

XVII.—REPOPULATION OF THE WATER-COURSES IN BELGIUM.

By BARON DE SELYS LONGCHAMPS.*

[Member of the Royal Academy of Belgium and president of the Senate.]

Belgium has finally decided to attempt the repopulation of her water-courses. Our river fisheries, formerly so rich, especially in salmonoids and crawfish, are in greater danger than those of almost any other country. The causes of destruction are manifold, and they can be partially overcome only by great and persistent efforts.

Our two great rivers, the Meuse and the Scheldt [Escaut], differ in their character, and consequently produce different fish. From Antwerp downward the Scheldt becomes an arm of the salty sea, and the tide can even be noticed above that city. In this portion of the river the existence of fish does not seem to be endangered by the pollution of the waters. They catch there, at the proper seasons, the *Alosa finta*, the *Osmerus eperlanus*, and the *Coregonus oxyrhynchus*; but the last-mentioned fish cannot be very common, for in the Brussels market I have only found it in rare cases, and mixed with the *Osmerus eperlanus*.

The eel (*Anguilla vulgaris*) and the small plaice (*Pleuronectes fesus*) are very common there at all times. The sturgeon (*Acipenser sturio*) ascends as far up the river. In its upper parts and its tributaries towards Flanders, Hainault, and Brabant the Scheldt is fearfully polluted by the factories of Roubaix, Turcoing, Ghent, and Brussels. Formerly it was full of fish, although the fish suffered greatly from the pollution of the waters caused by the retting of flax in those parts of Flanders where this industry is carried on.¹

The Meuse was celebrated for its salmon (*Salmo salar*), which ascended this river in order to spawn in its fresh-water tributaries which flow into it from the Ardennes and other mountainous regions on its right bank. The shad (*Alosa communis*) used to ascend the Meuse in spring

* "Repeuplement des cours d'eau en Belgique," par M. C. Baron de Selys Longchamps. [From *Bulletin mensuel de la Société d'Acclimatation de France*, 3d série, tome x, No. 3, Mars, 1883, Paris.] Translated from the French by HERMAN JACOBSON.

¹Under the title "Suppression totale du rouissage putride par l'application d'ex système de M. Lefèvre" (Total suppression of putrid retting by the application of Mr. Lefèvre's system) an important pamphlet has appeared, which was read at the meeting of the Central Society of Agriculture of Belgium, June 13, 1881. (Brussels, E. Guyot, 1881.) The practical results of this method are given in detail.

in enormous numbers, but rarely higher than Huy. Most of the rivers which flow into the Meuse, the Vesdre, Ourthe, Hayoux, Bocq, Lesse, Semoi, and their tributaries, were full of trout (*Salmo fario*) and ombres (*Thymallus vexillifer*), not to mention other food-fish which are found throughout the whole middle portion of Western Europe.

This paradise of fishermen has well-nigh been destroyed. To meet the needs of boating and navigation towards France great river improvements have been made along the entire course of the Meuse. The dams in the river prevent the greater part of the salmon from ascending it. Those fish which succeed in clearing these obstacles are scarcely able to do it except by favor of high tides and occasional inundations.

As regards the shad, which not long ago gave rise to truly miraculous fisheries near the city of Liège,² it is stopped by the dams found farther down the river; and I do not think that it will be able to clear the salmon ladders which are going to be established, let us hope under better conditions than those which have hitherto been tried. We may not indulge in the flattering hope of seeing the waters of the Vesdre again rendered sufficiently pure to support fish. They have been too strongly poisoned by the washing of wool and the dyeing establishments and cloth manufactures of Verviers.

It might not be impossible, however, to arrive at a satisfactory solution of the question by leading the polluted waters of Verviers as far as the Meuse through channels running parallel with the Vesdre. Works of this kind are now constructed, at a moderate expense, for leading the juice of the beets from the places where they are grown and first ground to the sugar-refineries, a distance of several miles. As a work of this kind on a larger scale we may mention the collecting channel of the Senne, at Brussels, and also the works constructed in England to lead the refuse water of London into the sea. This last-mentioned work has been so successful that recently trout have been caught in the Thames, where they had long since disappeared. In the water-courses of the right bank of the Thames, where the water has remained pure, trout is found, but unlicensed fishing is there carried on on a large scale.

As regards the tributaries of the right bank of the Meuse, the industries which there kill the fish are manufactures of chemicals, sugar-refineries, and to a less degree distilleries.

Excellent laws have been made for regulating the fisheries and for suppressing the mischievous destruction of fish, but as it is out of the question for us to restore the salubrity of the waters by taking measures which would render industry impossible, we must appeal to science if we wish to obtain the means for rendering healthy the poisoned waters of our rivers.

When pisciculture came into vogue, almost forty years ago, it was

²At the end of April and in the beginning of May I remember to have seen taken near Liège, at one haul of the net, as many as two hundred and fifty and even three hundred large shad.

thought people had solved the problem of the repopulation of our rivers. The founding of the Society of Acclimatization in France, and the establishment of the piscicultural station at Hünningen gave the first impetus. Prior to this the King of the Belgians, Leopold I, had successfully engaged in fish culture on his estates in the Ardennes, following the old methods of the German foresters.

In 1853 M. Ernest von den Peereboom had spoken in favor of fish-culture in the Chamber of Representatives. Experiments which were made at the time, but in waters very little suited to the purpose and with defective apparatus, did not prove successful.

Some time afterward a more important society of fish-culture was formed, and serious efforts were made. This society, however, only existed a short time. The mistake had been made to embrace in its work too many branches of this new science, and to attempt, moreover, the culture of oysters and salt-water fish at Nieuport, which place did not possess all the conditions necessary for such culture. People finally entertained the idea, which was widely spread at the time, that trout and even salmon could live in all the pure waters of the country and prosper, even when shut up and in a state of confinement. Hence the mistakes and finally the dissolution of the society, which was composed in great part of persons whose property was not in the region where salmonoids can live.

Although for twenty years the question may be said to have slept, from a practical point of view it has at least not been buried, for several times during this period it has given rise to public discussions and various publications. It is necessary to give a brief historical sketch of the phases through which this question has passed before its active awakening.

In 1865 and 1866 the provincial council of Brabant appointed a commission whose duties were to study the best means for purifying the water-courses, and to find means for repopulating our brooks. The late M. de Gronckel prepared the report of this commission, and stated in it that in this matter the most powerful interests centered, which it has become the duty of the authorities to protect, to harmonize, and conciliate as much as possible, above everything the interests of health and security from inundations. To this must be added, he says, a question of alimentation and national wealth, viz, that of preserving and multiplying the fresh-water fish.

The "Free Society of Emulation" of Liège, at the instance of my regretted friend, Theodore Lacordaire, professor of zoology at the University of Liège, set a prize for the best answer to the following question: "*To determine the causes which for the last twenty years have brought about a degeneration of fish in the rivers of the province of Liège, and to indicate the means for remedying this state of affairs.*"

The prize essay, which was printed, came from the pen of the late Charles Lehardy de Beaulieu, a well-known and highly esteemed cu-

gineer and economist. He attributes the decrease of fish to the excess of consumption over production. He strongly recommends pisciculture and a proper regulation of the ownership of water-courses, the use of which he would like to see placed in the hands of associations whose interest and perseverance would finally succeed in discovering the various causes by which the water becomes impure. He thinks that, forced by sheer necessity, people would endeavor to utilize as manure, or in some other way, the hurtful substances, which at present they find convenient to throw into the river. He cites the example of the city of Reims, where the soap water which has served for cleaning wool is used in the manufacture of gas³.

In the same year (1866) I was a member of a commission appointed by the Government for studying on our coasts various questions relating to the sea-fisheries. This commission expressed the wish that a similar inquiry might be made relative to the fresh-water fisheries. In December, 1866, I read, at the meeting of the division of science of the Royal Academy of Belgium, an essay *On the River Fisheries in Belgium*, which was published, accompanied by notes and documents.⁴ It would be useless to give an analysis of it in this place, for it would only be a repetition of a statement of facts, which are but too well known to the public, relative to the causes of the depopulation of our rivers and the means to lessen their evil effect. The portion of the evil which must be attributed to the pollution of the water has grown considerably since that time.

The draft of a fishery law which, as I announced in a postscript, had been prepared by the Government, had to wait for fourteen long years before it was discussed and voted on by the Chamber of Representatives.

In 1879 M. Emile Gens, doctor of natural sciences and professor at the College of Verviers, published a very interesting little brochure on the protection of fresh-water fish in Belgium (*De la protection du poisson d'eau douce en Belgique*). The author, after having sketched in brief outline the deplorable condition of our river-fisheries, proposes the following measures for remedying the evil: (1) Prohibition of fishing in all rivers and canals during the months of April and May; (2) prohibition of fishing from September 15 to January 1 in all water-courses on the right bank of the Meuse (it is here that the salmonoids live), permitting, however, the fishing of salmon after November 15, the spawning having then taken place; (3) severe fines for employing dynamite and *Cocculus indicus*; a systematized supervision of the rivers. (4) prohibition of the sale of *Cocculus indicus* in drug-stores; (5) prohibition of all night fishing; (6) prohibition of fishing in streams by means of

³The memoir of M. Lehardy de Beaulieu, preceded by the report of M. Lacordaire, was published in 1866, in vol. iii (new series) of the *Mémoires de la Société libre d'Émulation de Liège*.

⁴*Bulletins de l'Académie royale de Belgique*, 2d series, vol. xxii, 1866.

weirs or dams which lay dry for a time a portion of the bed; (7) regulating the size of meshes so as to allow all fish measuring less than 15 centimeters to escape from the nets; (8) establishing salmon-ways wherever obstructions exist of such a nature as to prevent the migration of fish; (9) prohibition of fishing with the hand, &c.; (10) measures to prevent as much as possible the pollution of the waters by manufactures established on their banks; (11) serious efforts at organized fish-culture; (12) committees of surveillance, furnished with the necessary authority to prohibit fishing locally and temporarily, in the interest of the repopulating of the rivers.

In the following year (1880) M. Gens was commissioned by the Government to visit the Berlin Fishery Exposition, and attend the Piscicultural Congress which opened its sessions in that city in April. His report was published in the *Moniteur belge* for September 19, 1880.

Our honored colleague M. Raveret-Wattel has in the *Bulletin Mensuel de la Société d'Acclimatation de France* produced such an excellent and complete work that I deem it unnecessary to give an epitome of M. Gens's work on the same subject. I will confine myself to pointing out some of its details. The author mentions the fact that several essays had been written on the problem of rendering the water from manufactures harmless to the fish in those parts of the river where such waters are emptied. It is well known that the King of Saxony had set a prize for the answer to this question, which is of great interest to us in Belgium. M. Gens also mentions a simple means, which had been spoken of at the congress, of rendering small water-courses, such as those which drive mills, pure. If the dam is constructed on an inclined plane, it is sufficient to place a beam obliquely across this place, which is certainly inexpensive, and should be done in all cases. In chapter 4 he takes up the principles laid down in his pamphlet of 1879, mentioned above, and supplements his former statement by giving a list of nearly all fresh-water fish found in Belgium, which he, according to their nature, classes in three groups: those which are common to our two regions, those which are found in the mountainous region, and those which are found in the plains.

In a special chapter M. Gens treats of piscicultural establishments.

Belgium did not possess a large sheet of water combining purity, coldness, and depth, where it might be hoped that the salmonoids of the Swiss lakes could be acclimatized. To-day this is different. In order to check the temporary inundations of the Vesdre, and at the same time to supply water to the city of Verviers, which at certain seasons suffered from the want of it, there has been constructed from one mountain to the other, near the mouth of the Gileppe, at the height of 241 meters above the level of the sea, a gigantic dam, 47 meters in height, which when filled holds 12,000,000 cubic meters of the waters of that sub-Alpine river, which receives all which flows into this dam from a forest of about 4,000 hectares called the "Hertogenwald," and from the marshy

regions called the "Hautes-Fagnes," which at their highest point rise to a height of 700 meters. The Lake of Gileppe, which has thus been formed, has an area of 800,000 square meters, and the water in the dam has a depth, varying from 25 to 45 meters.

Here I would advise the introduction of the great lake trout (*Salmo lacustris*) and the trout of the Alps (*Salmo salvelinus*), of the *Coregona fera*, and of certain American salmonoids which do not go into the sea, and which would find all possible levels for spawning from the dam to the river flowing in its pebbly bed and feeding the lake.

Our minister of public works commissioned M. de Clercq, chief engineer of bridges and roads, to prepare some propositions as to the best mode of repopulating the navigable rivers. The remarkable work of this skilled engineer was published in 1881.

The propositions which he makes for remedying the depopulation of our waters are classed in the following order:

- (1.) To prevent the pollution of the waters.
- (2.) To prohibit the destruction of sedentary fish during the spawning season, and to regulate the catching of migratory fish.
- (3.) To construct fishways at all dams in the Meuse and its tributaries which are too high for the salmon to leap over.
- (4.) To arrange spawning-places where the fish find all the conditions favorable to reproduction.
- (5.) To engage in practical fish-culture as far as the salmonoids are concerned.

These various points are carefully treated by a man fully competent to do justice to the subject. I will quote what he says relative to the pollution of the waters, because this is, in my opinion, the principal obstacle in the way of repopulation:

"There can be no question of prohibiting industries which are closely interwoven with the general welfare of our country, but it is important to prohibit the throwing of substances into the water without having been treated in the most efficient manner for freeing it from those substances which are hurtful to fish, and at least as much so to other animals which drink this polluted water. The pollution cannot be considered as sufficiently weakened unless the waters are rendered fit for fish to live in."

There is another chapter in this work which will repay careful perusal, the one in which M. de Clercq describes in detail the construction of good salmon-ways, and indicates the defects which make some salmon-ways worthless. We must here point out, in a humbler sphere than the management of great rivers and the interests of the salmon fisheries, the obstacle which many water-mills present to the repopulating the small streams. I refer to those mills which are placed near small water-courses in plains which have but a slight grade. When the mill is not placed on a channel branching off from the river, but blocks the river entirely, it interrupts the circulation of the fish. The level of the water will under these circumstances vary constantly: sometimes, when the

mill is at rest, it will be very high ; at other times, when all the water is utilized by the mill, it will be so low as almost to lay the river dry. Under these conditions the reproduction and the very existence of fish becomes impossible. If one takes account from another point of view, of the enormous harm which is done to rivers by the fact that the water in these water-courses is nearly always kept at too high a level, thus making the rivers marshy ; if furthermore it is remembered that mills render temporary inundations more dangerous, that great damage is done to agriculture, and finally that public health is endangered, it is to be desired that the water-mills of which I have spoken should as soon as possible, be replaced by wind-mills, or, still better, that they should obtain their motive power from a small steam-engine.⁵

By the provisions of the " Law of the river fisheries," passed by our Chambers towards the end of the year 1881, the supervision and preservation of these fisheries is placed in the hands of the administration of forests. The right of fishing in navigable rivers and canals belongs to the Government, which farms out the fisheries, thus deriving a profit therefrom. Fishing with a line held in the hand, however, is free to all citizens. In other water-courses than those mentioned above the people living on the banks possess the right of fishing. The season when fishing is allowed and the implements to be used are determined by the Government, which also regulates the sale of fish. Fishing is allowed at all times to proprietors of ponds and reservoirs whose waters have no natural communication with the rivers. Boatmen are prohibited from having on board any fishing apparatus but lines. As regards the throwing into the water of hurtful substances, when not done with the object of destroying fish, it is regulated by the " Law on water-courses," previously passed by the Chambers. As, unfortunately, the carrying out of these regulations is in the hands of provincial and communal authorities, which are elective, much remains to be desired. In my opinion the central Government ought to have charge of this supervision.

After the law on river fisheries had been passed a member of the division of science of the Royal Academy of Belgium thought that a favorable time had come for encouraging scientific researches and practical experiments in repopulating the polluted water-courses. He placed at the disposal of the Academy the sum of 3,000 francs as a prize to be given, in 1884, to the author of an essay which would indicate a satisfactory solution of this problem.

At the end of this article I shall give the conditions of this competition as they are found in the transactions of the Academy, with the view of directing to it the attention of scientists and practical pisciculturists who might feel inclined to compete for the prize.

Although the conditions mention certain local questions which spe-

⁵ This last-mentioned system has recently been recommended in a petition of the inhabitants of the banks of the Geer, a tributary of the Meuse on its left bank, in which petition they ask the Belgian Government to order the suppression of all water-mills, as a measure of public usefulness.

cially concern Belgium, it is my opinion that any one capable of answering the principal questions could easily put himself in possession of the necessary information. I am moreover convinced that many parts of France are situated like Belgium as regards rivers whose depopulation is caused by the pollution of the water.

It was on the 1st of April, 1882 (a very appropriate day for discussing the fish question), that the Academy, by a great majority, passed the resolution to invite competition for the prize referred to above. It was not a public session, but I believe that I shall not be guilty of an indiscretion if I state in a general manner the principal objections raised against this proposition by conscientious men of science. One of them thought that this would draw the Academy into an administrative sphere, which was not, properly speaking, its domain, and that it would look as if the Academy was under the impression that the laws of the land were not properly executed, especially that of May 7, 1877, "on water-courses not suitable for navigation and rafting," which imposes fines on persons who throw into the water substances liable to pollute or change it. The law also provides that owners of water-courses who have in this manner had their property injured may bring the matter into court.

Another member of the Academy remarked that he had made many researches with the view of finding a suitable and practical method for purifying the waters from manufactories, but that all these researches had failed to lead to a satisfactory end. He mentioned the evaporation of polluted water which certain manufactures are compelled to introduce, which process, however, produces a smoke having an odor which becomes almost unbearable for persons living in the neighborhood. He moreover thought that with our elective system few persons would dare to strictly carry out the necessary measures. He finally felt certain that the question was full of dangers on account of the exigencies which would arise if the present condition of the waters was made widely known, and it was stated at the same time that so far no remedy had been found for this deplorable condition.

A third member asked that statistics be prepared showing the amount of capital invested in the industries in question, and that this sum should then be compared with the value of the fish destroyed by waters polluted by manufactures. The author of the proposition has answered, in substance, that the scientific solution of this problem comes very properly within the province of the Academy; that there is no idea of finding fault with the administration, as, on the contrary, it was intended to call science to its aid to furnish it with the practical means of attaining the object for which the law was intended. He calls attention to the fact that the programme invites research for the purpose of finding means of purifying the water, which would make it possible for fish to live in it, with the express reservation that these remedies shall not endanger the existence of manufactures. In his opinion the value of the manufactures and that of the fish which they destroy by render-

ing the water impure are not, strictly speaking, comparable, because manufactures are private enterprises whilst water-courses and fish are of general use to all the inhabitants of the regions through which the rivers flow.

Soon after the Academy had passed the resolution referred to we received the programme of the Great International Exposition of the Products and Apparatus of Fisheries which was to open in London on the 1st May, 1883. It has given me great satisfaction to find in this programme two paragraphs which agree entirely with the demands of the Belgian Academy. Under Class IV (pisciculture) we read (division 39): "It is desired to show a system for destroying the hurtful effects to fish of rivers and streams impregnated with water from sewers, chemical and other products, a system illustrated by models and designs." In division 40 we read the request for the solution of a problem intimately connected with the one just mentioned, viz, "physico-chemical researches of the quality of fresh and sea water which is hurtful to aquatic animals," &c.

The Belgian Government, recognizing the necessity that our country should not remain behindhand in this great movement which is going on everywhere, has appointed a commission of six members to study the questions relating to the repopulation of our water-courses.

This commission is composed of Lieutenant-General Baron Goethals, president; Baron de Selys-Longchamps, president of the Senate and member of the Academy; Willequet, member of the Chamber of Representatives from Ghent; Edouard von Beneden, professor of the University of Liège, member of the Academy; De Clercq, inspector-general of bridges and roads, Brussels; Emile Gens, doctor of natural sciences, professor at Verviers; Leyder, professor of the Agricultural School of Gemblous; Mousel, inspector of waters and forests, Arlon; Denis, merchant pisciculturist, Brussels; and Bernard, chief of division in the department of the interior, secretary. This commission, appointed October 27, 1882, has already held several meetings, at each of which different communications have been made, and have led to discussions having for their object the study of the proper measures which should be taken to satisfy the wishes of the Government. We have reason to believe that this activity will not relax, and that active work will soon be begun.

Here follows the programme for competing for the prize, adopted by the Academy:

ROYAL ACADEMY OF SCIENCES, LITERATURE, AND FINE ARTS OF BELGIUM.

Class of Sciences—Extraordinary competition for 1884.

The Government has proposed and the Chambers have passed a law which has for its object the preservation of fish and the repopulation of our rivers.

The principal obstacle in the way of attaining this end is the pollution of the water in the small streams which are not suitable for navigation or rafting, which are corrupted by solid or liquid substances thrown into the water by various manufactures, and which are hurtful to the reproduction and existence of fish.

The Academy appeals to science to aid in the accomplishment of the objects had in view by the authorities. Accepting the proposition of one of its members, who has generously placed at its disposal the sum of three thousand francs, it requests that a thorough study should be made of the following questions, both chemical and biological:

(1.) Which are the special substances in the principal industries which when mingling with the water of small streams render them incompatible with the existence of fish and unfit for the use of man and beast.

(2.) Prepare a list of the Belgian rivers which have become depopulated from this cause, indicating the industries peculiar to each of the rivers, and give a list of the food-fish which used to live in these rivers before the establishment of the manufactures.

(3.) Indicate practical means for purifying the water before it leaves the manufactories, so as to render it fit for fish to live in, without endangering the industries, by combining the aids afforded by the construction of clearing-basins, by filtering, and by the employment of chemical agents.

(4.) Make special experiments relative to the substances which in each industry cause the death of fish; and also relative to the degree of resistance which each kind of food-fish can offer to its destruction by the causes above mentioned.

The treatises must be written legibly, and should be addressed, prepaid, to M. Liagre, permanent secretary, at the Palace of the Academy, not later than October 1, 1884. The Academy requests that all quotations should be exact. Authors will, therefore, indicate the edition and the pages from the works quoted. Illustrations will only be admitted when drawn by hand. Authors will not sign their name to their treatise, but will simply sign by some mark, which they will reproduce in a note containing their name and address. Failure to comply with this formality will prevent a person from obtaining the prize. Treatises sent in after the above-mentioned date, or those whose authors make themselves known in any way whatever, will be excluded from the competition.

The Academy deems it proper to call the attention of authors sending in treatises to the circumstance that from the time when such treatises are submitted to the Academy they are and will remain deposited in its archives. Authors, however, can have copies of their treatises made, at their own expense, by addressing their request to the permanent secretary.