BULLETIN

OF THE

UNITED STATES FISH COMMISSION

FOR

1887.

1.—REPORT ON A SUCCESSFUL ATTEMPT TO INTRODUCE LIVING SOLES TO AMERICA.

By THOMAS J. MOORE,

Curator of the Liverpool Free Public Museum.

[Abstracted from the Proceedings of the Literary and Philosophical Society of Liverpool, No. XL, 1885–'86, p. 185.]

The geographical distribution of animals has important bearings on the welfare, comfort, and luxuries of mankind. The camel of Arabia, the reindeer of Lapland, and the fur-bearing animals of the far West are examples among mammalia. The naturalizing of the fowl, turkey, and pheasant are examples among birds of the extent to which man can influence their distribution for his own benefit, and the progress of the modern science of fish-culture promises well for the naturalization of important and delectable food-fishes in parts of the world where they did not previously exist.

The success which, after repeated failures, crowned the efforts of the persevering men who have introduced salmon and trout to Australia and New Zealand is a case in point, and the successful breeding of the American brook trout (*Salmo* or *Salvelinus fontinalis*) in Britain is another. Now the American lakes, rivers, and coasts, though abundantly supplied by nature with food-fishes both of nutritious and dainty kinds, are not provided with certain sea fishes with which we are specially favored in the British Islands, and which are in the highest esteem for the table. The American States on the Atlantic side have neither soles nor turbots, and as a consequence the Americans are not happy.

In the Gulf of Mexico and East Florida they have a couple of flounders, and they have there also another flat-fish (*Hemirhombus pœtulus* Bean), but of this last all the specimens but one were taken from the

stomachs of red snappers (*Lutjanus blackfordii*). The limited supply of this flat-fish being so largely appropriated by appreciative snappers, there remain only the flounders, and what are they that they should serve as substitutes for soles or turbots?

The absence of the sole and the turbot has of late impressed itself on the American mind, and some ten years ago Prof. Spencer F. Baird, the head of the United States Commission of Fisheries, took the matter seriously to heart. The success which has attended the manual propagation of the salmon and other important food-fishes in Europe and America led him to consider the possibility of this method to supply the deficiency. With this object in view he wrote to me, asking if facilities would be given for the purpose by the owners of Liverpool fishing-smacks, if he sent a couple of agents from America to manipulate the spawn of soles and turbots as soon as taken from the trawl. The late Mr. Isaac, of St. John's Market, at once promised every facility for the purpose, as far as boats and trawls were concerned, but pointed out difficulties as to times and seasons which then, at least, were unfavorable.

Subsequently Professor Baird changed his views as to this method of proceeding, and determined to experiment on the transportation of the fish alive. To this end, after inquiries made, he put himself in communication with Mr. W. C. L. Jackson, then chairman of the Southport Aquarium Company, who, with Mr. Long, the manager, entered heartily into the proposal, for the mutual benefit of both parties by exchanges.

Accordingly soles and turbots of moderate size were obtained from the local fishermen and placed in the store-tanks of the Southport Company, where they remained in readiness for shipment. One of Professor Baird's practical fish-culturists, after delivering large numbers of impregnated ova of *Salmonidæ* in London and on the Continent, arrived at Southport, and after most careful preparations for transport shipped a moderate supply of fish. Great attention was paid during the transit as to temperature and aeration, but only two soles out of thirty shipped survived to be put out in Massachusetts Bay,* or less than 7 per cent. The losses were believed to be due to the fall of temperature when off the banks of Newfoundland. This was in January, 1878, and was very disheartening. A second attempt, in 1879, was a complete failure, as the fish were taken by rail from Southport to Southampton for shipment, and were bruised and fatally injured by the roughness of this overland journey.* Another attempt was made from Southport, in 1881, with poor results. Seventy soles were shipped on board the Parthia, and only three arrived out alive, or about 4 per cent.

In April, 1880, Capt. John H. Mortimer, a native-born American, first associate member of this society, had come in with his simple ship-aquarium, which I, at its first introduction some twenty odd years ago,

* Forest and Stream, November 3, 1881, p. 274.

named after him. In three or four of these Mortimer ship-aquaria he succeeded in safely landing five young soles out of nine that were shipped, or a proportion of over 50 per cent. These were provided by and sent from this Museum, and were deposited by Mr. Eugene G. Blackford just outside of Sandy Hook. This amount of success pointed to at least one promising method of solving the problem how to get soles alive across the Atlantic, and the trial in this case was the more severe inasmuch as it took place in a slow-sailing cargo ship, and not in a steamer. It had the great advantage, however, of Captain Mortimer's unremitting attention.

During the present autumn (1885) Mr. W. A. Duncan, of the firm of Duncan & Sons, fish-merchants at St. John's Market, Liverpool, being about to spend a few weeks in the United States, informed me that he contemplated taking some live soles with him. They were to be carefully collected by his own trawlers, and he was anxious respecting the best method of transport, about which he was desirous of consulting me. On due consideration, he ordered a supply of fish globes and slung them up on Captain Mortimer's plan. Circumstances, however, prevented him from carrying out his intention, and he had reluctantly to give it up.

By permission of the Liverpool Library and Museum Committee, I had placed half a dozen small soles, from the Museum aquaria (where they had become "seasoned" and accustomed to confinement), together with one of Mr. Duncan's own specimens, in Mortimer aquaria, with a desire to take advantage of Mr. Duncan's kind offices in bringing something in return for them on his voyage home. Being desirous of adding to our American specimens by way of exchange, I applied to Mr. W. S. Graves, who, on behalf of the White Star line, kindly gave permission for half a dozen globes to be shipped immediately before sailing, on October 8, 1885, by the steamer Britannic, under the command of Capt. Hamilton Perry. The six globes, with two soles in each, were delivered on board by Mr. R. Paden, Museum assistant, and by Captain Perry's direction were suspended in the saloon, and open, of course, to constant observation. My only fear, on hearing of their being so honorably placed, was lest the temperature might be too high. Great, however, was my satisfaction, on going on board immediately on the return of the Britannic to Liverpool, to hear that of the supposed dozen specimens three had died, and eleven had been delivered alive and in good condition. This report, though so eminently satisfactory, was, to say the least, somewhat puzzling. The discrepancy in numbers was, however, due to a couple of fish having so effectually buried themselves in the bed of sand, with which each aquarium is supplied, as to be unobserved when the census was taken before leaving the Museum. This result is equal to more than 78 per cent. delivered alive.

A report in the American Angler, published in New York on the 24th of October, states that "these soles are to be sent to the Cold Spring

Harbor Hatchery on Long Island and afforded facilities for breeding which it is hoped they may sensibly avail themselves of. The sole is, without question, the most delicious of the flat-fishes for the table, and its addition to the food-fishes of our waters would be a very valuable acquisition."

Mr. Blackford wrote as follows, under date of October 31, 1885:

"I received by the steamer Britannic the lot of soles which you have so kindly sent to this country, and I must congratulate you upon the success which attended their safe transportation. * * * I shall take great pleasure in sending you, at the first opportunity, some of the living amphibians, &c., which you desire."

The aquaria, or fish globes, used in the transport of these fish are of thick glass and weighty. They are 14 inches in diameter at the middle, 7 inches across the mouth, and hold about 4 gallons of water. They simply rest each on a circular wooden disk, an inch thick and 16 inches in diameter, suspended by light cords to a stout ring, by which they may be hung on a hook, like a swinging lamp. A layer, an inch or two in depth, of fine sea-sand from the Cheshire shore covered the bottom of each globe, which was rather more than half filled with sea-water. The whole affair is simplicity itself, and would be almost absurd for the accomplishment of any serious purpose if it was not for its proved success.

That it is not to be despised, however, is evidenced by the following summary of what has been accomplished with it in the service of the aquarium of the Liverpool Museum, as given on the placard attached to the pair of globes now exhibited, each globe containing a couple of soles* as in the experiments above recorded:

"By the simple contrivance of suspending ordinary fish globes (the most convenient vessels for the purpose) after the manner of cabin lamps, small aquaria of considerable utility can be kept at sea as easily and safely as on shore. They thus supply a very convenient means for the observation and study of the various living objects of small size obtainable by the dredge or by the towing net, and also afford a pleasant and useful resource to break the dull monotony of life at sea.

"Originally designed by Captain Mortimer to facilitate his own studies, and for the conveyance of living American fish to the Liverpool Free Public Museum, they have been the means, by himself and others, of importing to the aquaria of that institution a considerable number and variety of living fish and other objects, not only from New York, Boston, and other parts of North America, but also from Brazil, from Chili, from the Mediterranean, from the West Coast of Africa, and from the

* These soles so effectually buried themselves in the sand at the bottom of the globes that it was necessary to stir them up with the hand to prove they were really there; indeed, I had to do the same thing before bringing the globes to the meeting, to satisfy myself. This is conclusive proof of the kindly way in which they take to the sandy bottom provided for them.

Indian Ocean; and although the capacity of such simple vessels is necessarily small, it has sufficed for the successful importation of several young sturgeons from Hamburg to Liverpool."

The special advantages of the Mortimer ship-aquarium, for purposes like the present, are as follows:

(1) Its extreme simplicity, and the small amount of trouble involved.

(2) Its handiness in conveyance to and from the ship, as well as on board.

(3) Its transparency, giving every facility for observation, whether for study or mere inspection as to purity of water and health of fish.

(4) Its easy swinging motion when suspended, the surface of the water being but little disturbed during considerable departure from the vertical center.

(5) Its facilities for feeding the fish if required, and for the removal of refuse, as also for drawing off the water when requisite, and supplying clean water in its place.

(6) Its facilities for simple aeration.

(7) Its saving, more than any other form of vessel, of the fish from injuring themselves by striking against the prison walls, by the motion of the ship or otherwise, a matter of the greatest importance.

(8) Its comparative strength, similar aquaria having been carried four times across the Atlantic in all weathers, and in the long voyages of a sailing ship, without coming to grief.

(9) It facilitates also the use of sand as a bed or bottom.*

The soles, by the waving motion of their body and fins, cause the sand to rise, and, in falling, to cover them so effectually that they are scarcely discernible, as evidenced above. Sometimes only their eyes, or an outline of the head or body, can be seen; at others a circular track only is visible, caused by the continued moving of the fish, which perforce results in a circular outline of its track. The comfortable look of the soles, often to be seen in our large aquaria, was so striking in those put into the globes for Mr. Duncan that it made me more than ever bent upon so accommodating them. They had all the appearance of being literally tucked up in their bed, and lightly breathing.

These advantages are difficult or impossible of attainment, singly or in combination, in vessels of wood or iron. Much ingenuity has been exercised as to the construction and aeration of tanks of various kinds and sizes and the regulation of temperature for transporting soles on a far larger scale, but the results hitherto have not been commensurate with the labor expended, and the importation of soles to America in greater numbers than above recorded has yet to be accomplished.

There is, however, an all-important matter requiring attention besides the form of vessel in which the soles are to travel, and that is, as

* I attach great value to this use of sand, and always use it or an equivalent in all aquaria. The late Mr. W. Alfred Lloyd objected to it as likely to choke any fish, but I have never found it to do so; on the contrary, the gills keep themselves clear from its intrusion by their own action.

in so many other matters, you must first catch your fish, which itself is comparatively easy; but this is not enough, you must catch him without injuring him, which is by no means so easy, at any rate with a trawl, and impossible in a trawl working in the ordinary way for fish for market. Trawls so working are down for several, perhaps five or six, hours. And how can fish, especially small ones, escape without bruises of every degree of violence? And how can bruised fish be expected to live? Now the soles in the Museum aquaria are of small size, from 4 or 5 inches in length upwards. These are caught and brought in by poor boatmen, fishing with small nets only, in or at the mouth of the Mersey, and consequently the fish are less injured. The specimens sent to America were thus caught, and had time to die or to get well and used to confinement, "seasoned," in fact, or "educated," as Mr. Duncan called it, before being "transported." These circumstances have doubtless had a share in the success of the venture, the main cause of which was due to changing the water carefully every day. The three deaths mentioned occurred before the water was so changed, and none occurred after in that consignment.

Mr. Blackford has already sent in return living specimens of the *Limulus*, or king-crab, and promises fish and amphibia to follow. King-crabs are not new to us, but we have long been without them. Our first living specimens were brought by Captain (now Sir James) Anderson, while in the Cunard service, prior to laying the Atlantic cable from the Great Eastern steamship. That supply, I think the first imported to England, besides supplying our own wants to the full extent of our accommodation, enabled us to send living examples to London, Oxford, Dublin, and elsewhere.

Dr. David Walker, late naturalist to the Fox Expedition in search of Sir John Franklin's remains, going on a visit to Paris, kindly took one wherewith to initiate friendly relations with naturalists there. But the professor he took it to was at dinner and would not be seen, and was so long at dinner that Dr. Walker took umbrage and brought his king-crab back again across the Channel, till, just before landing, his patience and endurance being quite exhausted, he threw the exceedingly awkward prickly creature overboard. Some short time thereafter Dr. J. E. Gray, of the British Museum, received a specimen which had been washed ashore on the south coast, and, therefore, positively asserted it to be an important addition to the marine fauna of England.

Very recently several further consignments of soles have been successfully made by the same means and by the same channel as before noted. It has been found that four specimens may be safely transmitted in each globe, and on one occasion I was informed by Mr. Bartholomew, the chief steward of the Britannic, that every one of the twenty-four shipped in the six globes arrived alive at New York, showing that complete success is possible of attainment, though of course

some losses will generally occur. Mr. Blackford, previously to this, had written as follows:

"JANUARY 13, 1886.

"I am in receipt of your esteemed favor of the 31st ultimo, and am also in receipt, per steamer Britannic, of the live soles. I cannot express my joy and gratitude in view of the interest your institution has taken in this exchange. I see in it the promise of the successful carrying out of what I have long desired, that is, the importation of a sufficient number of these fish to enable us to determine whether they can be acclimated and reared in our waters."

Of one of the late consignments, Prof. Spencer F. Baird, head of the U. S. Fish Commission, wrote thus to me:

"WOOD'S HOLL, MASS., *July* 16, 1886.

"I am happy to report the success of the latest shipment of soles made to Mr. Blackford, per Britannic, for the service of the U. S. Fish Commission. Twenty of the twenty-five shipped are alive and in good condition, and feeding voraciously in our tanks."

Of a still later consignment of twenty-four fish, of which six died, possibly from the excessive closeness and warmth of the weather before the Britannic reached Queenstown, Mr. Blackford wrote as follows:

"NEW YORK, *August* 26, 1886.

"I received through the hands of Mr. Bartholomew seventeen live English soles, which I at once forwarded to the U. S. Fish Commission's headquarters at Wood's Holl, sending a special messenger along with them, and he has just returned, reporting their safe arrival at that point, where they were placed with the previous lots. We are keeping these fish in large salt-water ponds to see if it is possible to breed them there."

LIVERPOOL, ENGLAND, *September* 16, 1886.

2.—THE CANADIAN AND AMERICAN FISHERIES OF THE GREAT LAKES.

By JOHN H. BISSELL.

One of the ways in which the Canadian treatment of the general subject of fisheries is valuable is the exact and useful knowledge which they obtain of the whole subject. This accurate knowledge of the fisheries is serviceable in many ways. For instance, it enables the legislature to know its importance as a subject of legislation; it tallies from year to year the success or failure of the preservative measures; it points out distinctly the value of artificial propagation and the points at which natural sources of resupply need re-enforcement by artificial and scientific methods. The Canadian reports show the total value of the fishery product of the Dominion, and also minutely the relative value of each item or variety of fish, as well as that for each province.