

56.—FISH-CULTURE AS SEEN AT THE LONDON EXHIBITION, WITH SPECIAL REFERENCES TO ITS HISTORY, APPARATUS, AND THE METHODS USED IN THE UNITED STATES.**By A. A. W. HUBRECHT.***

“Neglected” is an ugly word; wherever it is spoken, the idea of “neglect of duty” seems to be implied.† Whenever a public interest is referred to, such neglect of duty can only be laid to the charge of the Government. This does fortunately not yet apply to the subject of which I am going to treat. The Government of the Netherlands has for a long number of years taken a lively interest in everything relating to our fisheries. Many measures taken by our Government show that it has at all times not only watched over the interests of our fisheries, but has also occupied itself with the question so intimately connected therewith, viz: Are our rivers, our inland waters, and the lakes along our coasts sufficiently supplied with fish; and, if not, how can the number of fish be increased? If there can be any question of neglect of a public interest, this can surely not be laid to the charge of our Government. Now, however, is the time to strain every nerve, if we desire to reap the fruits of the seed which has been sown here and elsewhere, and not to allow ourselves to be outdone by others.

If any one wishes to be convinced that a great public interest of the Netherlands is in danger of being neglected, unless the matter is taken in hand speedily and energetically, let him this summer visit the International Fishery Exposition in London.

After having left the Exhibition road, you turn to the left, and, by paying a shilling, are privileged to enter the portals of this world’s exposition, the seemingly endless hall extending before you, in which the British exhibitors have placed on exhibition innumerable models of ships and fishing apparatus.

About half-way up this hall you turn to the right, and you soon find yourself between the Netherlands’ and the Danish exhibit. Whilst the former, with its large number of nets, gracefully arranged, immediately makes you feel that you are in a Fishery Exposition, the latter, through its Arctic colonies, represented by skins and fishing apparatus from the cold North, forms a suitable transition to the Newfoundland exhibit, where ice bergs and seal-hunting will engage your attention. Turning again to the right, and proceeding a few steps, you find yourself in that

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† The title of this article in the original was “A neglected public interest.”—EDITOR.

part of the Exhibition where I intended to lead you, and where I shall hold you for some time, viz, the exhibit of the United States. Here you find gathered, with astonishing completeness, everything relating to the fisheries of the Union. Do not ask me how much Congress appropriated to cover the expense of America's share in the great London Exposition; but if you should ask, and receive an answer, don't compare it with the amount which the Netherlands exhibit had at its disposal; or, rather, keep in mind the comparison between the two sums whenever you wish to compare the completeness of these two exhibits.

This, however, is not the principal object of our visit to this exhibit, and its tasteful arrangement must not cause us to forget the circumstance that, for the present, we only wish to become acquainted with a part of it, viz, that relating to fish-culture. Every one knows what this word means. But it may not be generally known that the first fish-culturist was a German, by the name of Jacobi, who lived from 1709 to 1784, and who, in the year 1765, published a work on the subject, which was the first of the numerous publications relating to fish-culture which have appeared since. "Breeding of fish," "artificial breeding of fish," these are two other terms for the same idea, viz, that of human aid extended to fish at the time when they propagate their species. This aid consists in accelerating the production of the eggs, in impregnating them, and in protecting both the eggs and the young fish during the first period of their development.

It is self-evident that under these circumstances a couple of fish can produce a much larger number of offspring than when they are left to themselves, when the eggs, from the moment they have been laid, are, on all sides, exposed to numerous dangers, from which they are protected by man's interference. Hence the term "artificial breeding of fish," which, however, is not well chosen, as the whole process of breeding and the development of the egg takes place in an entirely natural manner, human aid only being engaged in removing as much as possible everything that could hinder or injure this natural process. If for this more numerous offspring suitable natural conditions can be found, such as good water and good food, there is no doubt that, by a constant repetition of this experiment, the quantity of fish will be considerably increased, and consequently a larger supply of healthy human food will be furnished, and the interests of the fishing-trade will be furthered, if not by securing a larger revenue to the fishermen, at any rate by giving employment to a larger number of people. By a rational application of the rules of systematic fish-culture, the well-being of a country—provided it possesses a considerable area of water, and a large portion of the population is engaged in the fisheries—can be furthered rapidly and substantially. Opinions, however, may be divided as to the idea of rational application; and here we are met by one of the main questions relative to fish-culture as a public interest.

This will become very evident if we look round a little in the Ameri-

can exhibit, and compare it with the efforts in fish-culture made by other countries represented in the Exhibition. We shall very soon become impressed by the fact that whilst in Europe fish-culture, if not exclusively, at any rate principally, occupies itself with the *Salmonidæ* (salmon and trout), America also raises artificially other kinds of fish. We find that, besides the *Salmonidæ*, America raises, on a large scale, fish belonging to the *Clupeidæ* and the *Cyprinidæ*, and even codfish (*Gadidæ*). As regards the last-mentioned species, this seems almost incredible. Whenever I have taken the trouble to protect a codfish, when still in the egg, and as a young fish, I found that in that condition it was worthless for me, because, to make it grow as it should, it must return to its own element, the sea; and there to find him again at a later period seems just as hopeless as the desire of Polycrates that the waves of the ocean should return to him his golden ring! And still, correct as this reasoning may appear, the Americans will prove the whole thing to us, even if you should wish it, in dollars and cents; whilst the happy fishermen of Gloucester, Mass. would soon convince you of the contrary, if you were to tell them that their increased cod-fisheries were simply caused by accidental circumstances, and not by the energetic work of Prof. Spencer F. Baird and the United States Fish Commission.

The fact that such a conservative class of people as the fishermen have so soon become convinced of the favorable results of the artificial breeding of codfish, finds its very simple explanation in the circumstance that those codfish which from the very beginning have been experimented with belong to a gray variety, whilst so far almost exclusively reddish codfish were caught in those regions. The year following the first experiment numerous young codfish of the gray variety were caught; likewise in the following year, when they were considerably larger; and in the third year even the greatest doubters had become convinced. Satisfactory proof had been furnished that codfish placed in the sea either remain in the same region, or, *at any rate, return to the neighborhood where they had been originally placed by the fish-culturists.*

I have specially cited this example with the view of illustrating what in my opinion, is the proper meaning of the term "rational application." It takes the form of "care of the Government," "matter belonging to the Government," not of private initiative or private industry. I ask, what private individual would have furnished the money to place millions of young codfish in the sea? And if such a man had been found, his future heirs would justly have called him light-minded, and he would have run the risk of being placed under supervision of proper persons as being a spendthrift. But when the Government makes these experiments and makes practical application of the results of such experiments on a large scale, it encourages not only an important branch of industry, but the increase in the number of fish caught will prove a benefit to the general public. The chairman of the American division said to me, "In our country we would as little think of leaving

fish-culture to private effort as of taking from the hands of the Government the care of the light-houses."

Well said; but probably not very pleasant for the ears of true adherents of the Manchester school. These words should be taken to heart in Europe, and especially in the Netherlands; although it must not be forgotten, that with us the propagation of the salmon, which is strongly encouraged by the Government—also financially—is in good hands, and that four institutions rival each other in producing young salmon, which are, at the rate of half a million per annum, placed in our rivers. Where private efforts aided by the Government have already obtained such important results, it would not be advisable all of a sudden to place the whole matter under Government care. But we mentioned already that in the public interest, of which we are speaking, the salmon is only concerned to a limited extent. River fish like the shad, pond-fish like the carp, and sea-fish like the cod, are still waiting for the hands and brains of men willing and competent to increase their number tenfold.

It is in our immediate interest that such men be found in the Netherlands, so we may be the first to reap the fruits of America's teachings, and to take the front rank in the European fish markets which belongs to us, on account of our more numerous marine products, rather than to other countries which, owing to their nature and location are less favorably situated, and are not able to imitate the example set by America as well as we can. Let us briefly review the history and practical application of fish-culture in America:

Although as early as 1853 experiments in fish-culture were made in the United States by private individuals, the first public measure of importance was not taken till 1856, when the State of Massachusetts appointed three "fish commissioners." The question was not yet ready for solution. It was not till 1865 that the same State appointed a permanent Fishery Commission.

"Meanwhile an enterprising private individual, Mr. Seth Green, had, in 1864, succeeded in showing that fish-culture may be carried on in such a manner as to become a source of pecuniary profit; and in 1867—only sixteen years ago—the first piscicultural establishment in the United States was founded by the State of Massachusetts. Till the year 1870 various kinds of fish, especially shad and trout, were raised with constantly increasing success, the above-mentioned Seth Green taking the lead, and distinguishing himself, among the rest, by the invention of the "shad-box."

The year 1871 was doubtless the most important year in the history of American fish-culture; as that year was to witness the founding of two institutions, originally differing in their character and independent of each other, but later mutually aiding each other and thereby exercising a most beneficial influence on each other's activity. I refer to the "American Fish-culturist Association" (which in 1876

changed its name to the "American Fish-cultural Association"), and to the "United States Fish Commission." Of the nine Government institutions, which are either wholly or in part intended for making investigations on the field of pure and applied science, * the United States Commission of Fish and Fisheries is at this day, to quote the words of its historian, "*the most prominent of the present efforts of the Government in aid of aggressive biological research.*" Every person in Europe who has followed its career and who has studied its reports, will cheerfully subscribe to the truth of the words quoted above, which in such terse form expresses the deep interest which the Government of the Union takes in these researches; and we must not fail to mention that the energetic American mind did not only invent this term ("aggressive research"), but that it has also understood to make the aggression in such a manner as to conquer all opposition.

On the 9th February, 1871, a joint resolution of Congress authorized the Government to appoint a "Commissioner of Fish and Fisheries." Year by year it had become more evident that the Central Government must give the first impetus towards a new development of the fisheries. A person was already in view who by his learning and experience would be the man to be placed at the head of this new Commission. This person was Prof. Spencer F. Baird, the one who, at the Berlin Fishery Exposition, was awarded the great prize of honor which the Emperor of Germany has given for the best exhibit. The object for which he was appointed was indicated by the following: "to prosecute investigations on the subject of the diminution of valuable fishes with the view of ascertaining whether any and what diminution of the number of food fishes of the coasts and the lakes of the United States has taken place; and if so, to what causes the same is due; and also, whether any and what protective, prohibitive, or precautionary measures should be adopted in the premises, and to report upon the same to Congress."

It will be seen that in giving this charge fish-culture was not yet mentioned. Nothing was done in this direction until 1872, when representatives of the Fish-Cultural Association petitioned the Government to make the necessary appropriations for this purpose. Congress granted the petition. Every year this item is given in the appropriation bill, and the amount has been increased from year to year. At the same time fish-culture has occupied a place of constantly growing importance on the programme of the Fish Commission. More than a million dollars has, during the last twelve years, been appropriated by the Government of the Union, whilst the thirty-one States which had created Fish Com-

* These nine institutions are: (1) The Geological Survey; (2) the Coast and Geodetic Survey; (3) the Naval Observatory; (4) The National Museum; (5) the Department of Agriculture; (6) the Entomological Commission; (7) the Tenth Census; (8) the Smithsonian Bureau of Ethnology; (9.) the United States Commission of Fish and Fisheries; to which must be added, as an institution founded by private individual, the Smithsonian Institution.

missions of their own appropriated sums for this purpose varying from \$1,000 to \$10,000.*

These figures will show sufficiently what pecuniary sacrifices the United States have cheerfully made in the interest of fish-culture; and we must now give some attention to the work of the Commission, which shows very important results.

In the first place it inaugurated a systematic investigation of the various rivers and water-courses of the United States, and of the physico-biological laws and problems which govern and relate to the life of fish in these waters. In making this investigation the Commission did not confine itself to those fish which are useful to man as food, but considered its task from a broader and more generally scientific point of view.

It devoted its attention alike to all inhabitants of the water; it gathered data for a natural history of all kinds of fish; it learned to know not only the fish themselves, but also their friends and enemies, their food, and the dangers threatening their life. At the same time it gave its attention to the food and the enemies of the various animals, both useful and hurtful, which share the water with the fish. Nor did the Commission fail to take note of the currents and their degree of swiftness, of the temperature of the water, and of many other physical conditions which exercise an important influence on the life and growth of most fish, and which doubtless have a good deal to do with the periodical migration which many kinds of fish undertake at certain seasons.†

In various ways a large collection of different fish and other marine animals was gathered, which formed an invaluable material for scientific investigations.

To aid the work of the Commission a steamship, the *Albatross*, was built, and which was first used by the Commission for studying the migrations of the mackerel, and the food and migrations of the herring. It has, moreover, now been resolved to establish a large and permanent zoological station at Wood's Holl, for which \$25,000 have been appropriated.

In the second place the Commission devoted its attention towards obtaining the most accurate data relative to the different methods by which the fisheries are carried on, and to the history of the fisheries.

* The following are the exact figures: New Hampshire, 1866-'79, \$22,663; Vermont, 1871-'79, \$7,880; Connecticut, 1868-'70, \$43,300; Pennsylvania, 1873-'80, \$99,030; Maine, 1867-'80, \$36,975; New York, 1868-'79, \$165,000; California, 1870-'79, \$37,000; New Jersey, 1871-'80, \$29,500; Rhode Island, 1870-'79, \$10,500; Ohio, 1873-'80, \$29,000; Wisconsin, 1873-'80, \$38,800; Iowa, 1874-'80, \$22,750; Minnesota, 1875-'80, \$22,500; Kentucky, 1876-'80, \$11,000; Kansas, 1877-'80, \$2,000; Colorado; 1877-'80, \$2,400; Nevada, 1877-'80, \$5,000; West Virginia, 1877-'80, \$3,900. [Cf. p. 150.]

† At the instance of my honored colleague, Prof. Buijs Ballot, director of the Meteorological Institute, observations have also been taken in the Netherlands, on board vessels which were engaged in the herring fisheries, relative to the influence which the temperature of the sea-water exercises on the migrations of the herring. These investigations, however, have been discontinued for a number of years.

This includes the gathering of extensive statistics relative to the fisheries and the fish trade.

In this way the Commission hopes to obtain an accurate knowledge of the influence which man is capable of exercising on the decrease or increase of fish; it also endeavors to make its work one of practical usefulness by directing attention to fishing-apparatus which threatens to cause the extinction of certain species of fish, and for which other, less hurtful apparatus might easily be substituted.

Recently Congress appropriated \$60,000 for gathering these statistics. The report of these investigations comprises about 3,000 pages, with 700 to 800 engravings. Of this report 10,000 copies will be printed, and freely distributed in the most liberal manner. A total sum of \$30,000 was appropriated for the publication of this work.

After having given some idea of the extent of the worth of this comparatively young American Fish Commission, and having anew assured our readers—as will become still further evident—that its work has borne rich fruit in all directions (which fact is also proved by the constantly increased appropriation annually made for this Commission), a comparison between America and the Netherlands—as regards activity in this field, may not be out of place. The Netherlands have possessed since the year 1857, and therefore for a period of more than twenty-five years, its Board of Sea-fisheries. This Board was exclusively an advisory body, advisory in the sense of directing the attention of the Government to existing abuses or defects. In other words, it took the initiative in all matters relating to the interests of the fisheries. Among the many important measures taken by the Government at the advice of this Board, confining ourselves to the most recent times, we will mention the abolition of the Government stamp on the herring-barrels, which caused a considerable increase in the quantity of herring exported from the Netherlands and the law of 1881 regulating the fisheries in the Zuyder Zee.

With regard to this last-mentioned law, whose practical advantages and disadvantages we will not discuss in this place, it would have been desirable to consult naturalists and profit from their knowledge and experience. In fact, the need was felt of a firm scientific basis for those rules and regulations which were to govern the fisheries. And for such a basis there was hardly any material whatever. It became evident that such material could not be obtained except by "aggressive biological research," and that not even a beginning had been made with the necessary investigations.

America, however, had set the example. Encouraged thereby the above-mentioned Board urged upon the Government the desirability of establishing a permanent zoological station at some place on the coast—best at Nieuwediep—with a permanent director and a changing staff of young and active assistants, for an exhaustive study of all the questions relating to our coast fisheries, with a view of drawing up reliable regu-

lations for governing these fisheries.* But alas the memorial of the Board did not meet with a favorable reception by the majority of the lower House of our Parliament. In spite of its being strongly advocated by Minister Klerch, many of the members could not see the direct use of such a measure (see the speeches by several members of the lower House), and in December, 1881, the motion, when put to the vote, was lost, 26 voting in favor, and 41 against it. Perhaps the time is near—and would that the London Fishery Exposition might hasten it—when the eyes of our representatives will be opened to the great importance to the welfare of our country of “aggressive research.” Some energetic men, to take the matter in hand, and a liberal appropriation for carrying on the work would be the warm sunshine and the powerful fertilizer which would in a short time turn this barren field into a rich and productive one, thus proving a benefit to our entire country.

But even more than these investigations, the importance of the third part of the programme of the United States Fish Commission will be evident to any one who has given some attention to the subject; I mean the carrying on of fish-culture on a large scale, and by the Government. And of its importance I would like to convince all my readers. For this purpose I must give a more detailed description of the manner in which, in America, this “Government care” is exercised.

I will begin by mentioning some of the aids which have been furnished by the Government for attaining the object in view. In the first place a steamship of 600 tons has been furnished (besides the steamship of the Commission referred to above), costing \$60,000, the officers and crew of which are furnished by the Navy Department, and whose duty it is to occupy themselves with the propagation of the shad in summer, of the codfish in winter, and of the mackerel in spring.

There is no better place for doing this work than such a floating workshop, more especially when we consider the great extent of the American coast line. Besides these steamships it became necessary to have railroad cars of a special construction. They were furnished at once, and at the present time live fish of different ages are safely conveyed throughout the whole vast territory of the United States. It is hardly necessary to state that these cars are of a special construction; nor will I here give a detailed description of the basins and various other contrivances for keeping the water fresh. All this can be studied at the London Exposition from excellent models.

After briefly mentioning these material aids, we must not forget to refer to the intellectual aid placed at the disposal of the Commission. Under the supervision of the Commissioner there is a full staff of experienced and skillful naturalists, which works into a whole all the various observations, and orders the new investigations called for by such observations. Their ranks are filled by young men who, after having completed their education at some college, desire to devote themselves

* See the Official Report on the Netherland Sea-fisheries, published in 1880.

to the science of zoology, more especially in a field where that science not only promises to supply many of the daily wants of the masses, but where it has already accomplished a great deal. They are the men who use for investigations in the field of embryology the exceedingly valuable scientific material furnished by the numerous stages of development of fish which may be observed in practical fish-culture. We may doubtless look for important communications relative to the results of these scientific investigations.

Round this staff of scientists there has gradually been formed an entire camp of officers who are thoroughly versed in the more mechanical work of fish-culture and fish transportation. The catching of mature fish, the impregnation of the eggs, the care of them during their development, and the raising of the young fish can only be intrusted to experienced persons, although a scientific education is not required for this work. It is self-evident that any one who desires to carry on fish-culture on a large scale must endeavor to obtain men who have had a good deal of practice in that line.

Let us now illustrate by two examples, the shad and the cod, what different methods and aids the Americans employ for reaching the great object in view, viz, a considerable increase of salable fish, cheap and wholesome food for the masses, and thereby an improvement in the condition of the common people.

As soon as the shad is ready for spawning, about the month of April, the officers in charge of propagation of this kind of fish go to those places where large numbers of shad are found. To these places the necessary apparatus is forwarded, and suitable locations are selected for carrying on the work.

The first object is to obtain mature fish of both sexes. These are caught exclusively by night. Thus there were, in 1878, from 82 shad obtained no less than 1,605,000 impregnated eggs. For the development of these eggs it is necessary that they remain in flowing water; and as they are heavier than the water, and therefore sink to the bottom, cone-shaped glass or metal funnels are used, into which the water enters from below through a narrow opening and flows out at the top through a gauze covering. Thus a very large number of eggs may be kept in a fresh condition within a comparatively small space, and may thus be safely developed. By a small modification of this apparatus the same current is used for separating the dead eggs and all impurities from the healthy eggs; while the latter remain near the bottom, the former are by the current carried towards the top and over the edge, and are thus easily removed.

In order to work a large number of eggs at the same time, Seth Green many years ago invented a so-called "shad-box," which he kept floating in the current, the water being freely admitted to the inside through the front, which is of gauze, and placed in a slanting position. This was doubtless a great improvement. In stormy weather, however,

these boxes, of which there were always several joined in a row, ran the risk of being hurt or upset, whilst they were useless in places where there was not much of a current, or, still worse, where the influence of the tide made itself felt, and where, therefore, for a certain time, there was no current passing through the boxes.

Major Ferguson has made an invention which not only obviates this difficulty, but which also enables the Americans to carry on shad-culture on a much larger scale and with the aid of steam-power. Briefly described, this invention is as follows: On the left and right side of a vessel, or raft, a large pole runs parallel with the sides of the vessel, from which are suspended a large number of buckets with gauze bottom. Their number may be increased as occasion requires. The poles, and with them the buckets, are moved up and down by means of a steam-engine placed in the vessel, or on the raft, in such a manner that the upward motion is slow and the downward motion rapid. In these buckets are placed the impregnated shad-eggs which are to be developed, and the upward and downward motion is regulated in such a manner that the buckets do not leave the water, but are not entirely submerged, which would endanger their contents or cause them to be lost. This can also be prevented by placing a gauze covering on the top of the buckets; if this is done the entire motion of the buckets may take place under the water, which sometimes becomes necessary, when the temperature near the surface is too low, and thus exercises a hurtful influence on the development of the eggs.

It will be seen at once that by this apparatus (1), shad-culture can, if necessary, be carried on in water where there is no current whatever, and (2), that this culture can be carried on on a much larger scale than could be done formerly. In 1879, or four years ago, no less than 16,062,000 young shad were distributed and placed in different rivers.

It should also be observed that the American shad (*Alosa sapidissima*) greatly excels, by its delicate flavor, our European shad (*Alosa vulgaris*), and is by gormands justly placed on the same line as the salmon.

After having given a short description of some of the apparatus employed in shad-culture, we will turn to the codfish. When, in 1878, codfish-culture was first begun, it was soon observed that the peculiar character of the codfish-eggs necessitated the invention of other apparatus; for whilst mature shad or salmon eggs sink towards the bottom, codfish-eggs are lighter than water and float, at a varying depth, near the surface. The apparatus which, after much experimenting, has been found to most satisfactorily answer the purpose, is also a row of buckets connected with each other by a pole, which are kept in motion by a steam-engine, but not up and down, but backwards and forwards, thereby giving to the buckets a swinging movement round their axis.

The extent of this swinging movement is about 90°. In these buckets there are four slits running lengthwise and covered with gauze; on the outside of each of these slits there is a slanting valve, as also under

the gauze bottom, only that here the valves are placed like sails. By this contrivance the motion given to the buckets by the steam-engine causes the water to rise continually and pass through the buckets with a screw-like movement, which of course keeps it fresh all the time and in a condition suitable for the development of the codfish-eggs. The result has amply proved the usefulness of this apparatus, for during the first year more than 70 per cent. of the eggs developed to young codfish, and no less than half a million were placed in the sea near Gloucester, Mass. I have already mentioned that these codfish, constantly increasing in weight and number, have been caught and brought into the market, and we may therefore consider codfish-culture in America established on a safe basis.

In what manner can the Netherlands derive the greatest possible benefit from the lessons taught by the American exhibit at the London Fishery Exposition? Certainly not by leaving fish-culture, in the future, principally in the hands of private individuals. In this way we may get a number of establishments which may be placed on a line with establishments for raising chickens and pigeons, but the public interest is not advanced thereby. For this purpose it is absolutely necessary, as has been mentioned above that the Government take the matter in hand and follow out a carefully prepared programme.

The first requirement, viz, numerous inland waters and rivers having suitable food for fish, we possess to an eminent degree. The carp, which, as the vegetarian among fish, would prove highly valuable in inland waters, the shad and the salmon in the rivers, and the codfish on the coast, are all fish whose adaptability to fish-culture has been fully proven. We have a large fishing population on our coasts; there is no need of seeking a market for our fish; and it will certainly be easier now than it was in former times to find young men of scientific education, competent and willing to do their share of furthering this important public interest. Men thoroughly conversant with the *technique* of fish-culture should be brought over from America, and teach some of our young men the practical part of fish-culture, so that they, in their turn, may be able to supervise and teach others this part of the work, which, though mainly consisting of manual labor is of the greatest importance for the ultimate success of the work.

It is not necessary, however, to begin everything at one and the same time, and to load down our budget during the very first years with a large appropriation for this purpose. The best plan would be, to make a beginning with carp and codfish; carp,* because they can be distributed throughout our entire country, as both Friesland and Groningen, Holland and Utrecht will be immediately benefited by their increase; and codfish, because our fishermen can easily obtain mature codfish,

* The carp of which we speak here, are the leather and mirror carp, and must be distinguished from the common carp already found in our waters. The former have a different shape and a much finer flavor.

since our coast waters seem to possess all the necessary conditions for the propagation of this fish and for its development; and finally, because for this culture one of our vessels could easily be prepared, thus avoiding, at least for the present, the necessity of building more costly apparatus on land. Such a vessel, if stationed at Nieuwediep, could certainly be employed under the most favorable conditions, because there are in that place many cod-fishermen and an abundance of excellent sea-water. If any one desires to study the construction and arrangements of such a vessel, he can do no better than visit the American exhibit in the London Fishery Exposition, where he will see excellent models of the American vessels and other apparatus employed in fish-culture.

I have mentioned above that as regards the salmon, whose culture—thanks to private enterprise—is in good hands in our country, it may for the present be left in these hands, thus freeing the Government from this responsibility.

I cannot conclude my article without once more directing attention to the circumstance that if we seriously think of having the third part of the programme of the American Commission, viz, the propagation of food-fish, placed in charge of our Government, we must by no means lose sight of the first and second part. With this view America has established a zoological station at Wood's Holl. Also in the Netherlands the establishment of such a station—much of whose work would prove of great benefit to the fisheries and fish-culture—would lead to a harmonious co-operation of science and practice, which could not fail to bear rich fruit and to increase the general well-being of our nation.

If after a number of years some one should again report on fish-culture in the Netherlands, let us hope that he will be able to present a different picture from mine, and give a glowing account of a public interest, no longer neglected, but advanced to such a degree as to prove a blessing to our entire country.

57.—AN ANALYSIS OF ARTESIAN WELL WATER FROM THE SHAD-HATCHING STATION AT HAVRE DE GRACE, MD.

By FRED. W. TAYLOR.

[Chemist of the Smithsonian Institution.]

An examination of the specimen of water from an artesian well at the Battery Station of the United States Fish Commission at Havre de Grace, Md., shows it to be heavily charged with iron, lime, and chlorides. Magnesia is also present in considerable quantity. The iron and lime are very heavy. Sulphuric acid is present only as a trace.

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