The relation of forage fishes to trout in high altitudes needs study. In one lake suckers and dace may thrive with trout while in others they may completely spoil the vegetation which is necessary for insect life. Some lakes containing suckers are clear, others muddy.

The short season retaining pond is a means of helping food conditions for young trout. Daphnia, Diaptomus and Gammarus usually flourish in ponds warmed to 60° - 70° in midday. To these are added midge larvae, caddice worms, may fly nymphs and other aquatic insects. Brook trout fry one inch long were raised to 4½ inches in 90 days on natural food raised in such a pond at an altitude of 10,00 feet. The introduction of the scud, Gammarus, has not been uniformly successful.

Low temperatures may be modified by small dams. Dams of 10 to 20 feet maximum height covering areas from one to twenty acres have proven valuable in fish propagation. Construction of such dams and their continued usefulness depends on control of soil erosion, caused largely by excessive grazing. Limited grazing and soil conservation are recommended.

In most mountain states recreational uses of water have no legal status. Reservoirs may develop a rich fish population only to be drained to complete dryness by the needs of farms. The fish situation would be helped if recreation were recognized as a third right in water.

R. L. C.

FOUNDERS OF FISH CULTURE

DWIGHT LYDELL, 1861 - 1927

By Dr. Jacob Reighard
University of Michigan

DWIGHT LYDELL was born on a farm in Chautauqua County, New York, on September 26, 1861, shortly after the outbreak of the Civil War. His father was William Lydell and his mother was born Emily Coe. While he was a child his father moved to a wilderness farm in Michigan, at a time when the trees of the primeval forest were still felled in windrows and burned to clear the land. Dwight worked on the farm until he was twenty-two and meantime finished his education in the local rural schools. Those

were the days when Dr. Chase's "Receipt Book" was kept in every farmhouse and consulted by the farmer for all sorts of things, from bronzing his gun-barrel or mending his harness to doctoring his horse, his family or himself. Roads were so bad and farms so far from town that the farmer had to be resourceful and self-independent, a jack-of-all-trades. The farm was a school in which men learned by doing. In this school young Lydell grew up and in it, no doubt, he gained that ready practical insight into the ways of doing things which was always one of his outstanding traits, for, with whatever tools and materials were at hand, he was ever able to do what had to be done. To paraphrase Huxley, he could "bore with a saw and saw with an auger".

And so, with little formal education, but with a world of practical resources, he was equipped to pass from the work of the farmer to that of the fish-culturist. The chance came in 1883 when he joined the staff of the Michigan Fish Commission's trout hatchery at Paris, no doubt as an apprentice. Here he learned the technique of the trout hatchery. During the summer he was usually one of a party sent out by the Michigan Fish Commission to examine the inland lakes of the state. During the first summer the party of four or five traveled by wagon across the southern tier of Michigan counties from west to east, then back westward across the next tier to the north, and so ever northward. It usually took a summer to traverse a single tier. It was the custom to camp for several days on some large lake of a group and using the camp as a base to examine that lake and several others of the group. Thus a week might be spent at one camp. Rough hydrographic maps were made of the selected lakes, bottom and surface temperatures were taken, nets were used to find what fish were present and a record was made of their stomach contents. During a part of the summer of 1891 I was with this party as it traversed the state from Grand Rapids westward. Besides the driver of the wagon, Uncle John, and the cook, there were four practical fish-culturists - men of little schooling who had gone from the farm or the small town into the hatcheries, to learn the trade. They were quite innocent of science, but had a first-hand knowledge of fish and a shrewd handiness that enabled them to do good work. Their findings, carefully recorded and still on file, were a valuable guide in the later planting of fish in these lakes. Here, as on the farm, Lydell was learning by doing.

While working at Paris in the winter and spring and examining inland lakes in the summer, Lydell went each fall to some one of the islands in the Detroit River to take whitefish eggs for the Michigan Fish Commission. Owing to failure of the fisheries elsewhere in the river, this work was finally restricted to Belle Isle. In 1901, it came under control of the United States Bureau of Fisheries and was continued by it until 1908, when further decline in the fishery led to abandonment of the Bell Isle work and closing of the Detroit hatchery. During the period 1901-1908, Lydell was in charge of the Bell Isle fishery for the United States Bureau of Fisheries. Here, in November, great seines were operated and the captured whitefish were held in pens until ripe. They were then stripped and the eggs transferred to the hatchery on Joseph Campeau Avenue in Detroit. The stripped fish were sold and many people came from Detroit to buy them for home use. In this work Lydell broadened and deepened his practical experience.

In 1894, the Michigan Fish Commission began the pond culture of blackbass at Cascade on the Thornapple River, and placed the work in Lydell's hands. After four years, i. e., in 1897, this work was transferred to Comstock Park, on Mill Creek, near Grand Rapids. There Lydell carried it on until his death in 1927. Including the years at Cascade he had thus devoted thirty-three years chiefly to study and experiment in the pond culture of the large and smallmouth black bass. That was really his life work, for which all that went before may be thought of as preparation.

So far, I have sketched Lydell's growth from farm worker to practical fish-culturist and then to independent and original student of the problems of pond culture of the black bass. Before going into the details of the black bass work I must deal with his contacts with the work of scientific men and with its effect on him. In the spring of 1890, I went to the mouth of the Kawkawlin River on Saginaw Bay to study the eggs of the walleyed pike. At that time, as now, most of the eggs placed in the hatcheries died before hatching and I hoped to find a means of increasing the percentage hatched. Lydell was among the spawn takers stationed at the mouth of the Kawkawlin, and there I had my first contact with him. I soon found that, unlike the other men, he had a keen native curiosity. He wanted to know what I was doing and why and he showed a ready understanding of it all, asked many questions and wanted to see and learn all he could. In the summer of 1892, Professor H. S. Jennings, now of Johns Hopkins University, was with the Michigan Fish Commission's field party examining inland lakes, and Lydell was a member of the crew. In the fall of 1892 I spent some time on Belle Isle in the Detroit River studying the eggs of the whitefish and found Lydell in charge of operations there. In the summer of 1894, I was at New Baltimore, on Lake St. Clair, in charge of a party making a biological study of the lake. Lydell was assigned to us as a man of all work. We had to rig up a laboratory in an old warehouse at the wharf and Lydell's resourcefulness was an enduring comfort to us. He served as plumber, carpenter, boatman and in many other capacities, and was always efficient. He seemed to have an inborn sense of how to do things that solved for him problems that might puzzle us, though we approached them with calculus and trigonometry. One day we had spread on the floor a costly piece of silk bolting-cloth and were trying to make a pattern to be used in converting the flat cloth into a conical plankton net. We had calculated angles and chords and radii by the book, but we had not succeeded in getting a pattern that rolled into a perfect cone. Lydell was looking on and finally said, "Let me see if I can't do that". Then, with a piece of string and a lead pencil, he marked out a pattern which proved, when rolled up, to make a perfect cone of the size and form that we wanted. Parenthetically, I may add that at Comstock Park, he built bridges of concrete and did other engineering work by similar direct methods and without seeking professional help. In the summer of 1894, Lydell was an assistant at Charlevoix where a party under the direction of Professor H. B. Ward, now of the University of Illinois, was making a biological survey of Lake Michigan in that region.

In the spring of 1903, and again in the spring and summer of 1904, I was at Comstock Park to study the black bass. Troubles were many, and it was hoped that some of them might be overcome by scientific work. I lived with Lydell's family

during my stay, and came into intimate daily contact with him for several months. He had then been working at the pond culture of bass for nine years and had solved some of its problems, but there were more problems still to be solved and we spent long days discussing them. So it happened that in the course of thirteen years Lydell had been in close contact with scientific men on six occasions and had had opportunity to observe their work, to help them with it and to discuss it with them. He had learned much of their technical methods and he seemed to me to have taken on their ways of thinking and of working. He came thus to his work on black bass with the practical training of the farmer and the fish-culturist and with no little knowledge of scientific ways of doing and thinking.

At Comstock Park in 1897, he found Mill Creek, a stream that traversed several miles of open cultivated land above the hatchery location. It was subject, as he was to learn, to great fluctuations of discharge, even to the extent of floods. Owing to its shallowness and exposure to the sun, it was subject to great fluctuations of temperature from day to night and from week to week. Beside it he found a cool spring and a tract of low flat land in which ponds could be easily excavated. Here he set to work to build his bass hatchery, to construct ponds, and to put brood fish into them.

At Cascade he had watched the smallmouth bass build their nests in the Thornapple and learned to tell the sexes apart. He had learned that the males were the builders of the nests and the guarders of the eggs and young fish, and he was the first to make it known to others. He had learned that the breeding males fought one another and that they sometimes destroyed the nests of their rivals. He had tried artificial fertilization and found it impracticable, so that he now knew that pond culture was the only means left. When he began the cultivation of bass in ponds he learned much more. With fluctuations in the temperature of the stream, the pond temperatures often went below 50° Fahrenheit and then the males deserted their nests and the eggs died. When the stream became turbid, silt settled over the eggs in the nests so rapidly that the guarding males could not keep them free of it. The eggs were smothered and the fish deserted the nests. When the fish were put into breeding ponds, there was much fighting among the males, and many nests were destroyed. He must find ways of overcoming these difficulties, and he did, but they remained real difficulties until 1905.

How he met his troubles is told in the papers that follow. To keep the males from fighting he invented nest boxes and so placed them in the ponds that the fish could not see one another while on the nests. To accommodate the nest boxes, he built ponds with shallow water about the shores, in imitation of a natural lake. To further reduce fighting, he sorted the fish before placing them in the breeding ponds in such a way that the males in each pond were of the same size and were fewer than the females. Thus each male found a mate without needing to fight for it and as each male could pick a fight only with another of his own size (there were no little fellows to pick on), fighting became rare.

But these troubles being met, there were others. The cold and often roily water had to be dealt with. This was accomplished by placing the breeders in small retaining ponds of cold water and without suitable bottom for spawning and leaving them there until the water in the breeding ponds was warm and clear and likely to stay so. In the retaining ponds, the fish did not spawn, but when transferred to the breeding ponds they spawned at once and were too busy to fight. It was found that stock bass must get enough of the right kind of food or they do not produce viable eggs. Out of this need grew the use of clam meal, made from the dried bodies of fresh-water mussels thrown away by the pearl fishermen. Blood coagulated with rennet also came into use. The fingerlings also must have suitable food, and this led to the cultivation of Daphnia and other fresh-water food forms. To rear these forms Lydell learned to drain his ponds in the fall and let them freeze and to fertilize them with clam meal and other fertilizers.

Every failure was an incentive to fresh effort and much of each winter was given to thinking out ways of meeting difficulties. This continued until about 1925. By then he seemed to have gained such control of the pond culture of black bass that he could formulate the necessary procedure with all needed detail. Even before the date named, he had begun the rearing of perch and bluegills in his ponds. He now found that the same pond might be used for perch in the spring and for bluegills a little later. The output of the pond was thus doubled. He succeeded also in raising fingerling rainbow trout to a length of three and a half inches in ponds that had produced fingerling bass earlier in the season. Again the production of the pond was doubled.

It had been one of the cardinal tenets of fish culture that brook trout would not thrive in water of a temperature above fifty degrees; but, at Comstock Park, Lydell reared healthy brook trout to a length of four to six inches in five months, in ponds in which the water temperature varied from 46° F. to 75° F.

Thus for thirty-three years, Lydell's chief occupation was the pond culture of black bass. That was his life work, but as preparation for it, his earlier experience on the farm and in the various sorts of practical fish culture are invaluable. Endless patience, great skill, devotion and ingenuity went into this work, and the published results are a lasting monument to his memory. But back of all training, all experience, were the innate qualities of the man. From natural aptitude and from contact with scientific men, he had, it seemed to me, come to have the outlook on life of the best of our scientific men, and he had their ways of experimenting and thinking. He gave little thought to advancing himself, but devoted himself to his work for its own sake, after the manner of the best type of scientific investigator. Under other circumstances he might have become one of our great leaders in science. That he was besides that a kindly, lovable, generous man, always sincere and upright - a gentleman always, as many friends can testify.

From 1915 to 1925, he was Assistant Superintendent of Hatcheries for the Michigan Fish Commission, a position which he retained when the Commission was absorbed by the present Conservation Commission. He was a member of the American Fisheries

Society and was listened to with great attention. He was a member also, of the Marion Fish and Game Association, Indianapolis, Indiana; of the West Michigan Fish and Game Association of Grand Rapids; and of the Izaak Walton League, the Grand Rapids Chapter of which bears his name.

Thrice married, he is survived by his wife, Mrs. Jennie Noel Lydell, by her two sons, by a daughter of his first marriage, a sister and two brothers. He died February 8, 1927, and is buried in Greenwood Cemetery, Grand Rapids.

COMMENTS FROM OUR READERS

A BASS FRY TRAP

Editor, THE PROGRESSIVE FISH CULTURIST:

Attached you will find a blue-print showing the type of bass fry trap that I am using very successfully. This trap is not new, but I think the concrete or terra-cotta nest is. We place a concrete or terracotta pipe with a 10-inch nipple, putting the nipple into the ground up to the bell of the pipe, filling this partly with dirt and rock, and lastly, with sand and gravel, filling it up to the level of the bottom of the bell. After this gets wet it will settle down a little below the level of the bottom of the bell. We usually mound this and gravel in a pyramid in the middle of the nest so that the Bass will have a little work to do in making the nest. After the eggs are laid in this nest we simply drop a cylindrical screen into the bell of this pipe and take the fry out of the screen trap from the top. This, I think, is very much better than the old box trap. It is permanent and can be made very economically by purchasing the proper size form. This can be 24, 30, or 36 inches in diameter - to suit the hatchery superintendent. He can make such a trap during spare time at the hatchery. He will have a permanent bass nest that doesn't have to be made over every year.

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