XIX.—THE PISCICULTURAL ESTABLISHMENT OF MR. AUGUST FRUWIRTH IN FREILAND NEAR ST. POLTEN, LOWER AUSTRIA.

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[Abhandlungen der k. k. zoölogisch-botanischen Gesellschaft in Wien for 1877.]

An interest has been manifested with us in Austria in transforming waste and unproductive river regions into territories capable of sustaining fish, and the government as well as private individuals have at different periods taken steps towards bringing about this result. But as these efforts were neither systematic nor united, the results were not very striking. It is but a rare case that a private individual owns extensive fishing-waters. Intricate claims to use the water and fish in it—claims made from every side—blunt his energies or frustrate the beneficial measures which he has inaugurated, and even the greatest zeal will grow cold when continually meeting with such hinderances, especially with ignorance and covetousness. Our present system of title-deeds to water property is insufficient, our legislation for protecting the fishing interest is imperfect, and even if there are laws they are not properly carried out. And without such laws properly observed the experience gained nearly a century ago, that the propagation of fish at the right time and right place may be caused artificially, and that with proper measures for protecting the young fish they may be raised without such enormous losses as threaten them in open waters, will be practically useless. While, therefore, private individuals will feel little inclination to place impregnated fish-eggs in waters which they only rent under certain conditions, or whose neighboring waters are owned by persons whose sole aim seems to be the destruction of fish, the impregnation of fish-eggs on a large scale will, at least in our country, be hardly a paying business. Under these circumstances, our object in directing attention to a new piscicultural establishment, well furnished with all modern improvements both foreign and domestic, can only be to awaken sympathy for a most praiseworthy undertaking or to encourage the enterprising manager; but by no means to meet a long-felt general want. But the author is of opinion that the new Austrian fishery laws, which will soon be in force, will form the basis for great improvements in pisciculture,

* *Die Fischzuchtanstalt des Herrn August Fruwirth in Freiland bei St Pölten in Niederösterreich.* Vienna, 1877. Translated by Herman Jacobson.

which will then with us assume its place among the industries of the country, which by right belongs to it, and which in other countries it has occupied for some time. The successful steps taken by Germany in this direction, the activity of the great piscicultural establishment at Hüningen and of other similar establishments, and the noble zeal displayed by the German Fishery Association cannot fail to encourage our pisciculturists in their endeavors. And even if we do not reach very great results in the immediate future, piscicultural establishments, if properly directed, can do much to remedy the lack of fishes in our waters, and become quite profitable to their owners; and this may be done by raising fish for the market. As the grand results of our Bohemian fisheries with regard to the carp and pike are so well known, it is scarcely necessary to say that I am only thinking of the decimated inhabitants of our mountain streams, the trout, &c. Pisciculture so far is, any way, almost confined to the salmonoids. All the piscicultural textbooks show the method to be pursued. In our piscicultural establishments fine specimens of fish raised by them are from time to time exhibited; but all this only conveys the impression as if the possibility of the thing were to be demonstrated, but not that the enterprise in question is and should be independent of various outside influences, and could be successful if certain conditions were properly observed, the efforts and sacrifices to be made as well as the results to be obtained being well understood beforehand. We should be able to determine beforehand the productiveness of a piece of ground about to be transformed into trout-ponds just as much as we are able to do this with regard to carp-ponds, of course taking into account the necessary expenses for feeding or fattening the trout. It should be accurately known under what conditions the greatest possible yield may be secured in the shortest time, and the most favorable conditions for a rapid growth of the young fish should therefore be determined; in short, it should be our aim to gain such general principles and experiences that a person who intends to use his favorable natural surroundings for raising fine food-fish would not be obliged to treat the whole matter in the light of a more or less doubtful experiment, for it *would* remain doubtful, because the causes of success or failure are not fully understood, to do which requires considerable talent of observation, patience, and endurance.

A short time ago I had occasion to visit a new and little known piscicultural establishment, which I resolved to describe more fully in this journal because all its arrangements seemed very fine and perfect and because its proprietor and manager pursues his object with unusual energy. I was convinced that in so doing I would render a service to all persons interested in pisciculture and to this industry itself.

The piscicultural establishment of Mr. August Fruwirth can, by railroad and stage-coach, be reached in five hours from Vienna. It is located in the little village of Freiland, numbering only a few houses, half an hour beyond Lilienfeld, on the banks of the Traisen. It takes two

hours and a half, by stage-coach to reach Freiland from the well-known town of St. Pölten; but soon it will be reached in an easier way by the railroad to Schrambach which is shortly to be opened. The piscicultural establishment is located on the right bank of the Traisen at the foot of the Lilienfeld Alps, on a meadow rich in springs, almost at the point of the angle formed by the confluence of the Traisen and the Unrecht-Traisen. Mr. Fruwirth selected this place because it was hoped that after the ponds had been dug there would be a sufficient quantity of water, and because in case of necessity any quantity of water might by a canal be obtained from the Unrecht-Traisen. The establishment, which our diagram shows in its present condition, has not sprung into existence at one time. The proprietor proceeded in a very rational manner by first making an attempt on a small scale, and only extending his operations when he found his expectations realized. In October, 1873, he dug the the pond S_1, because the springs were most numerous in this neighborhood. From this pond the water flowed through four sluices in four canals, which united in the neighborhood of the pond marked *Wa.* In these canals Mr. Fruwirth placed Jacobi's hatching-boxes, without vessels, but simply with a layer of sand for the eggs, near to the sluices, therefore within the limits of somewhat agitated water. The eggs developed in an excellent manner, and it is said that nearly 500 trout trace their origin to this first experiment. As everything succeeded so well, Mr. Fruwirth during the following year built a hatching-house, and by digging a number of new ponds for the young fry he almost brought his establishment to its present condition. After the five ponds for the young fry had been dug, water began to appear in such quantity as to determine Mr. Fruwirth not to get any outside supply for the present. In the beginning the water which flowed off was led direct into the Traisen. This proceeding, however, had some disadvantages which considerably diminished the results of the hatching-period, 1874–'75, and compelled Mr. Fruwirth to adopt energetic measures. As the right bank of the Traisen is very flat, the water which should have flowed off occasionally remained stationary, or the Traisen water entered the establishment and threatened it with destruction. Dams were of not much use under the circumstances. During the winter of 1874, the hatching-house was exposed to very serious dangers. It was impossible to drain the ponds in order to empty them of fish. One or more larger trout remained in the small water-puddles and seriously endangered the life of the small-fry. The only way to obviate the difficulty was to construct a tunnel 108 feet long through the solid rock, through which the water could flow off right by the side of a large weir, thus abolishing all communication with the Traisen. From this tunnel the water flows into the river in the shape of a small water-fall. Much damage was also done by having the sluices closed with a fine wire grating, as the tender young fish were pressed against it by the force of the current and thus perished. Nothing would remedy this evil but an invention which I shall describe

further on. During the season 1875–'76 a considerable number of eggs were placed in the hatching-boxes, not only of trout, but also of saibling, and of bastards of trout and saibling, as well as of bastards of trout and salmon, which, through the Salzburg establishment, were ordered from Hüningen. Both in 1875 and 1876 a large number of young fish were placed in the small tributaries of the Traisen. In the autumn of 1876 I saw 1,200 trout, saibling, and bastards of the two, all of them the results of the two above-mentioned hatching-periods. Besides these there were 1,200 large trout in the pond *Wa*, which are used for propagating; but only a portion of these—about 500 from the hatching-period, 1873–'74—are raised in the establishment; the others have been caught and fattened. In the autumn of 1876 the feeding-ponds, 1–16, were constructed, and the system of "chambers" for the young fry was introduced, and some improvements made in the connections between the various ponds and canals.

After this brief historical introduction, I will proceed to describe the present condition of the establishment. The soil which was gained by the digging of the ponds was piled up along the edges, thus forming dikes, on which walks have been constructed between rows of alder and willow trees. There is a fall between all the ponds, so that the surface of the last pond, *Wa*, is about 2 feet lower than that of S_1. It may be stated that on an average there is a fall of about 2 inches to the fathom. The bottom of the ponds is covered by a species of *Chara*, which is growing luxuriantly. At many places of the basins, but especially in the principal pond, S_1, there are numerous springs. With this exception, every pond receives its water from the preceding one. The experience of three years has proved that the fish thrive very much under this arrangement. At the end of the first year the percentage of mortality was 0. From the pond S_1, the water flows through four sluices into the ponds S_2, S_3, S_4, from this one into the pond S_5, and from here through the canal *J K* into the pond *Wa*. The water also flows into the pond *Wa* from the pond S_1 through the canal *S K* and *J K* (to the left), and from the pond *Wa* it flows into the Traisen through the tunnel *A T*. The average depth of the ponds is 2 to 2½ feet. The temperature of the water even in August was 50° to 52° F. near the springs; farther away from these or near the surface, 61° F. In the beginning the sluices were simply protected by a vertical grate; but as the young and tender fish were pushed against it by the violence of the current and were thus frequently injured, Mr. Fruwirth made two new improvements. The one consists of two boards rising above the surface of the water and meeting at an angle. Immedlately below the surface square holes are cut in the boards and are covered with a grating; the lower part of the board is hidden by a pile of sand reaching as far as the grating. The other improvement is very similar to this one, only that the place of the boards is taken by a box open on two sides, viz, at the bottom and in the rear; the gratings are in the lower portion of the three

sides, quite near the edge. By introducing these improvements Mr. Fruwirth prevents the little fish from coming within the immediate reach of the strong current, and also keeps his gratings free from mud, leaves, &c.

The pretty hatching-house *B* lies about 3 feet deeper than the main pond S_1, and receives its water from this pond through two pipes. The pipe, which is protected by one of the above-described cuniform mud-catchers, begins with a broad portion covered with flannel and perforated like a sieve, leading into a filtering-box 9 feet long and 2 feet broad, filled with alternate layers of sand and charcoal, which are separated from each other by thin perforated boards and pieces of linen. From this filtering-box the pipes branch off to the four Coste hatching apparatus with 25 vessels each, which are inside the house. The number of vessels in the hatching-house is therefore 100. Counting 5,000 eggs for each one, we find that Mr. Fruwirth's hatching-house can accommodate 500,000 eggs. Besides these vessels I saw six Jacobi hatching-boxes with 36 vessels, each capable of holding 2,000 eggs, so that 72,000 more eggs can be accommodated. If all these vessels were filled to their utmost capacity, this establishment could develop more than a million of eggs. After having left the eggs, the young fish go into two wooden boxes placed in the ground on the outside of the hatching-house (on the diagram it would be the south side). From each of these boxes a pipe which can be closed (the two dotted lines) leads into the narrow and shallow ditches marked *j*. These provide for the case that the young fish gathered in the wooden boxes should be too numerous, and that they could not immediately be placed in the "chambers for young fry," which are to be described further on. The thick black line beginning at the letter *Z*, in the pond S_2, is a pipe, by which any amount of water can be introduced if the influx from the hatching-house should not be sufficient. Model order and neatness characterize the interior of the hatching-house. All the necessary apparatus is found here in a suitable selection. I must not forget to mention that there is a reservoir in the floor of the hatching-house, from which water can be obtained by means of a pump. We shall soon see for what purpose this reservoir has been introduced. If we leave this cheerful house by way of its southern front and go to the opposite side, a wooden stair-case invites us to the inspection of a superstructure rising from the middle portion of the hatching-house. Here we find a small but admirably arranged laboratory. On one wall we see several aquaria ranged in stories one above the other. In the lowest and largest one young trout and saibling are sporting.

By means of the above-mentioned pump in the hatching-house, a reservoir placed in the loft above this little room is filled with water, which from here either flows direct into the aquaria or is used in putting in motion some of Spengel's ventilating apparatus. The effect of this very simple and cheap arrangement is excellent. The importance of these large and small aquaria cannot be overrated. In the first place, the

little fish can be easily observed, especially as to how they take to the different kinds of food which is offered to them, and, in the second place, the conditions of life of the numerous animalculæ living in the water can be investigated, and such observations will in nearly every case yield some practical result for the pisciculturist. He learns to know a large number of facts which will furnish him the key to many phenomena which are insoluble mysteries to the majority of men. As Mr. Fruwirth also possesses a Zeiss microscope with every contrivance which is required in making microscopic observations, a person may at once go to work. A stove makes it possible to use the laboratory all winter. I must not forget to mention that this room also contains a very complete, well preserved, and tastefully mounted collection of specimens of the trout, the saibling, and bastards, in all the various stages of their development from the egg to the completed second year.

In the pond *Wa* those fish are kept which have reached the age of maturity. During the spawning season they ascend to the hatching-house by way of the channel marked *L;* and as this channel can be closed by a trap-door where it opens into the pond *Wa*, they are easily caught. In extracting the roe Mr. Fruwirth pursues a method different from the one generally adopted. He takes hold of the fish by the head and tail and simply bends it; in doing this only the fully matured eggs come out; there is no danger, like in the so-called "squeezing" process, that many of the immature eggs are also torn loose. The fish which have yielded a portion of their eggs are again placed in their native element separate from the others, and are again taken up after some time. Mr. Fruwirth informed me that as long as he pursued the usual method he often found in the vessels eggs which, although outwardly perfectly healthy, had not begun to develop, whilst at present this is no longer the case. As even when entirely free the trout never discharges all her eggs at one time, this simple and natural procedure adopted by Mr. Fruwirth must be highly recommended.

Before describing some special arrangements, *e. g.*, the feeding-ponds (1 to 16) and the "chambers" for the young fry (*I K*), I will explain the diagram. The gray squares in the ponds S_1 to S_5, and *Wa* are floating boards, which are placed there to give the trout a chance to protect themselves against the rays of the sun or to find a dark place. This object, however, will be better reached in a few years by the growing willow-trees. These boards are weighed down by stones and are therefore a little below the surface. This is very essential, for fish jumping out of the water, as they frequently do, might accidentally alight on these boards and would soon die if the boards were dry and hot. *S K*, the so-called "sorting-chambers," are compartments where during fishing, or whenever it is desirable, the fish may be sorted according to size and species. *W* and *H* mark the dwelling of the keeper and a dog's kennel. *F* is a place for storing salt horseflesh for feeding the growing and matured fish. Nothing but perfectly healthy meat is used. It is

cut in strips and pieces with a knife, a sausage-machine having been found impracticable, as it only partly tore the sinews but did not separate them entirely. It frequently happened in consequence that fish were choked by endeavoring to swallow large pieces of meat and sinews sticking together.

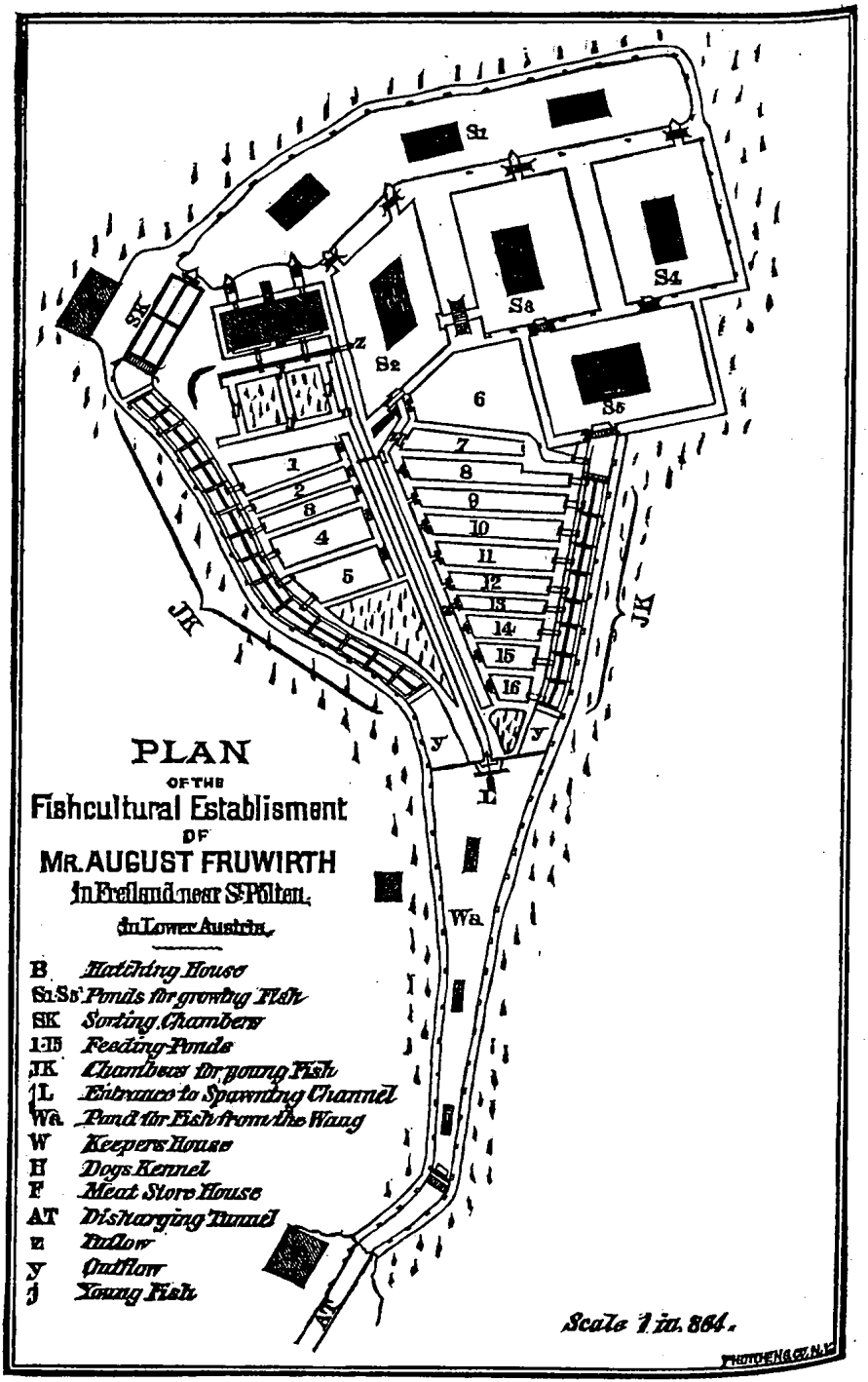
The feeding of the young trout and saibling with good and sufficient food, from the moment they lose the umbilical bag till the time when they can be fed on meat or fish, is really the point on which their rational culture depends. This will influence the percentage of their mortality, and their more or less rapid and successful growth. It is absolutely necessary to give the fish not only good but also sufficient food. Brains, liver, &c., which have been proposed, cannot be called "good" fish food, and the question as to what is understood by "sufficient" can scarcely be answered by those who immediately place their young fry in the ponds, leaving their further fate in the hands of a kind Providence. People who do this will say that the fish when put in ponds are placed in similar surroundings as they would find in open waters, and this is all that is considered necessary for their further development. In reasoning in this manner, however, people entirely forget that it ought to be the object of pisciculture to offer the fish *more* than nature can do—a luxurious but never a starving existence. This does not exclude the possibility that occasionally such experiments are successful, and that the ponds to which the young fish have been assigned contain a superabundance of food; but then it will always be a venture. There should be absolute certainty with regard to the occurrence of food, and wherever the fine net or the microscope only shows few animalcula suitable for fish-food, this want should immediately be supplied. When I visited Mr. Fruwirth's establishment I was surprised at the enormous quantity of insect larvæ and lower crustaceans* living in the dense wilderness of *chara* which covered the bottom of the ponds. One pond, however, which only three weeks ago had been dug up, showed no signs whatever of vegetation. The clear and rapidly-flowing water of the Traisen does not seem to contain any of the above-mentioned animalcula, but when I pulled up some of the thick moss (*Fontinalis antipyretica L.*, *Rhynchostegium rusciforme* Br. et Schimp.) covering the pieces of rock and quickly examined it, I discovered a rich animal life, which had found shelter and food among the moss. Thus the well-known proportional relation between vegetable and animal life also proves to be of great importance to the pisciculturist. It will be his first care to produce a luxuriant vegetation. The natural conditions of Freiland, which must be considered extremely favorable to the development of the

* Prof. Dr. F. Brauer recognized among those gathered during August the larvæ of *Perla cephalotes P.*, *Nemura* sp., *Chloëcon dipterum L.*, *Hydropsyche* sp., *Rhyacophila* sp., *Stenophylax* sp., *Hydroptila* sp., *Atheryx Ibis*, *Simulia* sp., *Culex sylvatica L.*, *Chironomidens*, *Elmis æneus* Müll., &c. I myself found two species of *Daphnid* (*Alona*, *Simocephalus*), two species of *Cyclops*, and one species of *Cypris*.

lower aquatic fauna, did not satisfy the proprietor. He was anxious to find if it would be possible to increase the fish-food by creating still more favorable natural conditions. He therefore applied to Prof. Dr. Gustav Jäger, in Stuttgart, who several years ago had advocated the construction of "gnat-ponds" as a great aid in raising young trout. After having personally examined the establishment in August, 1876, Dr. Jäger drew up the plan for the feeding-ponds and for the "chambers" for the young fry, as they are represented in our diagram. He thought that it was not good to distribute the young fish immediately over a large pond, as they escape observation; in his opinion it would be far better to place them first in a small pond, and then gradually into larger ones. The fish should be within easy reach, so that their mode of life could be controlled, and the so-called "gluttons," *i.e.*, the stronger ones, which use much of the food destined for the smaller ones, could be removed. But, as in the small space they have less chance to find food, it must be introduced from outside; and to facilitate this process is the object of the feeding-ponds (1–16); they are shallow ponds, with stagnating water, and full of aquatic plants. The feeding-ponds 6–16 receive their water from the canal *Z*, which is connected with the pond S_2. Sluices regulate the admission of water; subterranean wooden pipes 8‴ square, which can be closed, make the connection with the "chambers" for the young fish. From the canal *Z* a pipe going over the spawning-canal leads the water into a similar canal running alongside of the feeding-ponds 1–5, which are arranged in the same way as 6–16. The ditches leading to the pond *Wa* from S_5 and S_1 are used as "chambers" for the young fish. Wooden cross-walls with a wire grating divide these ditches into smaller divisions, which are again subdivided into two parts by a single board running lengthwise. All these separating walls can be removed, and the compartments be made larger. Into these "chambers" for young fish, the contents of the feeding-ponds can be conducted by pipes. These feeding-ponds and "chambers" for the young fish were constructed during my visit, and will already come into use after the hatching-period 1876–1877. The water coming from the feeding-ponds must, of course, not rush into the "chambers" too violently, because this might kill the young fish. As long as ice forms, they cannot be used, on account of their limited depth; but as soon as spring begins, they will, if the vegetation is luxuriant, and if the water is stagnating, and can therefore be easily warmed, become a most successful hatching-place for numberless lower aquatic animals. If even the large ponds, by using a fine net, yielded in a very short time sufficient food for thousands of young trout, it will be all the easier to obtain such food with a fine net from smaller ponds, if the draining of the ponds should not yield the desired result. *The young trout and saibling are therefore raised in the Freiland establishment on exactly the same food as they eat when in open waters; but special arrangements have been made to supply this food in unusually large quantities.*

The period up to which Mr. Fruwirth intends to employ this method of feeding is the end of the first year. During the winter months it is not necessary to add any extra food, as the fish do not require so much food during this season. After the first year the feeding with horse flesh commences.

The piscicultural establishment at Freiland is able not only to supply a very large number of impregnated eggs—this year (1877) it shipped about 40,000 eggs, principally to Germany—but it possesses all the necessary arrangements to raise an indefinite number of fish. In order to ascertain whether it would be possible to transport fish to Vienna, Mr. Fruwirth undertook, in January, 1876, to transport 600 trout (not raised in the establishment), all of them milters, to Vienna. The fish left Freiland at 11.30 p. m., and reached the Vienna fish market the following day at noon in perfectly sound condition. Mr. Fruwirth keeps an exact account of everything which takes place in his establishment, *e. g.*, the number of eggs placed in the vessels, the number of fish hatched, the losses, the number of fish placed in the different ponds, and the expense of feeding the fish and running the establishment. He is always anxious, either by personal observation or by the advice of others, to follow up cause and effect, so that if he continues his work with the same energy with which he has commenced it he will soon be able to supply all the necessary statistics of the hatching and raising of trout and saibling. We have no doubt that he will soon find many imitators who will benefit by his experience, and we see in this prospect the sweetest reward for the many sacrifices which the proprietor of the Freiland establishment has made to the cause of pisciculture.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OF THE
Fishcultural Establisment
OF
MR. AUGUST FRUWIRTH
in Freiland near St Pölten,
in Lower Austria.
B Hatching House
S1 S5 Ponds for growing Fish
SK Sorting Chambers
1-15 Feeding Ponds
JK Chambers for young Fish
L Entrance to Spawning Channel
Wa Pond for Fish from the Wing
W Keepers House
H Dogs Kennel
F Meat Store House
AT Discharging Tunnel
z Inflow
y Outflow
j Young Fish
Scale 1 in. 864.