

XVI.—THE EXPERIMENTS IN PROPAGATING MAIFISCHE (*ALOSA VULGARIS*), IN 1876 AND 1877.

BY R. ECKARDT.*

On the 26th of May, 1876, I received by Privy-Counselor Fastenau the honorable commission from Chamberlain von Behr-Schmoldow, president of the German Fishery-Association, to undertake a journey to the Rhine, in order to effect if possible in this year the increase and spread of the "maifische"† by artificial raising.

I must here mention that Mr. Christian Schieber, of Hameln, superintendent of fisheries, had made very thorough investigations of this whole matter in Wesel, from May 7 to June 9, 1875, and in Neuwied, Coblenz, Neuendorf, and Berncastel, on the Moselle, from the 13th to the 28th of May, 1876, and had ascertained that spawning "maifische" are but rarely caught in those localities. The fishermen say that the "maifische" in that neighborhood do not spawn till June, and sometimes not till July, but that this did not occur every year.

On the 8th of June I was able, after having arranged some private matters connected with my farm, to set out for Hameln, via Berlin, in order to obtain from Mr. Schieber an oral account of his observations. He very readily communicated to me all he knew, and showed me his very favorably located and practically arranged salmon-breeding establishment, as well as his interesting contrivances for catching salmon and eels, which were in full operation during the time of my visit.

The breeding establishment is fed by very pure spring-water, of 7.5+ Réaumur (48 $\frac{3}{4}$ ° F.), which comes from the ground in the immediate neighborhood, is caught in two covered wells only 10–15 meters distant, and is led through underground pipes. The water does not leave any oxides

* Report of Mr. R. Eckardt-Lübbinchen, landed proprietor, on the experiments in propagating the "maifische" (*Alosa vulgaris*), made in 1876, at the request of the German Fishery-Association, and on the continuation and successful termination of these experiments in 1877, by artificially breeding and raising these fish, transporting them, and by stocking the rivers Elbe and Neisse with them. "Bericht des Rittergutsbesitzers R. Eckardt-Lübbinchen über die im Auftrage des Deutschen Fischerei-Vereins im Jahre 1876 angestellten Versuche zur Vermehrung der Maifische, sowie über die Fortsetzung und glückliche Ausführung dieser Versuche im Jahre 1877 durch Künstliche Befruchtung, Erbrütung und Transport wie Aussetzung in Elbe und Neisse." From Circular No. 5 of the German Fishery-Association. Berlin, July 17, 1877. Translated by H. Jacobson.

† It has been deemed expedient to retain throughout this article the German name of the *Alosa vulgaris*, viz, the "maifische."

either in the wells or in the hatching-channels or in the round clay breeding-vessels, and is consequently free from mineral, chiefly metallic, substances which are easily oxidized, and although it does not come in contact with the air until it reaches the hatching-channels, it is nevertheless well suited for hatching salmon-eggs, as more than a million have been hatched in it. I cannot but mention in this connection the fact, long since proved satisfactorily to my mind, that all spring-water, and other water, too, contains a quantity of air sufficient for maintaining organic beings, but that spring-water is but rarely free from mineral, particularly easily oxidized metallic, substances and gases, and that consequently organic beings cannot live in it without sustaining some injury. If such mineral water is led into an open ditch or into a small pond, large enough, however, to bring the water which flows in for twenty-four hours in contact with the air, the mineral substances are oxidized to such a degree that, unless there is any putrefying organic matter in the pond, it will become capable of sustaining animal life, and be well suited for a hatching-pond.

Salmon-fishing was still going on in Hameln; on the 9th of June, from 6 to 8 a. m., eight had been caught, and from 8 to 10 a. m. ten, with an average weight of 11 to 15 pounds apiece, and the salmon were still ascending the river. To me the leaping of the salmon endeavoring to get over the large weir, three meters in height, which spans the Weser, was a most interesting sight. Toward noon, when the sun is very bright, some salmon succeed in getting across, but by far the larger number are caught in the nets.

The salmon-fisheries, which formerly were rented out by the city of Hameln for \$214 annually, rent now for \$3,770, a very palpable proof of the success of artificial hatching. The city pays Mr. Schieber, for his trouble in hatching one million salmon for the Weser, about \$100.

I left Hameln at 1 p. m. on June the 9th, and reached Coblenz late in the evening.

On the 10th June, early in the morning, I visited Mr. Joseph Glöckner, in Neuendorf, in whose possession were most of the hatching-boxes which had been prepared for hatching "maifische."

Mr. Glöckner had ceased to catch "maifische" for this season, because there was no sale for them, and because they had been caught in such large numbers that people had gotten somewhat tired of them; the lease of his fishing district was, moreover, soon coming to an end, and he did not wish by catching very large quantities to raise the rent any higher. As I learned afterward, he was not successful, for his rent has been raised from about \$21.42 to upward of \$238.

Next year he was going to produce "maifische" capable of spawning; this year it was too late to do this, and if it did not get warmer they would not spawn, any way. In consequence of many violent thunder-storms the temperature had fallen to 50° F., and it was raining incessantly.

He was of opinion that in spite of all prohibitory regulations a great

deal of damage was inflicted on the Rhine and Moselle fisheries by renting out the fisheries to capitalists who understood nothing about fishing. He likewise informed me that people were allowed to use nets with narrow meshes for catching *Cyprinus alburnus*, from the scales of which artificial pearls are manufactured in Paris, and that this was a great trade in Cologne. But with the small *Cyprinus* many young salmon, "maifische," pike, perch, lampreys, barbel, pollard, mackerel, &c., &c., are caught, which being of no use to these fishermen, are destroyed. By catching so many *Cyprinus* the quantity of food for the finer class of fishes is diminished, and catching and destroying so many young salmon of course does incalculable harm to the salmon-raising. Mr. Glöckner thought that until these abuses were stopped the Rhine fisheries would not amount to anything.

The same opinion was expressed to me by the following superintendents of fisheries: Georg Weber in Irlicht, Christian Wattler in Cologne, Hackenbroick and Schlömer in Dale near Deutz, all of whom urged me to do all I could for having these abuses stopped.

As no spawning "maifische" could be obtained from any of these gentlemen, I came to the conclusion that the "maifische" must spawn farther up the Rhine or its tributaries, and I therefore went to St. Goar, where there are large salmon-fisheries belonging to the town, and was told by Mr. Robert Herpell, inspector, and Mr. Klein, superintendent of fisheries from St. Görshausen, that near St. Goar and as far up the Rhine as Bingerbrück the current was too strong for catching "maifische." I was likewise informed by these gentlemen that many "maifische" were caught in the Neckar above Mannheim. I therefore traveled direct to Ludwigshafen and remained there over night with the intention of making further inquiries at Heidelberg the next day.

At 8 a. m. on the 13th of June I arrived in Heidelberg in a pouring rain. I immediately went to see some of the prominent fishermen, and from them got all the information I desired; but could unfortunately not put it to any use, as the Neckar had risen $1\frac{1}{2}$ meter during the night, and its water was very muddy. The "maifische" do not like such water, and let themselves be driven down the stream by it, so that within a quarter of an hour about 30 "maifische" were handed to me from a stationary fishing-apparatus which had been placed out in the stream, among these 3 entirely firm "spawners," which, however, were not yet ready to spawn. From the 23d to the 29th of May the weather had been remarkably fine, and the "maifische" had spawned in the Neckar in such enormous quantities as never before, and the spawning season for the stragglers extends till near the end of June. Spawning might consequently still be observed if only the water would get clear and the weather be favorable; but from all signs the rainy season had not yet come to an end. As I had no time to wait any longer, I went home and sent Mr. Wilke, the superintendent of my fisheries, to Heidelberg to make further investigations. The weather did unfortunately not get any better; thun-

derstorms accompanied by hail and rain made the Neckar a roaring torrent, and enormous quantities of "maifische" went down the stream, so that no spawner was caught. Mr. Wilke therefore returned on the 24th of June without having attained the object of his journey.

As the result of my observations for this year may form some sort of guide for next year, I will mention the following :

1. From the beginning of May the Neckar fisheries, from Mannheim to Heilbronn, should be carefully watched with a view of catching spawning "maifische."

2. Suitable hatching-places should be prepared and every arrangement made for quickly transporting fish by railroad.

3. The superintendent accompanying the fish should receive a permit from the managers of the different railroads to stay with the fish in the baggage-car all the time, and he should also have the privilege to use fast or express trains.

4. The manager of this whole enterprise should be allowed to exercise his own discretion in making the necessary investigations, in engaging assistants, and in making all the required arrangements.

5. The most suitable stations for placing young "maifische" would be Fulda on the Weser, Dresden on the Elbe, and Guben on the Oder.

6. The fishing association of Seckenheim, Ilvesheim, and Fendenheim would be the best for trying the experiment of raising "maifische" in an artificial manner.

On the 8th of May, 1877, I was again commissioned by Chamberlain von Behr-Schmoldow to make experiments on the Rhine and Neckar to obtain if possible artificially-hatched spawn of "maifische," and transplant the young fish into the Elbe, Oder, or Neisse. At 5 a. m. on the 14th of May I left my home in company with Mr. Müller-Tchischdorf, superintendent of fisheries, and reached Heidelberg at 10 a. m. on the 15th.

As my investigations of the previous year had taught me that the best way to reach my object would be to place myself in direct communication with the fishing association of Seckenheim, consisting of sixteen members, who have the privilege of fishing in the Neckar with a large net from Maunheim upward as far as the mill at Bergheim, we immediately went to see these persons, traveling via Mannheim by railroad, hack, and on foot.

We found these fishermen enjoying a rest in a frame-hut, where they kept their provisions and implements. We immediately informed them of the object of our visit, and placed ourselves on a friendly footing with them. I handed them my card, from which they could see that I had also something to do with fishing, and promised to pay them \$3.50 for the first female "maifische" suitable for artificial hatching.

The fishermen seemed favorably inclined toward our enterprise, but were doubtful of its ultimate success. They promised, however, to do all in their power to further it, and thus we left them in order to get our hatching-boxes, vessels for transporting fish, &c., which had been left

behind at Heidelberg. It was a very comforting assurance which the fishermen made to me, that so far they had not caught any "maifische" that were ready to spawn, all the more so as I had been somewhat frightened by the assertion which Director Haackat-Hüningen had made on the 1st of May at the piscicultural congress, that this year the "maifische" would already spawn in the Rhine, which assertion has fortunately not proved true.

On the 16th of May Mr. Müller went down the Neckar in a boat, with seven hatching-boxes and two vessels for transporting fish, and took his station at Fendenheim, where he arranged everything for his experiments. Various articles, such as a file, pincers, wire, tin, a thermometer, a microscope, &c., were procured at Heidelberg and taken along by him. I went to Heilbronn, in order to gather further information regarding the ascent of the "maifische" in the Neckar, and visited Mr. Friedrich Drantz, who owns the Neckar fisheries a few miles below, and has rented them out to three fishermen, whom he has given certain regulations for protecting the fish. This gentleman informed me that in his fisheries "maifische" were only caught in very exceptional cases; that they scarcely ever go up as far as Heilbronn, where there is a stone weir, and were not found beyond that place.

On the 17th of May I again went to Seckenheim via Mannheim, gave orders to have the covers of the hatching-boxes arranged in a simpler and more practical manner, and had ten new boxes made, as dissecting a female "maifische" had convinced me that three to four boxes might be required for all these eggs, and we might consequently be short of boxes. The weather was cool all the time, and on the Neckar never higher than 13°-14° R. (61°-64° F.), and the air was raw, which makes the fish disinclined for spawning. If the weather got warmer, the fishermen told us, spawning fish might be caught next week.

On the 18th of May I went to Coblenz and Neuendorf, via Mayence, to visit Mr. Joseph Glöckner. He was just engaged in catching "maifische," but none of the females which he had caught were ready to spawn. I paid him the money which he had laid out for sending hatching-boxes to Basle, Hüningen, and Heidelberg, and asked him to go on with the hatching process as soon as he caught any spawning "maifische." He took a deep interest in this matter, and told me that last year he had got artificially impregnated spawn of the perch and had hatched it in the boxes, and that on the 26th of June he had caught a very fine specimen of a female "maifische" ready for spawning, that he had immediately impregnated the spawn artificially, and had placed it in the hatching-boxes. This spawn had remained in good condition for some days, but one morning he found that it was all white and dead. I told him that this was caused by the fine mud contained in the Rhine water, which stuck to the lower part of the sieve and finally covered the eggs entirely; in future he should twice a day take off this mud with a brush from the outside of the box, for thus a new current was

created and the eggs were saved, as the little mud which remained would be rubbed off by their rolling against each other in the box. I also asked him to send word to me at Heidelberg as soon as any "maifische" spawn had been hatched.

On the 19th of May I returned to Seckenheim and found some boxes which Mr. Müller had placed in the Neckar, and in them some "maifische" eggs which had been impregnated before maturity, and with which Mr. Müller was making further experiments, with a view of eliminating bad eggs and of learning the general way of treating the eggs. After many experiments it became quite clear to us how the "maifische" eggs should be treated. We got another strong brush, and Mr. Müller made a spoon of wire-gauze, with a wooden handle, with which the eggs could easily be taken up; the bad ones could then be picked out with a pair of pincers and the good ones put in a special box by themselves, so they could not suffer from being mixed together. Thus all our arrangements had been perfected, and nothing was wanting but the fish.

On the 20th of May, Whitsunday, I went to Freiburg to see the mayor of that city, Mr. Schuster; from there I went to Basle on the following day to see Mr. F. Glaser; from there to Hünningen, returning to Heidelberg late at night. Mr. Schuster met me at the depot and showed me his excellent fish-hatching establishment, and we agreed as to the manner of artificially hatching "maifische" eggs, which I said I would supply to him, as I felt certain that the eggs packed according to my own fashion would arrive in good condition.

Early on the 21st of May I went to Basle, in order to have an interview with Mr. Glaser, to whom a hatching-box had been sent. I found him at one of his seven salmon-fisheries, about one-half (German) mile farther up the river. The hatching-box had already arrived, and we quickly nailed it together and placed it in a suitable location in a gentle current. Mr. Glaser told me that the "maifische" were so far entirely unfit for spawning, and had, in fact, only come in his neighborhood a few days ago, so that but few had been caught. He had placed two in a basin in his garden, but one, the male, had died, and the female was living peacefully together with carp, gold-fish, &c., but seemed to be very restless. Mr. Glaser intended to put another couple of "maifische" in another basin, to put a male fish to the deserted female in the first basin, take out the other fish, and let the spawning process go on undisturbedly. He said that he moreover intended to get artificially impregnated eggs in his salmon-fisheries and hatch them, letting me know the result. Unfortunately I have so far not heard from him, although I have written to him several times.

From Basle I went to Hünningen to see Director Haack and his extensive hatching establishment, which has been greatly improved by him. The most interesting part to me were the very ingenious arrangements for raising the finer kind of food-fish, all the specimens showing an excellent condition and healthy growth. Here one can see what may be done

in this respect even under the most unfavorable local circumstances, and what a great and promising future there is in store for pisciculture in this special branch, if once it has been rightly understood and the proper interest taken in it. It is an unfortunate circumstance that we neither possess the means to make researches in this field more general, and to make full use of the knowledge gained thereby, nor that we can offer to those men who under the greatest difficulties and at their own expense make these researches and gain this knowledge any public position which would be remunerative, but that we must invariably refer them to their private enterprise; and therefore we always meet them as fishermen, who must make their living by the fisheries but who have very little time left for any questions of general interest. They consequently remain stationary on that slightly varying step of knowledge where accident has placed them. In my opinion there is no field of human knowledge for which the state should provide educational institutions as much as that of pisciculture. I shall have occasion to refer to this question again, and I hope sincerely that my remarks may contribute their share in spreading more knowledge as to the ways of increasing articles of human food, so that nature's vast treasures are not, as has been unfortunately the case, wasted from sheer lack of knowledge how to use them.

After having been hospitably entertained by Mr. Haack and his estimable lady, I returned to Basle, accompanied to that city by Mr. Haack, where I took leave of him, my heart full of bright hopes regarding pisciculture and its future. Arriving in Heidelberg at 5 a. m. on the 22d of May, I took a short rest, and, as Mr. Müller had sent me word that there were as yet no spawning "maifische" to be seen, I went to Würzburg, in order to gain further information from Mr. Seifried, one of our oldest pisciculturists, who had formerly lived in Mayence, and who was well acquainted with the river Main and its fisheries. Mr. Seifried showed me his trout-raising establishment in Zell, and told me that occasionally a few "maifische" had been caught in the Main in former times, but that for many years none had been seen there. He thought this was caused by the great quantity of refuse from various factories which get into the Main, but in my opinion other causes have brought about this change.

I here learned to know a fish-dealer and trout-raiser, Mr. Carl Helmstädter, who had worked for six years in American piscicultural establishments, among the rest in the one owned by Mr. Seth Green, and who gave me a great deal of interesting information. Wherever I went I gathered information corroborative of my supposition that the Neckar from Mannheim till below Heilbronn would be the only location where sooner or later we would reach our object. Very well satisfied with my excursion, I returned to Heidelberg, and on Wednesday the 23d of May I again went to Seckenheim to see Mr. Müller, and found some well impregnated eggs taken that morning. Mr. Müller had the process performed by a fisherman, and had afterward himself squeezed $\frac{2}{3}$ of the

eggs out of the fish and impregnated them at a temperature of the air of 9° R. (52° 25 F.), the water temperature being 11° R. (56° 75 F.). The eggs were nearly all in excellent condition; about fifty or sixty thousand were put in the box, and the few bad ones were picked out by means of Müller's gauze spoon, and everything passed off successfully. Through our little microscope we could distinctly watch the process of impregnation.

On Thursday, the 24th of May, I was again in Seckenheim, and convinced myself of the healthy further development of the eggs. I now resolved to make experiments in transporting the impregnated eggs, and believing that the third day after impregnation would be the most suitable time for this, I made all the necessary arrangements and wrote to Mr. Von Behr in Schmoldow, to Mayor Schuster in Freiburg, and to the superintendent of my own establishment at Lübbinchen. My letters contained the following: "On Saturday, the 26th of May, I shall send to your address by mail a small number of impregnated 'maifische' eggs, and would ask you to let me know the number of good and bad eggs and of young fish." In Schmoldow the majority of the eggs arrived on the third day in good condition; of 894 eggs sent to Lübbinchen, 694 were in good condition and 200 were spoiled; in Freiburg, where the eggs arrived the next day, only 50 eggs proved good after they had been placed in a box. Mr. Müller took further care of the eggs, and was all the time on the lookout for more spawners, while I, on the 26th of May, once more went to Neuendorf to see Mr. Joseph Glöckner and ascertain whether there were any "maifische" in the Rhine. The "maifische" had unfortunately gone, and none were caught. Returning to Mr. Müller, on the 27th of May, I found about 150,000 eggs all in excellent condition, which had been impregnated the day before my arrival. There were among this number scarcely any unripe, spoiled, or unimpregnated eggs. The first eggs of the 23d of May had already far advanced in their embryonic development, so that the shape of the fish could be distinguished.

On the 28th of May, another batch of 100,000 eggs were artificially impregnated, but among these a number of white, *i. e.*, spoiled eggs showed immediately; these were picked out on the following day, and the development went on in its normal course. On the 29th of May the fishermen caught only 26 "maifische," and on the 30th only 11, so that the association dissolved.

As I had learned that the Heidelberg fishermen, forming an association of 12 members, Mr. Peter Rohrmann being president, had, on the 28th of May, caught upward of 400 "maifische" at the fish-weir near Neckarhausen, and they were going to fish again on the 31st of May, I made arrangements with Mr. Rohrmann, at Heidelberg, to leave at 5 a. m. on the 31st for Neckargemünd, to go from there to Neckarsteinach, and witness the fishing from one of the fishing-boats. I committed the care of the eggs to Mr. Raufelder, a gentleman eminently fitted for this duty, and left Heidelberg, accompanied by Mr. Müller, in a pouring rain.

Upward of 300 "maifische" were caught during our presence, but unfortunately there was among them not a single one ready to spawn, but many with spoiled eggs; so, in spite of all our efforts, we could not obtain any suitable eggs.

On the 1st of June, at Seckenheim, I saw the first young "maifische" which had slipped out of the eggs. I took 2 fish and 3 eggs in a glass vessel to Heidelberg, where I placed them in a larger vessel, and observed, to my greatest delight, that the fish came out of the eggs in an entirely healthy condition; the same was the case with 3 eggs of a pollard, which had also been artificially impregnated. I was now in a position to make a direct experiment as to how these young fish would stand the journey. I was delighted to notice that I could warm them in the sun to a temperature of 17° R. (70°. 25 F.), that they did not need any fresh Neckar water till after two days, that in three days they had absorbed the umbilical bag, and that they developed in a remarkable manner if Neckar water was given to them twice a day. I thus felt confident that they would stand the journey.

On the 2d of June I telegraphed to Chamberlain von Behr that the young fish had left the eggs. I likewise telegraphed to his excellency Minister von Nostitz, in Dresden, that 100,000 young "maifische" would arrive in that city at 8.24 a. m. on the 8th of June, and to Mayor Kämpffe, at Guben, that the same number would arrive there at 1.40 p. m. of the same day. I asked that two fishermen might be at the Dresden depot to receive the fish, as I had only one hour's time; at Guben I asked for a formal reception at the depot.

On Sunday, the 3d of June, Peter Rohrmann was going to make another haul near Neckerhausen; but this intention was frustrated by the very sudden rising of the Neckar, which made its water quite muddy; but, as this only lasted a short time, our young fish did not suffer at all from it.

On the 4th of June I made another excursion to Neckarhausen, got a few more "maifische," but none of them contained any good spawn. I then had a few more caught, and placed them in a basin in the botanical garden in Heidelberg, to see whether they would keep healthy, and perhaps spawn there; two were dead the next morning and one the following evening. The basin was intended for aquatic plants, and was arranged in four separate divisions, producing many sharp corners, against which the "maifische" had rubbed and thus hurt themselves. I spoke with Mr. Pfitzer, professor of botany at the University at Heidelberg, about making an artificial hatching-place for "maifische," which could be fed with Neckar water, but owing to their peculiar circumstances he could give me no encouragement.

On Tuesday, the 5th of June, I visited Mr. Müller, in Seckenheim, to see in what condition the young "maifische" might be. The water was still quite thick, but the fish were in a healthy condition. They could only be seen when taken from the water with a small dipper. All the necessary

arrangements for the journey were perfected. On Thursday, the 7th of June, at 4.40 p. m., we were to leave Mannheim by the through-train, and I was to come to Seckenheim at about 11 a. m. with a carriage, place the fish in my two vessels, and fill a third one with ice.

On Wednesday, the 6th of June, I paid a visit to Mr. A. Pagenstecher, professor of zoology at the University of Heidelberg, to ask him to examine some "maifische" eggs which I considered unripe or spoiled. He very cheerfully promised his co-operation, and said that if he could pursue his observations for several years, he felt convinced he would find the causes of this and explain it scientifically; he was, moreover, inclined to favor the establishment of artificial hatching-places, and showed me a large salt-water aquarium, which, however, contained no animals. He has, unfortunately, no Neckar water for the "maifische," and this is absolutely required; for in the hard well or brook water, with a low temperature, they cannot be hatched.

On Thursday, the 7th of June, I started on my journey, going first to Seckenheim in a hack; here Mr. Müller placed the young "maifische" in two vessels, and filled a third one with ice. The road from the river to the Mannheim turnpike was a little rough, but we got over it safely and soon reached Mannheim. Here we unfortunately made a mistake and got in the train which only goes as far as Frankfort-on-the-Main; in this city we had therefore to transfer our fish to another depot, and then traveled uninterruptedly to Corbetha; here we had to change cars again, as the train on which we had come went through to Halle and Berlin, while we wanted to go to Dresden.

In Dresden we were met at the depot by Privy Counselor Koch, by Mr. Friedrich, and Mr. Klemm, superintendents of fisheries, who received the fish. Mr. Müller had time to place them in the river, while I was kept busy transferring the other vessel to the Guben depot, which took about half an hour. The remaining half hour I spent with the above-mentioned gentlemen in the depot restaurant, where I showed them some young "maifische," which I carried with me in a bottle; these fish, however, are so transparent and small, that they can only be seen after the eye has become a little practiced. Through Mr. Koch I also sent a live specimen to his excellency the minister. At 9.30 a. m. we left Dresden, the thermometer being 25° R. (88° 25 F.) in the shade, and arrived in Guben at 1.40 p. m., where we were met at the depot by Mayor Kämpffe, several members of the city council, Count Reventlow, governor of the district, and many landed proprietors, all desirous of being sponsors on the occasion of these young German natives of the Rhine and Neckar being baptized with Neisse water.

The few young "maifische" which I had with me in a glass were still in good condition, although the temperature of the water was 23° R. (88° 75 F.) but they died before we reached Lübbinchen during the long journey in the hot sun performed in an open carriage.

I have still to make the following general remarks: On the 23d of

April of this year the fishermen of Seckenheim have commenced to fish for "maifische." The first were caught on the 28th of April, and the largest number on the 10th, 11th, and 12th of May, none of them, however, ready for spawning. About as many fish were caught as in 1875, but only one-third as many as in 1876, in which year the "maifische" in this district were ready for spawning between the 23d and 29th of May, and have spawned very freely in the Neckar.

From the mass of information gained this year the following points may deserve special consideration for the future:

Along the Neckar there are three fishing districts which are suitable for obtaining artificially impregnated eggs of "maifische:"

1. The district of Seckenheim where the first and the largest quantity of eggs may be obtained during spring if the temperature is not too cold. The sixteen members of the fishing association presided over by Mr. Johann Raufelder have all the necessary apparatus, and take a deep interest in the matter. In this district, therefore, the first spawning "maifische" are found, because it is tolerably warm and possesses great advantages for fishing with a seine.

2. The district of the Bergheim Mill, extending past Heidelberg as far as Ziegelhausen. Here fishing is carried on by the various fishermen living along the river; in favorable years many spawning "maifische" are caught near the Bergheim Mill and near Ziegelhausen.

3. The district of Neckarsteinach and Neckarhausen, extending up the river as far as Hirschhorn. This district is colder and has much rocky bottom, and the fish consequently spawn somewhat later in the season. There is here a fishing association of twelve members, presided over by Mr. Peter Rohrmann in Heidelberg. This year the largest number of "maifische" were caught in this district, but their eggs were not at all developed and many were spoiled.

During a favorable year artificially impregnated eggs may, therefore, be obtained in Seckenheim early in the season, a little later in Heidelberg, and still later in Neckarhausen.

As soon as the Rhine rises to its high-water mark in spring, many "maifische" come into the Neckar, because they cannot be caught in the Rhine; the same is the case in the Neckar in the three above-mentioned districts which lie one above the other.

For hatching the "maifische" eggs in the Neckar the American floating hatching-boxes are well suited; but as the current cannot well be regulated, a simple wooden screw is fastened in the front part of the floating frame, by means of which the box may be placed higher or lower according to the different currents.

As soon as the eggs have been hatched, *i. e.*, after five days, they must be placed in well-protected boxes covered with the finest kind of gauze, or better still with a firm glass bottom and gauze-covered openings on both sides which permit the water to flow through.

Such an apparatus may be furnished by having three small boats con-

nected in front and behind by strong ropes, and perhaps surrounded by a light frame-work of floating timber ; between every two boats there is a frame holding two rows of the boxes mentioned above, placed at such a distance that they can easily be reached from the boats.

The large outer frame-work must in front and behind be protected by boards connected at an angle, so that the boxes are safe from strong currents and waves, wind-storms, and floating objects, such as scum, dirt, wood, grass, &c. On the outside the floating apparatus for hatching may still be fastened for four or five days.

Boats for this purpose may be rented in Mannheim for 23 cents a day ; the floating timber and all the necessary wood-work can be furnished by a carpenter in Seckenheim, and nothing would remain to be done but to prepare the stationary hatching-boxes, in which the young "maifische" immediately after having left the eggs, and in fact the eggs themselves before they are hatched, are perfectly safe. This apparatus, which is absolutely necessary, which facilitates the whole process very much, and which is a strong protection for the eggs and young fish, may, after the "maifische" season has come to an end, also be used for hatching other Neckar-fish, as the perch, the pollard and others, which are hatched in 3 to 4 days, lose their umbilical bag in 4 more days, and may then be placed in any river. Such an apparatus, or several of them, which can easily be taken to pieces and stored away, should be found in every fishing district ; this would be the best way of increasing the number of river fish, and the result would be seen in two or three years. The leading principle for the healthy development and increase of the river fish must, however, invariably be found in the catching of the fish during the spawning season, and in the artificial impregnation of all the eggs that can be obtained ; in this way the eggs are saved from the numerous fish of prey which devour them and inflict incalculable damage to the fishing interests during the spawning season.

The young fish can easily be transported in any tin cans. We had to change cars quite a number of times during our journey, and the fish stood these changes very well, so that about 70,000 young "maifische" could be placed in the Elbe and as many in the Neisse. The best temperature for transporting "maifische" is 12° - 15° + Réaumur, which can easily be furnished by placing ice in the neck of the tin can ; air is not required during so short a journey.

In future it will be best to place the "maifische" destined for the Elbe in the Saale near Halle, where the through train from the south arrives at 4.28 a. m. The fish destined for the Neisse would leave Halle for Guben at 8.5 a. m. by express train. If, therefore, the fish leave Mannheim at 4.40 p. m. they need not change cars till they reach Halle, so that the whole journey may be accomplished without any difficulty.

If the number of fish sent should amount to several million, a special baggage-car might be engaged at Mannheim.

I clip from my diary the following table of temperatures :

	o	o	o	o	
May 15.	Water, 14 R.	63.50 F.;	air, 15 R.	65.75 F.	
16.	14	63.50	16	68.00	
17.	13	61.25	14	63.50	
18.	12	59.00	13	61.25	
19.	11	56.75	12	59.00	
20.	11	56.75	12	59.00	
21.	11	56.75	12	59.00	
22.	10	54.50	11	56.75	
23.	9	52.25	10	54.50	1 fish ; 500,000 eggs.
24.	9	52.25	10	54.50	
25.	10	54.50	9	52.25	
26.	10	54.50	11	56.75	1 fish ; 150,000 eggs.
27.	12	59.00	14	63.50	
28.	13	61.25	16	63.50	1 fish ; 100,000 eggs.
29.	13	61.25	16	63.50	
30.	13	61.25	13	61.25	
31.	12	59.00	14	63.50	The fishermen ceased to fish.
June 1.	13	61.25	16	68.00	
2.	14	63.50	14	63.50	
3.	16	68.00	23	83.75	
4.	16	68.00	25	88.25	
5.	17	70.25	23	90.50	
6.	17	70.25	28	90.50	
7.	16	68.00	22	81.50	
8.	16	68.00	25	88.25	

During the best time 100 to 200 fish have been caught in Seckenheim every day, and in Neckarhausen 430 and 350 at a single haul. These fish find their market in Frankfort-on-the-Main, Mannheim, Strasburg, and other cities along the Rhine. Their sale, however, comes to an end with the 31st of May, for although even in June some very fine "maifische" are caught, there is a prejudice against eating them during that month.

The fishermen, unfortunately, do not take the proper care of the fish which they catch; after every haul they are piled in an open boat, covered with a little grass, so as to protect them against the rays of the sun and the air, and are then brought to market the next day. The price is not very high; early in the season 23 to 39 cents are paid for a "maifische" weighing $3\frac{3}{4}$ –5 pounds, and soon it gets down to 20 cents and even less.

No one ever thinks of smoking these fish, because the fishing season is of such short duration, and the results vary so much in the different years, that it would scarcely pay for any one to come from a distance and erect the necessary buildings.

I was told that a Frenchman had in former times smoked the "maifische" in Heidelberg, had only paid $1\frac{1}{2}$ cents apiece to the fishermen, and had nevertheless become bankrupt. As long as the "maifische" are only increased in the natural way the object of fishing for them will only be to sell fresh fish; but if they are increased artificially, and conse-

quently in much larger numbers, it will almost become necessary to smoke them in order to avoid a waste. All the smoking establishments, however, should be under strict government supervision, so that no fish are smoked which have spawned and are in a poor sickly condition, and might produce epidemics if extensively used as an article of food. Such fish and all the other refuse might be mixed with alkaloids and make a very excellent fish guano. In the above I have only briefly indicated the great importance of raising "maifische," and I only hope that we may soon succeed in raising millions of these useful fish.