

XVIII.—POND-CULTIVATION ON THE KANIÓW ESTATE (DISTRICT OF BIALA, GALICIA), THE PROPERTY OF HIS IMPERIAL HIGHNESS, ARCHDUKE ALBRECHT OF AUSTRIA.

Paper prepared for the International Fishery Exposition at Berlin, 1881.

By ADOLF GASCH, the present farmer of Kaniów.*

It is not my present intention to write a manual of pond-cultivation. The sole object of the following monograph is to present a sketch of pond-cultivation at *Kaniów* as it is actually carried on, with all its defects and excellencies, for exhibition, criticism, and, possibly, imitation; and, in presenting this sketch, I shall treat the subject principally from an agricultural point of view, as the Berlin Agricultural Club will mainly view the subject from that stand-point.

The special data relative to pisciculture have reference only to carp, as the principal object of fresh-water fisheries, although they will apply more or less to all fresh-water fish, at least to all those fish which form objects of special cultivation.

The domain of *Kaniów* (and *Mirowiec*) which belongs to His Imperial Highness Arch Duke Albrecht of Austria, lies north of the *Beskidien* range in the lowlands of the Vistula, on the right bank of the river Bialka, which forms the boundary line between Galicia and Austrian Silesia, and near its confluence with the Vistula. On its territory, comprising 1,000 Austrian acres (575.46 hectares,) it shows all the characteristics of old alluvia of a large river and a mountain stream combined; clay alternates with occasional rocky strata, sand, loam, and humus in this bottom land, from which the water has receded. Fully one-half of the estate has a heavy clay soil, one-fourth is composed of peat-bogs and sand, and the rest has a light loamy humus-like soil. With the exception of the sand all these soils contain iron. They are damp, and, in some places, even marshy, but show a rich vegetation of grass and clover, probably owing to their strong alkaline qualities caused by the decay of the carpathian sandstone; and this peculiarity is still more favored by the exceedingly moist climate. Till within four years the estate was frequently subject to inundations. Since, moreover, the water of the Bialka, which passes the manufacturing towns of

* Die | Teichwirthschaft | auf dem | Sr. Kaiserlichen Hoheit dem Herrn Erzhertzog Albrecht von Oesterreich | gehörigen Gute | Kaniów, | Bezirk Biala, Galizien. | Zur internationalen Fischereiausstellung in Berlin | im Jahre 1880, | dargestellt vom gegenwärtigen Pächter | Adolf Gasch."—Translated by HERMAN JACOBSON.

Bielitz and *Biala*, often contains a considerable quantity of fertilizing matter, nature has very clearly indicated that stock raising and pisciculture must be the principal objects to which attention should be paid at *Kaniów* and *Mirowec*.

From time immemorial the *Kaniów* estate had large but badly watered ponds, which, in former times, occupied almost the entire territory, and which, even now, after having been regulated, occupy 450 acres, or 45 per cent. of the total area. Of this pond area, 250 acres are on the heavy clay soil, 50 on the marshy soil, and 150 on the light loamy soil. In many cases, however, two of these soils are found in one pond. All the ponds are fed by the *Bialka* water which, especially during seasons of violent rain-storms, carries with it a great deal of fertile mud, so that the ponds actually serve as mud reservoirs. But as pond cultivation is carried on in these parts on an extensive scale, the *Bialka* water is often insufficient, especially in midsummer, when there is so much evaporation from the large sheets of water. This, of course, injures pisciculture, and does not allow it to be carried to its highest perfection. Nearly all the ponds in this part of the country are shallow, and invariably incline towards the *Vistula*. In former times they were badly watered, and a system of regulating was inaugurated by my predecessor, Herr *Potyka* (who deserves great credit for his energy and perseverance), and has been completed by me at my own expense, so that at present nearly the entire pond area is covered with water. All the ponds can be drained so thoroughly as to allow of their being plowed and planted throughout their entire extent. In these parts it has, fortunately, long been known that it is not sufficient to provide the ponds with an ample supply of good water, and to keep their soil fertile, but that it is absolutely essential that the ponds can be entirely drained at any time for the purpose of fishing or planting. Wherever this cannot be done, there can be no systematic and profitable pond cultivation, but merely irregular lake fishing. The most profitable part of pond cultivation, viz, their agricultural utilization by planting, is thus entirely lost.

Of the 450 Austrian acres of our pond area, 400 acres are occupied by nine main ponds, one of which has twice the average size; 3 acres by five spawning ponds, and finally 47 acres by eight ponds for the young fry, to which, since 1877, there must be added 22 acres occupied by three ponds for young fry which were rented from a neighboring farm, so that the total pond area of this estate is 472 acres.

Of the above-mentioned nine main ponds, which are equal to ten medium-sized ponds, Mr. *Potyka*, who deserves great credit for his zeal in carp culture, only had the smaller half under the water, the remainder being either planted by himself or rented out for the same purpose. The young carp were always left in the main ponds two full years, which produced a very fine marketable fish of about $1\frac{1}{2}$ kilogram average weight. The average yield per acre was, according to the

official reports, 103 kilograms of fish, each fish weighing on an average 1.394 kilograms. These fish even at that time enjoyed the reputation of being the finest carp in the whole neighborhood, and were nearly all shipped on the Vistula to *Cracow* and *Warsaw*. After a pond had been under water for 4 years, it was entirely drained, and served agricultural purposes for 5 or 6 years.

When in August, 1873, I took *Kaniów* and *Mirowiec* on a lease of twelve years, the ponds contained a fine well formed species of carp, and pond cultivation had been carried on systematically though perhaps not as vigorously as it might have been. I immediately took steps to extend the pond cultivation, by allowing one year to pass, and then, in 1875, planting or renting out for the same purpose one-half, and fishing in the other half after the first summer. From that time on one pond was plowed and planted every autumn, whilst at the same time one pond was freshly watered. This system I have maintained ever since, in spite of the difficulty experienced in the beginning, of obtaining the very large quantity of young fish required, because it offers many and great advantages. At present the greater half of all my ponds are under water, and I confine myself to plowing and planting one pond, either main pond or pond for young fry, a year, with the view of providing a sufficient quantity of fodder of the very best quality for my valuable herd of cattle. All the ponds are of course at present managed by myself, and none are rented out.

It is well known that the carp grows most rapidly during the first year of its life, and slower as it grows older. If the main ponds are, therefore, drained of their fish *annually* the most favorable result will be obtained. By avoiding one wintering the risk is greatly decreased and the stock of fish is under more frequent and better control. This system, moreover, offers the advantage that one has a certain regular annual income, which will vary but little; and thereby that point is reached which, owing to the slowness of all agricultural processes, is after all mainly to be aimed at, viz, to decrease the working capital and to obtain a rapid sale for the products of the farm.

I did not rest satisfied with this change, but aimed at a further improvement of our breed of carp by selecting the breeders very carefully, having special regard to their build and to rapid growth (if this can be considered a peculiarity of any breed of fish). Herein I was guided by the view that a fish possessing a well-shaped body is apt to develop a larger quantity of flesh, thus obtaining not only a greater total weight, but also a more even proportion between the valuable and valueless portions of the body, which of course increases the worth of the fish. I therefore principally look for a comparatively small head, a well-arched full back, and a broad and well-rounded body. In other words, a good carp of pure breed is to be among the fish what shorthorns are among cattle, particularly as, in all probability, the carp will, for a long time to come, remain the principal fish bred and raised in our ponds.

I begin to select my future breeders among the one-year-old fish, and continue to select some from the two-year-old fish, as well as from those which have reached a marketable age, 3 years, so as to have on hand a considerable number of breeders from among which I then select the best.

Following *Dubisch's* method, I only place one spawner and two milers in one and the same pond. These are fully able to supply my demand for young fish, which at present amounts to 60,000, for stocking the original *Kaniów* ponds and those I have rented from *Prince Pless*.

It is not necessary, but even injurious, to place a larger number of breeders in one pond, because they are apt to produce too large a number of young fish, which might suffer from want of food; and if carp are to grow rapidly, it is very essential that the growth of the young fish should be favored as much as possible by supplying them with ample food, which can be done even without having recourse to artificial food; so that by merely furnishing a sufficient supply of natural food one can, during the first summer, obtain fish 5, 8, and even, in exceptional cases, 10 inches. With these young fish I stock my ponds for young fish during the second summer, allowing 240 to 360 per acre (about 420 to 630 per hectare) according to the size of the fish and the nature of the pond. In this manner I obtain carp weighing $\frac{1}{2}$ to $\frac{3}{4}$ kilogram, and even reaching in some cases the weight of 1 kilogram. Of these I place 90 to 120 in the main ponds during the third summer, and thus obtain carp weighing 1 to 2 kilograms a piece, when ready for market.

I have not always been able to supply the necessary number of carp for raising, and as there are no spare ponds for young fish near *Kaniów*, and as unfortunate accidents will sometimes occur, even in the best piscicultural establishments, I have repeatedly been obliged to supply the places of the lacking fish by placing selected fry of unusually large size in the main ponds, and in these cases I have invariably obtained fish weighing about 1 kilogram each and having particularly fine and tender flesh. I have also observed that young fry, which have grown rapidly, will continue to grow fast till they are ready for the market, and actually grow faster than young fish of the same age which have been somewhat retarded in their growth; but that the latter, although of equal size, will weigh heavier, when they have reached a marketable age, than fish raised from young fry, because their flesh has a greater consistency.

It should therefore be the aim to accelerate the growth of the fry and the young fish as much as possible, because fish which have grown rapidly are apt to continue this rapid growth; and it would be very bad policy to be stingy with the extent of water allowed for the raising of fish, because the final result will amply compensate for this.

As regards the stocking of the main ponds, it is an old experience that in stocking a certain extent of water with a small number of fish,

finer and more valuable specimens will be obtained; whilst the stocking of the ponds with a larger number of fish, if kept within reasonable bounds, will result in a greater total weight, but in an inferior quality of fish. Stocking ponds with a small number of fish is therefore to be recommended, but, like everything else, it should be kept within proper bounds, and a correct calculation will herein form the safest guide. No more than 90, and never more than 120, fish per acre are placed in the *Kaniów* ponds. The result has been that our breed of carp has steadily improved, and the number of kilograms of fish caught per year and per acre has been as follows:

	Kilograms.
Up to 1873.....	51.5
1876*	76.76
1877 and 1878†.....	83.00
1879	104.50

thus, the yield of the ponds has more than doubled in six years, and regarding the quality of our fish I can state that in one year we raise very fine carp, weighing $1\frac{1}{2}$ kilograms and more, which enjoy an excellent reputation in the Breslau and Hamburg markets.

In favoring the growth of carp from their earliest youth, one has the special advantage that the fish, in spite of their size, remain slender in figure (that is, do not have those monstrous stomachs which are seen in some fish), and that they begin to grow fat at an early age, whereby, as in all animals, the development of the sexual organs is often entirely stopped, and the favorite fish of all gourmands, the "barren carp," is obtained.

With the view of increasing the natural food in the ponds, they are allowed to lie dry during the winter, in order that the frost may deprive the mud of its acidity, thus making it, by atmospheric influences, a suitable breeding-place for insects and infusoria. For the same reason I never allow the bottom of a fresh pond to be hoed before its first watering. This method has stood the test of a number of years. It seems best, however, if during winter the larger portion of the pond is exposed to the frost, leaving a small portion under water to serve as a place of refuge for valuable aquatic animalculæ, where they may be sheltered from the destructive cold, so that with the beginning of spring they can breed all the more rapidly and numerous in the freshly filled pond, and in this way be of great benefit to the carp. I have demonstrated with two of my ponds, which were treated in this manner, that by wintering some of the fish in the deepest places the result will be a steadily increasing number of fish during the fishing season, which is not the case when ponds have been under water for a long time.

* The years 1874 and 1875 being transition years, have not been taken into account.

† The greater portion of the fish of the year 1877 were not sold, but were kept in tanks. They were recently placed in ponds with the other stock of fish of 1878, and were finally sold with these.

In order to dispel the erroneous idea that I obtain the above-mentioned results only by going to a great expense, I will mention that for tending the *Kaniów* ponds of 450 acres I only employ one assistant, and that for the 22 acres of ponds which I rent I only employ one person as a watchman. During autumn, when there is more danger from fish thieves, and during winter, when holes have to be cut in the ice, I generally employ an extra assistant for the *Kaniów* ponds.

Even while under water the ponds do not merely serve piscicultural purposes, but also, in a narrower sense, assist agricultural objects. As soon as spring sets in, and the ponds are released from their icy yoke, varied life begins to stir in the water; manifold aquatic birds begin to make their appearance with the first warm rays of the sun; insect-life begins to awaken, and a grand and mysterious activity is developed in the ponds. Long before the land casts off its wintry mantle, the ponds as far as the water reaches are clothed with verdure, as a welcome indication to the farmer that the time is near, when after a hard winter he will, as stock-raiser, derive advantage from his ponds, in the cheap, profitable and ample pastures they will furnish. As soon as the water has lost its icy temperature, which does not agree with cattle, they may be allowed to go into the ponds, where, wading about, they seek their food. They are thus not only benefited themselves, but through their excrements, dropped here and there, they indirectly benefit the fish. By treading about in the muddy bottom they stir it up, and thus enable the fish to catch more readily worms and other aquatic animalcula which serve as fish-food. Cows generally become accustomed to these pond-pastures very quickly, and actually show eagerness to go into the water, which from a sanitary point of view, also, is beneficial to them. No one, who has not seen it himself, would believe with what delight cows take their bath, eagerly eating all the while, until they are satisfied and seek a place of rest in the higher portions of the pond. Even if the number of cattle is very large, they are not able to destroy the luxuriant growth of grass and reeds; and the farmer will soon have to place them in another pond where the grass is younger and more tender. As soon as cows enter a new pond, they will act like boys just let out of school. The new pond, a veritable *terra incognita* for them, is eagerly explored in every direction, until they seem to have taken all its bearings, when their appetite returns and they begin to graze. The wild ducks, scared away by the first noisy approach of the cattle, again enter the pond and boldly swim about close to the grazing animals, whilst the carp peacefully seeks its food, without being in the least frightened by either ducks or cattle. Such a pond therefore resembles a small but harmonious and happy community, where every one is doing well and feels contented, and lives on the most friendly footing with his neighbor, much as he may differ from him in nature and habits. Below the surface, however, and hidden from the eyes of the human observer, a terrible war for existence is waged among the diminutive animalcula which fill the water of the pond.

These pond-pastures not only supply the cattle with pleasant and healthy food, but actually become a source of profit to the farmer. My cows, always well fed, give better milk when grazing in the ponds, than when they are stable-fed with fresh clover. There is no fear that the reed-grass (Polish, "*odymka*") will make the cattle bloated; for this quality of the reed-grass—which it undoubtedly possesses—is entirely lost when it grows in the water. Although my cattle have pastured in ponds for seven years, I have not had a single case of the kind. Whoever has time and opportunity to mow the reed-grass before it blossoms, and dry it, will thus obtain excellent hay for the winter. On account of the large quantity of nitrogen it probably contains, of its fine texture, and finally, on account of its tough character, it easily becomes heated and to some extent begins to ferment; great care should be taken to avoid this. The same applies to the remnants of grass, &c., which are left after a pond has served as pasture. The best way is to let this grass lie for a considerable time, and then to put it up in stacks or small heaps, only using it mixed with harder winter straw, when it will make a good and effective fertilizer.

It would doubtless be profitable to make experiments with feeding cattle on hay from the ponds, mixed with winter-straw and rape-stalks, for this would in all probability furnish excellent food for the young cattle during winter. Unfortunately I cannot speak in this matter from personal experience; but it would be very gratifying to me, if my remarks would encourage others to make the attempt.

I need not dwell on the utilization of the mud from the ponds, as being too well known. This manner of utilizing ponds will only be profitable in cases where the mud can during winter be taken direct to a neighboring field, to be used as manure, such as for clover, or for making the hot manure from the cattle-yard somewhat milder; for if the mud is to be transported any great distance, the expense will exceed the profit, as is often the case when heavy manure is sent any distance.

All these small profits yielded by a pond whilst still under water are insignificant if compared with the vast benefit to accrue from a pond which, after having served piscicultural purposes for a number of years, furnishes the farmer with a rich and well-manured soil, fit for almost any kind of plants.

A farmer who is able to drain his pond entirely and plow it thoroughly before winter sets in, will find it easy work in spring to plant the muddy bottom of the pond, transformed by the frost into the very best of soil. If he does his work carefully, he may confidently look forward to a rich harvest, which will fully repay him for the considerable trouble involved in the first plowing, and which will prove beneficial to his entire farming operations. Let no one say that it is too difficult, or even impossible, to plow large ponds in autumn, after the fishing season has come to a close; for if it is possible to plow the large *Rosenberg* pond near *Wittingau*, in Bohemia, measuring 1,500 acres, where fishing does not.

commence till the beginning of October, it will be an easy matter in small ponds, especially if one takes care to get a number of extra oxen for this extra work, to be employed, of course, only temporarily for this specific purpose. It will be found most profitable to employ for this work oxen which, being well fed during the season of labor, may often be sold with advantage, after the work is done, to butchers for fattening. The capital invested will thus be profitably reduced.

Possibly it would be found advantageous to use a steam-plow in very large ponds, but this will of course depend on the locality, the means at the farmer's disposal, &c.

Under all circumstances it is not only a short-sighted policy, but actually an injury to the national wealth, if any farmer, who has the means, does not drain at least those of his ponds where this can be done easily, and periodically devote them to agricultural purposes, thus deriving the greatest possible benefit from every part of his property. There are many farmers who are unfortunately compelled to obtain their manure from abroad, partly on account of insufficient harvests from poor fields, partly because industrial enterprises necessitate a greater production. Many farmers who possess arable ponds, unfortunately have recourse to the comparatively easy system of buying artificial concentrated fertilizers, before they have made careful and repeated experiments, to determine whether these fertilizers will suit their peculiar soil, and the consequence is that they soon become convinced by bitter experience of the mistakes they have made, which, moreover, in most cases has proved a considerable expense.

In my opinion it would be far more practical, and, at least as long as agricultural chemistry, owing to the great and general ignorance of the nature of soils is not able to give absolutely reliable advice as to the application of fertilizers, much more rational, to make use of those advantages furnished by every locality, *i. e.*, to use that fertilizer which, so to speak, has grown on the same soil (the mud of ponds is nothing but a portion of the soil), and will, therefore, be particularly suitable, can easily be assimilated, and with very little trouble can be transferred from the ponds to the neighboring fields. No harm will be done, even if in some cases this fertilizer is mixed with other substances not having such strong fertilizing qualities. In using mud from the ponds as manure, the plants growing on fields, whose soil has thus been improved will of course draw from the ground only those substances needed for their growth. In this manner a circulation, on a small scale, of the most valuable mineral substances serving as food for plants, is inaugurated, atmospheric influences uniting with these during the growth of the plant; whilst the mineral substances above referred to, during this process, again return to the inexhaustible source whence they came, of course excepting that small portion which was taken away in the fish, of which, during the flooding of the upper portions of the pond, does not return to it.

What wealth of excellent food for plants may eventually be secured by the pond-harvest, may be gathered from the observation that the water of the ponds is, even in its original condition, the bearer of dissolved fertilizers, which become a portion of the mud at the bottom and increase its existing wealth of food for plants, to which are added the valuable refuse, &c., from the manifold animal life of the water. The correctness of this view is proved beyond doubt by the exceedingly luxuriant vegetation of the ponds.

As long as the ponds are not plowed and regularly planted, a greater or smaller quantity of plant-food lies almost idle in the mud of the ponds, as only a very small portion of it is utilized as pasture, hay, &c. Every farmer, therefore, who has the opportunity, should aim at the greatest possible utilization of the mud in his ponds, by regular plowing and planting their bottoms. For my part I do not hesitate in the least to derive the greatest possible profit from my ponds, by benefiting my other fields through them, and I feel convinced that even *Justus von Liebig* would have sanctioned this system, because during the very next period of flooding or filling the ponds, all those substances which were removed with the mud, would gradually be replaced by fresh accessions thereof.

As to the manner in which the hidden treasures of the mud may best be secured in various localities, *i. e.*, what kind of cultivation will best suit the different ponds, we must say that no doubt every intelligent farmer will find this out for himself, and all that is necessary is to give a few hints.

The following method has, after a number of timid experiments, proved eminently successful in the *Kaniów* estate: in poor ponds I plant, the first year after the pond has been drained, oats, the second year again oats, or, applying a small quantity of manure, wheat mixed with clover, followed in the third and fourth year by clover which, mixed with grass, furnishes excellent pasture during the fifth year, unless I prefer to fill the pond after the fourth year. I do not hesitate to apply some manure to such ponds, especially in the higher places which have not been thoroughly flooded by water, which I can easily do, as I have always some manure to spare. Whatever I have planted in such ponds has thriven better than, or at least as well, as on the best fields on my farm, and moreover, I thereby furnish a suitable breeding-place for the insects and infusoria which, when the pond is again full of water, will have their home there.

In better ponds, however, all other agricultural plants may be successfully cultivated, with the exception of barley, which in *Kaniów* (though reaching a relatively heavy weight per standard measure) only gives a medium harvest, and does not furnish a fine quality of malt. As regards wheat and clover, my ponds often produce richer harvests than my fields. In these better ponds I hardly ever use any manure. I find that the following method will yield the greatest profit, both in money and in additional fodder for my numerous cattle: the first year I plant

peas (a small early variety of green peas); the second year, rape, and in exceptional cases, potatoes; the third year, wheat (on heavy soil, Galician wheat, and on loamy humus soil, Frankenstein wheat) mixed with clover, so that during the fourth and fifth years clover finishes the agricultural period of the pond. I take the special precaution to add some grass-seed to the clover for those portions of the wheat-fields which lie on the higher portions of the ponds, with the view of furnishing better pasture for my cattle when at some future time they will seek their food in the ponds.

I prefer to close the agricultural period of my ponds with clover, because the remnants of clover will furnish a very large quantity of vegetable food for insects, and will thereby supply a large amount of food for the fish, which eventually will benefit me by producing larger and finer fish.

After all my experience I can say that my safest harvests have always been those gathered from my ponds, and that I have found pond-cultivation productive of a decided addition to my annual income.

Although I cannot but highly recommend to all farmers the plowing and planting of their ponds, I must caution them to be careful not to plow too close to the dikes, because by doing so they run the risk of destroying the reeds, which are of primary importance to the safety of the dike. I always leave about 2 to 4 meters from the base of the dike, which the plow never touches, and where I do not even mow, because in stormy weather the waves will be broken by the reeds, especially if by the growth of years they have become very dense. It is, under all circumstances, a much cheaper way of saving the dikes and keeping them in repair, than to erect stone dikes or walls (as in the *Rosenberg* pond). Where no reeds are growing below the base of the dike they can easily be supplied by cutting some reeds in the pond deep under the water and laying these in the water near the dike, where they will soon send out water-roots towards the bottom and thus grow and flourish near the dike.

I will also mention here that localities which, probably owing to the lack of forests, suffer from aridity, may have their climate changed in a very cheap and profitable manner, by the filling with water of a number of large ponds.

I will here close my communication, which has come from the unpracticed pen of a practical farmer, and which does not in the least claim the merits of a literary production. Nor will this be required of a work like the present, because it simply intends to add another contribution to the experience of those who have given some attention to fresh-water fisheries (pond-fisheries) and the farming operations connected therewith. I know very well that I am still far from the limit of the possible in this line, but I honestly claim that, as far as my experiments go, they have been very successful. I shall of course not rest contented on my laurels. I would, in conclusion, direct attention to the circumstance that

most practical farmers have, as a general rule, been but little benefited by the grand results of scientific investigation, and that, unfortunately, they lack a thorough knowledge of the aquatic fauna which is of such great importance for the feeding of fish. In the interest of pisciculture I herewith express the justified wish that scientists may give us still more practical advice. By carefully raising the respective aquatic animalculæ for fish-food, we should, perhaps, succeed in favoring the growth of the fish during the second and third year in a similar way as is done during the first year.

I cannot too strongly urge all farmers who take an interest in pond-cultivation to make—in their respective localities—further observations and experiments relative thereto, and I sincerely hope that their experience will be published for the general good. It is one of the beauties of agriculture, that it knows no professional envy, and dare not know any, for even if the greater experience of one man benefits another, the first one will not deem his interests endangered thereby, since a larger production, by creating a greater demand and better markets, will in the end again prove a benefit to him.

As far as I am concerned, I shall also in the future gladly make known to the general public the results of any further experiments in pond-cultivation. I shall rejoice at every success obtained by other farmers and pisciculturists, and in anticipation of such happy results I herewith bid them, from the depth of my heart, a sincere *God-speed*.

