The Birge-Juday Era

David G. Frey

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A remarkable chapter in the development of the science of limnology extends from 1875, when the young E.A. Birge became an instructor at the University of Wisconsin, to the early 1940s. Chancey Juday, who was Birge's close associate for more than four decades, retired in 1942 and died in 1944. Birge lived until 1950, just 15 months short of his 100th birthday. The accomplishments of these two men and their associates are outstanding. Since a mere listing of their more than 400 publications occupies 21 printed pages, I cannot aspire in a single chapter to give a critical appraisal of this vast effort in terms of its overall impact on the development of limnology.

The studies of Birge and Juday, although they are largely what is known today as descriptive limnology, are of interest not merely for their limnological descriptions of Wisconsin lakes but also for their significant contribution to our understanding of limnological processes in general. "To summarize their impact on limnology in a few words is difficult; but I believe he [Birge] will be chiefly remembered because he laid bare the mechanics of stratification, and showed (with Juday) how the living processes of photosynthesis, respiration, and decay combine to produce a concurrent stratification of the dissolved gases.

The Wisconsin partners will further be remembered for their chemical analyses and crop estimates of plankton; and for the extensive survey of water chemistry and plankton in northeastern Wisconsin" (Mortimer 1956). To this should be added the pioneering studies of Birge and Juday and their associates on transmission of solar radiation by water.

Another important consideration is that Birge and Juday developed a program in limnology in which persons of many different primary interests participated – chemists, physicists, bacteriologists, algologists, plant physiologists, geologists, etc. Most of these persons were staff members and students from the University of Wisconsin, but during the operation of the Trout Lake Laboratory more and more persons from outside the state and even from outside the United States became associated with the program. Hence, the story of limnology in Wisconsin is not merely that of Birge and Juday, although they were the motivating force, but also that of their many associates. A chronological listing of the papers and reports arising from this total effort closely parallels the general development of the science of limnology, as reflected by changing rationale, methods of attack, and problems being investigated.

The Men

E.A. Birge (Figure 1) was born in 1851 in Troy, New York. He received his A.B. and A.M. degrees from nearby Williams College in Massachusetts,

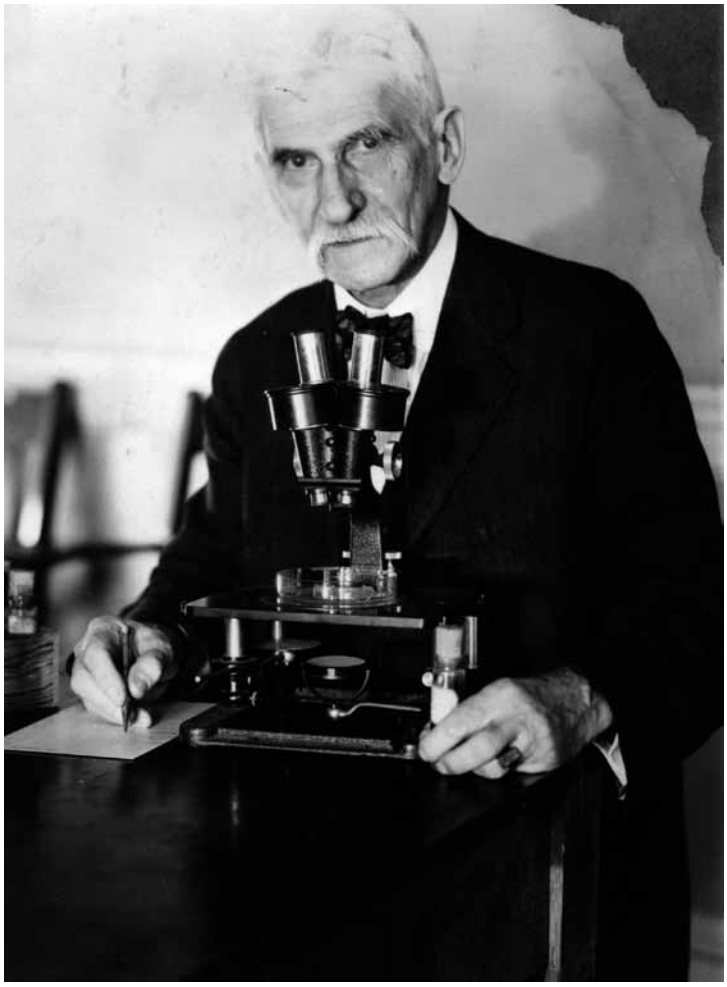

Figure 1. Edward Birge, 1928. Photo courtesy of the UW-Madison archives.

where he had already started working on Cladocera. "His early interest in the planktonic crustacean and the chance which brought him to the shores of Mendota combined to start him on an exploration of the world in which lake plankton live" (Mortimer 1956).

Promotions were more rapid in those times. Birge became a professor at Wisconsin in 1879 after only four years as an instructor, including time off to complete his Ph.D. at Harvard in 1878. During 1880-81 he studied at Leipzig with Carl Ludwig, working on the nerve fibers and ganglion cells in the spinal cord of the frog. On his return to Wisconsin he constituted a one-man department of biology, teaching courses in zoology, botany, bacteriology, human anatomy, and physiology. Later when a separate Department of Zoology was organized, he served as its first chairman until 1906.

Birge became more and more involved in administrative work at the university. Among other responsibilities, he was appointed dean of the College of Letters and Science in 1891, and he served as acting president of the university from 1900-05 and as president from 1918-25.

His early studies on the plankton Crustacea of Lake Mendota represent the first real beginning of limnology in Wisconsin and of Birge as a limnologist. His earlier studies were primarily faunistic. The study on the seasonal distribution of the plankton in lakes led him directly into an investigation of thermal stratification and chemical changes in the hypolimnion.

Fortunately, through the establishment of the Wisconsin Geological and Natural History Survey in 1897, of which Birge served as director until 1919, he was able to initiate a broad program of obtaining basic morphometric data on the lakes of southeastern Wisconsin, and he was then able to hire a full-time biologist to help direct and carry out the limnological activities of the survey. This biologist was Chancey Juday.

Juday (Figure 2) was born in 1871 at Millersburg along the northern edge of the lake district in Indiana. Very likely as a boy he was stimulated by lakes and by the excitement of discovering the diversity of life they contain. At Indiana University, where he obtained the A.B. and A.M. degrees (in 1896 and 1897) and much later an honorary LL.D., he came into contact with Carl Eigenmann, who in 1895 had established a biological station on Turkey Lake (now known as Lake Wawasee) only a few miles from Juday's home. It was perhaps inevitable that Eigenmann and Juday should get together, and that Juday should participate in the summer research program at Turkey Lake. Juday's first papers are concerned with Turkey Lake and Winona Lake, to which the station was relocated in 1899, and with Lake Maxinkuckee, where he spent some time in 1899 studying the amount of plankton in the water and the diel movements of the plankton Crustacea.

Figure 2. Chancey Juday, ca. 1930-39. Photo courtesy of the UW-Madison archives.

Juday was appointed biologist of the Wisconsin Geological and Natural History Survey in 1900. His first assignment, appropriately, was to study the diel migration of zooplankton in Mendota and other lakes of southeastern Wisconsin, but after only a year he had to withdraw because of health, and for the next few years he served on the biology or zoology staffs of the universities of Colorado and California. During these years he studied the fishes and fisheries of Colorado and Lake Tahoe and the marine Cladocera and ostracods of the San Diego region.

In 1905 he rejoined the Wisconsin Geological Survey as biologist, a position he held until 1931. In 1908 he was appointed lecturer in limnology in the Department of Zoology at the University of Wisconsin, and from this time until 1941 (serving as professor of zoology from 1931) he taught and directed the training of graduate students in limnology and fisheries.

The early efforts of Birge and Juday as a team were concentrated on the Madison lakes, especially Lake Mendota, and on other lakes of southeastern Wisconsin. These studies were either problem-oriented or lake-oriented. The volume on dissolved gases Mortimer (1956) regards as "the most outstanding single contribution of the Wisconsin School." This study led directly into quantitative studies of plankton standing crops and still later to an investigation of the dissolved organic content of lake waters as a means of studying the differences among lakes in their ability to produce organic matter.

After 1917, their effort shifted away from the Madison region. During the period 1921-24 they carried out an intensive chemical and biological investigation of Green Lake, the deepest (72 m) lake in the state and also the deepest lake in the United States (exclusive of the Great Lakes) between the Finger Lakes of New York and the mountain lakes in the West. Unfortunately, the results were never completely analyzed and published.

The study on dissolved gases was based mainly on lakes in southeastern Wisconsin, although many lakes in the northeastern and northwestern lake

districts were examined briefly. Birge and Juday believed it might be desirable to shift their base of activities from near Madison to the northern part of the state. Birge had previously spent part of the summer of 1892 in northern Wisconsin and a preliminary survey in August 1924 showed the lakes in the northeastern district to be diversified both in biology and in chemistry. Accordingly, in June 1925 a summer field station was established on Trout Lake (Figure 3) with the close cooperation of the State Forestry Headquarters there. Juday served as the director of this laboratory until his retirement in 1942. The approach here was not so much problem-oriented or lake-oriented, but rather it was concerned with surveying large numbers of lakes for various chemical and biological properties and studying the range of variation of these properties and their presumed controls, especially as related to drainage and seepage categories.

Many students, both undergraduate and graduate, were involved in these studies. Many senior investigators from the University of Wisconsin and from other states or nations were attracted to the Trout Lake Laboratory to conduct studies of interest. Some of the persons associated with this period of research are Manning, Pennak, Hasler, Twenhufel, Whitney, Woltereck, Kozminski, Wilson, Potzger, and others. Regardless of one's opinion concerning the value of survey-type programs, he must admit that a large volume of basic information concerning limnology derived from these efforts.

"If the aim of limnology is the better understanding of the environmental control of living processes, it is a debatable point whether, for a given effort, more knowledge is to be gained by concentrating on a problem selected for one lake or organism, or by the wider survey of the kind we are reviewing. Or, stated differently, did Birge [and Juday] advance more on the narrow front on Lake Mendota or in the wider campaigns in northeastern Wisconsin? This is a matter of opinion. . . . No doubt the future will show that both methods of attack, in their time and place, have value" (Mortimer 1956).

Although Birge and Juday did most of their research in Wisconsin, separately and together they carried on some short-term studies outside the state. From October 1907 to June 1908 Juday visited various limnologists and limnological laboratories in Europe and in February 1910 he visited some lakes in Guatemala and Salvador. The resulting paper represents one of the first studies in tropical limnology. Birge and Juday together investigated the Finger Lakes of New York and likewise made a brief study of Lake Okoboji in Iowa. Other studies in which the field work was carried out by their associates, concern lakes of the northwestern United States and Karluk Lake, Alaska.

Figure 3. Stillman Wright, E.A. Birge, and Chancey Juday pictured by their state research vehicle at Trout Lake, 1925. Photo courtesy of the UW-Madison archives.

Both men were active in national affairs, serving variously as president of the American Microscopical Society, American Fisheries Society, Ecological Society of America, and the Wisconsin Academy of Science, Arts, and Letters. Moreover, Juday was one of the persons instrumental in bringing about the birth of the Limnological Society of America, and he was elected president for its first two years. Juday was awarded the Leidy Medal by the Academy of Natural Sciences of Philadelphia in 1943, and Birge and Juday together were awarded the Einar Naumann Medal by the International Association of Limnology in 1950 in recognition of their important and numerous contributions to the field.

They were not summer vacation limnologists; their approach was the opposite of dilettante. They were by no means averse to speculation; but first of all they assiduously collected the facts. The complexity of the questions (in the dissolved gases study) have "become more and more manifest as our experience has extended to numerous lakes and to many seasons. If this report had been written at the close of the first or second year's work it would have been much more definite in its conclusions and explanations than is now the case. The extension of our acquaintance with the lakes has been fatal to many interesting and at one time promising theories." Without such "extension of acquaintance" they might never have achieved that insight into the mechanisms of stratification, interplay of sun and wind, and the quantitative bonds between plankton activities and dissolved gases, which form the unique and really valuable core of their work (Mortimer 1956).

These are good words to remember at a time such as the present, when there is so much emphasis on speed of publication and length of personal bibliographies.

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David G. Frey was a doctoral student of Chancey Juday's at the University of Wisconsin where he earned his Ph.D. in 1940. He was the founding editor of the journal *Limnology and Oceanography* and was a Professor of Limnology at Indiana University from 1950 until his retirement in 1986. David died in 1992.