PROFESSOR C. DWIGHT MARSH AND HIS
INVESTIGATIONS OF LAKES

MRS. FLORENCE W. MARSH

Dr. Charles Dwight Marsh was born at Hadley, Mass., December 20, 1855; he graduated from Amherst College in 1877, and received from the same college the degree of A.M. in 1881. After graduating, he taught for four years in secondary schools, and in 1883 came to Ripon College, Wisconsin, as Professor of Natural Science. During the earlier years in this position his energy was fully claimed by the duties of organizing the college work and the teaching of his classes. But from boyhood he had interested in the minute forms of fresh-water life, and he recognized at once the opportunities which Green Lake offered for such studies. He spent the summers of 1885 and 1887 at the marine laboratories at Annisquam and Juniper Point, working at the microscopic forms of marine life. In 1885 he made his first collections in Green Lake; and in the summer of 1886 he collected from Green, Winnebago, and Puckaway lakes.

In the following years Green Lake became the center of numerous investigations which grew in extent and importance. He kept a boat on the Lake, which he had fitted with a sail so that he could collect at all points of the Lake and at all depths. Collections were made throughout the year, from the boat in the open season and in the winter through the ice. From the first he was attracted by the unique opportunities offered by the great depth of the Lake. His earlier studies extended to the depth of nearly 200 feet, which was greater than any which had been explored in an inland lake of the United States. His dredgings revealed an "abyssal" fauna quite like that of Lake Michigan, as explored by Dr. Wheeler and Dr. Hoy in 1879, almost 20 years earlier. These studies of Dr. Marsh were the first of the kind to be done in this country on a small inland lake.

This early work had a decisive influence on all of the later studies of Dr. Marsh. The Copepoda, and especially the Diaptomidae, are the most numerous and most conspicuous members of the micro-fauna of these deep waters of lakes; and they be-
came the special objects of his later studies. The choice was a natural one, indeed, an inevitable one; and perhaps the limitation of his special studies to these groups was the more natural, since Dr. Birge had already done much work on the other great group of freshwater micro-crustacea, the Cladocera. Dr. Marsh became a member of the Wisconsin Academy of Sciences, Arts, and Letters in 1888. In 1891 he presented his first papers on Green Lake; one related to its deep water life and another gave its surface and bottom temperatures. He found a minimum temperature of 5.28°C. at 58 meters depth. He noted that this was substantially the same as the temperatures of 5.0-5.5 found by Dr. and Mrs. Peckham in the lakes of southeastern Wisconsin. The observations of the Peckhams were made in 1879; they were the first of the kind to be made in Wisconsin, and those of Dr. Marsh were the second.

Dr. Marsh continued his work on Green Lake through the ’90’s; he constructed a dredge which could be closed at any depth; with this he made elaborate studies of the vertical distribution of the plankton crustacea, using five meter intervals. Thus he ascertained the diurnal variation of distribution, making twelve hauls in twenty-four hours in order to determine the effect of light and darkness. He also worked out the seasonal vertical distribution of the crustacea, through similar methods, during the period Sept., 1894-Dec., 1896. He reported the results in Vol. 11 of the Transactions of the Wisconsin Academy, having determined them for eight genera of crustacea. It is worth recording that this work coincided in date with similar study of Dr. Birge on the limnetic crustacea of Lake Mendota, which ran from July, 1894-Dec., 1896. Thus there is a comparable record for these two Wisconsin lakes, not far separated in distance, but very different in their ecological character and in their crustacean population.

The Wisconsin Geological and Natural History Survey was established by the State in 1897, and after this date much of the limnological work of Dr. Marsh was done in cooperation with the Survey and with its aid. In 1897-98 he directed and took part in a careful hydrographic survey of Green Lake, which resulted in a map on the scale of three inches to the mile and with contours of twenty feet. This was published by the Survey in 1899. The soundings were later converted into the metric scale and
were employed for the map of Green Lake which appears in Bulletin XXVII of the Survey, by Dr. C. Juday, on the hydrography and morphometry of the inland lakes; this was published in 1914.

The last important work on lakes done by Dr. Marsh in Wisconsin was a careful comparative study of the total plankton collected by the net in Green Lake and Lake Winnebago. This was carried on from July 1899 to 1902 by Dr. Marsh and assistants in the two lakes. A summer laboratory was set up on Lake Winnebago, near Oshkosh, and work was done continuously there. Dr. Marsh also visited some thirty lakes of Wisconsin, scattered all over the State, and determined the quantity of their total plankton.

The results of this study were published in 1903, in Bulletin XII of the Survey, entitled *The Plankton of Lake Winnebago and Green Lake*. It is a thorough examination of the quantity of plankton found in these two large lakes, with especial attention to the micro-crustacea, which constitute much of the food for the fish of the lakes. The comparative study has a peculiar value since the two lakes are as different, ecologically, as it is possible for lakes to be.

Dr. Marsh was President of the Wisconsin Academy, 1897-1899, and on retiring from that office gave an address on *The Plankton of Fresh-Water Lakes*. This is a general account of the work done in this field of study, both in Europe and America, with a statement of the factors controlling the quantity and types of plankton, so far as these were known. It is published in the Transactions of the Academy, Vol. 13.

Dr. Marsh left Ripon in 1903, having leave of absence from the College for the year 1903-1904. He employed this leisure in study at the University of Chicago, from which he received the degree of Ph.D. at the close of the year. It may be added here that his alma mater, Amherst College, gave him the well-earned honorary degree, Sc.D., in 1927, on the fiftieth anniversary of his graduation from the College.

In March, 1905, Dr. Marsh was asked by Dr. Rodney H. True to undertake work with the Drug Plant Division of the United States Department of Agriculture. This was an experimental study of domestic animals poisoned by forage plants; it led to a permanent connection with the Department and to extensive investigations of poisonous forage plants and their effects. These
continued for twenty-five years, and in their prosecution Dr. Marsh became the first authority on the subject.

The work took him into the new country of the far West in pioneer days. Transportation was primitive and slow; conditions must be provided in field camps, not only for living, but also for scientific studies; under such surroundings stations must be set up and operated for experiments on animals. He engaged in and directed such work on the high plains of Colorado, 1905-09; in South Central Montana, 1912-15; in Southern Utah, in the Fishlake Forest, 1915-30. The work increased in proportions and in value, and in nearly every state of the Union were found cases of poisonous forage plants affecting horses, cattle or sheep. All came to Dr. Marsh and they resulted in innumerable experiments, conferences and addresses. There remain as witness to this work, besides many temporary publications, a list of 82 reports and papers, mostly published by the Department.

But through these twenty-five years Dr. Marsh maintained his interest in the fresh-water crustacea; the group of animals which had kindled in him the love of research and had trained him in its meaning and methods. He received and studied collections of Copepoda from all parts of the United States and from foreign countries, and the results are published in twenty papers which are listed in the appendix.

After retiring from the work on forage plants Dr. Marsh was at Put-in-Bay with Dr. Stillman Wright, working on the Plankton of Lake Erie. Later through the kindness of Dr. Schmitt, curator of the Marine Invertebrate Division of the United States National Museum, he was allotted a table for his private study of crustacea. He received an honorary title from the authorities of the National Museum, that of Curator of the Collections of Freshwater Copepoda. In the Laboratories of the Museum he continued the studies which were his first love and interest until his death. This came on April 3, 1932, at Washington, D.C.

LIST OF PAPERS ON LAKES AND ON CRUSTACEA


The Crustacea of the plankton of western Lake Erie. (To be published in the Bulletin of the U.S. Bureau of Fisheries as a chapter in a general report on the lake.)

NOTE

The active scientific life of Dr. Marsh covered nearly a half century; it may be dated approximately from 1883, when he joined the faculty of Ripon College, to his death in 1932. This period is divided into two parts, not very unequal. The first is twenty-one years long, from 1883 to 1904; this period was spent at Ripon and its scientific activities concerned limnological subjects, and especially the freshwater Copepoda. In 1905 he became a member of the United States Department of Agriculture; in that capacity he gave most of his attention to poisonous forage plants, and their effects; and he became the leading authority in that field.
This long and active service in an important field has tended to obscure his services in another and far distant field of science, which were contributed during his life in Wisconsin. He was among the earliest and the most important students of fresh-water life and of fresh-water ecology in the United States.

Ripon College is seven miles from Green Lake, the deepest inland lake between the Finger Lakes of New York and the mountain lakes of the Rocky Mountains. Dr. Marsh fully appreciated the situation and he began his work on Green Lake early in his life at Ripon. We should not fail to note the initiative and independence of Dr. Marsh in this early limnological work. Green Lake is seven miles from Ripon, and this was by no means a negligible distance in the days of the horse and buggy. Every series of readings in the lake called for much time in coming and going. So, also, limnological study was not suggested to Dr. Marsh by other work of the sort in Wisconsin, for there was then no such work in progress. I had been interested in fresh-water life in the '70's; but my time from 1881 to 1891 was more than filled by the teaching of pre-medical students; and the fire of 1884, which destroyed Science Hall, also burned all of my notes on Cladocera and discouraged such incidental study as I might otherwise have given to our lakes. A short paper on the Cladocera of Madison, presented at the meeting of the Wisconsin Academy in 1891, marked my return to fresh-water studies. At the same meeting Dr. Marsh read his first papers to the Academy, on the deep water crustacea of Green Lake and on the depth and temperature of the Lake.

In 1888, Dr. Marsh became a member of the Wisconsin Academy of Sciences, Arts, and Letters. He was an active member, constant in attendance at its meetings, and contributing papers to its Transactions. He held various offices, including that of President, 1897-99. In 1903 he left Ripon College and in 1905 he went to the United States Department of Agriculture, engaging in the study of poisonous forage plants. To this work he gave the following twenty-five years, retiring in 1930. This period constitutes the most important side of the scientific work of Dr. Marsh, in which it developed a national scope and a national value. No adequate account of it can be given in these Transactions, which are concerned with that part of his life and work which is more intimately related to Wisconsin and to this Academy. The larger story must be left to the Department to which he gave such distinguished service during a quarter-century. This sketch of his work in Wisconsin
and on the life found in its fresh-waters has been prepared at my request by Mrs. Florence W. Marsh.

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