than dead water, and the fishing there is destroyed. These are two out of many cases which could be cited.

of artificial hatching, seeing that the process had been successful on the Clyde, and I also advocated the increase of the stock of trout by the same means. After considerable discussion, the matter was at length taken up, and a committee, consisting of Messrs. Lawrence, Ponder, Hedges, Buckland, and myself, was formed to carry out the process. The first year we got our apparatus ready, but hatched only a few perch. The next year we hatched and turned out about 30,000 young fry, the majority consisting of trout, with a few salmon, some Rhine salmon, ombre, chevalier, and sea-trout. A few adult greyling and trout were also placed in the river. I had nothing to do with the subsequent proceedings. The next year a larger number of salmon was turned out, a considerable number of trout, and a small number of greyling fry; about 33,000 in all. Last season, that of 1863 and 1864, according to their report, they turned out about 40,000, 12,000 of which were salmon, and a considerable portion of trout, but no greyling. It is scarcely probable that the results of these operations will be immediately evident; still it can hardly be doubted that, if they are continued, a few years will see an improvement in the trout-fishing on the Thames. The greyling may eventually be established wherever the streams are found to suit it; and if the "Drainage" scheme is found to render the river sufficiently pure for the purpose, the Society will have the credit of having done much towards the re-stocking of the river with salmon. These are benefits to the river which deserve the commendation and support of the public. The Society have nearly twenty miles of the chief part

of the river under their protection ; and as netting is now abolished in these waters, should salmon ever be brought back to the river, this twenty miles of freedom from nets will be an invaluable safeguard to the fishery.

VIII.

SALMON-STAIRS.

I HAVE spoken of salmon-stairs. These are certain appliances adapted to falls or weirs, for the purpose of breaking one large fall into a number of small ones, and so giving the ascending fish an opportunity of breaking

the journey up it. When the fall is tolerably light and not perpendicular, as over weirs for example, the task is easy. A large trough is fitted to the weir, the part being

selected where most water flows over. In this trough are fixed stout, transverse boards or steps, properly supported, to resist the weight of the stream. Stone will be found cheapest in the long run. These boards or steps do not of course continue entirely across the trough, so as to bar the fish out; but an opening is left at either side alternately, through which the fish can rush. In fact the stream, instead of being in one fall impassable to the salmon, is broken up into many falls, each in turn being easily passable.

The accompanying diagram will illustrate the manner in which this is contrived. The arrows denote the direction of the stream, and it will be seen that behind every step the salmon can find a safe resting-place. When the fall is very heavy and perpendicular, it is less expensive to make a cut round it, which is done by digging a passage from some distance above it, as close to the foot of the fall as possible,—this cut, of course, being broken up by steps into a series of small falls, easily practicable to the fish. This plan was adopted at Ballisodare and at Lough Mask.

IX.

COREGONUS LAVARETUS AND FERA.

I GIVE here short descriptions by Dr. Carl Voght of the above two fish; not of course adopting those descriptions

or opinions, but simply that students may have an opportunity of weighing testimony :—

“ THE GANGFISH.

“ The Lavaret (*Coregonus Lavaretus* or *Wartmanni*) of the Lakes of Bourget, Geneva, and Neuenberg, appears to be the same variety as the *Palée blanche* of the Neuburg Lake, the *Neuerling*, *Stuben*, *Gangfish*, *Renker Drewer*, the *Blanföfchen* of the Lake of Constance, the *Bälchen* of the Lakes of Zug and Lucerne, the *Aalbock* of the Thun and Brienz Lakes, the *Edelfish* of the Lake of Lucerne, and the *Renke* of the Upper Bavarian lakes.

“ BODEN-RENKE (*Coregonus Fera*).

“ A second larger species of the *Fera* (*Coregonus Fera*) of the Lake of Geneva, the *Weisföfchen* or *Sand-gangfish* of the Lake of Constance, the *Bläuling* or *Bratfish* of the Lake of Zurich, the *Boden-renke* of the Starnberg Lake.”