first intended to furnish the materials for demonstration, become centers of active investigation. What a chain of famous names and brilliant discoveries is associated with this private enterprise! In July, 1801, Thomas Young became the first resident professor; he was the father of all our knowledge of color vision and of the properties of the lens of the human eye, the discoverer of "interference" and the first to define "energy." Humphry Davy joined the institution in 1801, at a salary of £100 a year, a room, coal and candles, in return for which he gave his patrons lectures which drew all London, and gave the world the anæsthetic nitrous oxide, the safety-lamp, the process of electrolysis by which he discovered potassium and sodium, and many of the foundation stones of modern scientific knowledge. To Davy succeeded Faraday, a name inseparable from the history of science, and to him Sir James Dewar, the present resident professor, joint inventor of cordite, inventor of the thermos flask, the first man to liquefy hydrogen, the profoundest student of low temperatures. So far as can be traced, the sole support given by the state to this brilliant and beneficent accomplishment was a Civil List pension of £300 enjoyed by Faraday for a few years. Still more wonderful is the small total cost, amounting for the whole of the nineteenth century to only £100,620 for the professors, attendants, and laboratories with their apparatus and materials. Gifts and donations have been few and small in amount; the revenue has been derived almost wholly from fees paid by the audiences who wished to see and hear the professors. There is no institution of which London should be prouder, none for which the world should be more grateful. Fortunately it flourishes, and offers no pretext for absorption by any state department.—*The London Times.*

SCIENTIFIC BOOKS

Lake Maxinkuckee, a Physical and Biological Survey. By BARTON WARREN EVERMANN, Director of the Museum of the California Academy of Sciences, and Howard Walton Clark, Scientific Assistant, U. S. Bureau of Fisheries Biological Station, Fairport, Iowa. Vol. 1, 660 pages; 36 colored plates; 8 half tone plates; 24 text figures. Vol. 2, 512 pages. Publication 7 of the Department of Conservation, State of Indiana.

The work on Lake Maxinkuckee by Dr. Evermann and Mr. Clark is the most comprehensive and most symmetrical treatment of the organisms and their physical environment of one of the numerous small inland lakes of America, yet published. The material of the volumes is almost entirely that obtained from the investigations in the region, there being scant reference to similar work done elsewhere. It is contributory largely to aquatic biology and ecology, but it appeals to a wide range of interests among naturalists. There is much for the specialist in ichthyology, ornithology, botany, and other special fields of natural science. Persons attracted by the recreational offerings of such a body of water as Lake Maxinkuckee, such as anglers, sportsmen, and campers will find much of interest in these books. Science teachers can use the work advantageously for developing in school pupils a wider and deeper interest in nature and outdoor life. The clear and readable style is favorable for teaching purposes as well as for a general use of the publication.

The work on Lake Maxinkuckee is likely to promote proper measures for conserving wild life since it contains information pertaining to the direct and indirect relations of the animals and plants of the region to man. This value was undoubtedly recognized by The Department of Conservation of the State of Indiana and determined its assuming the responsibility of the publication and distribution of the work.

The field investigations were carried on from 1899 to 1914 by the United States Bureau of Fisheries. Dr. Evermann, who was in charge, and Mr. Clark did most of the field work, but with them were associated at different times and for varying intervals eleven other investigators, who were: Dr. J. T. Scovell, Thomas Large, Chancey Juday,

T. Bronté Evermann, Harry Warren, S. S. Chadwick, Leonard Young, Wm. F. Hill, Millard Knowlton, Robert Gillum, and Dr. C. B. Wilson. The work was carried on mostly in the summer and fall, but something was done each month of the year.

The Bureau of Fisheries undertook the investigations at Lake Maxinkuckee through realizing the importance to fish culture of an exact knowlege of the physical and biological conditions in the different types of lakes and streams of the country including the small inland lakes of glacial origin like Lake Maxinkuckee. With reference to the importance of these investigations the authors say:

> With scarcely an exception these lakes teem with food and game fishes of the finest quality, besides many other species of greater or less importance. Many of these lakes are inhabited also by a large number of species of turtles, batrachians, mollusks and crustaceans, some of which are already used for food or otherwise utilized by man. They are the home also of many other species of aquatic animals and many species of aquatic plants which are known to serve an important purpose in the economy of the lakes in their relation to food fishes, and of still many other species whose status we do not yet know. The value of exact knowledge concerning this type of lake and the inhabitants thereof is appreciated by all biologists and fish culturists and can scarcely be overestimated.

Lake Maxinkuckee was chosen for special and detailed study principally for the following reasons: it was of suitable size, not being too large for any of its parts to be reached readily from a central station; the tributary waters were not of such large size as to "complicate the problem"; it was a fairly "homogeneous environmental unit"; there are fishing and angling interests there; it appeared to be "typical of the class of small glacial lakes"; it was easily accessible; and field expenses there were especially small.

The purposes of this work were chiefly three: (1) "To gain a fairly good understanding of the physical and biological conditions obtaining in a typical glacial lake. Accurate knowledge of *one* lake of a type enables a study of other lakes of that type to be made more readily and easily." (2) "To study carefully the physical and biological conditions under which the more important of the species thrive." (3) "To study carefully and fully the habits of as many species of animals and plants of the lake as time permitted."

The treatment is under two main topics: (1) Physical Features and (2) Biology. Under the first are discussed in some two hundred pages the location, size, form, depth, bottom topography, soils, lake tributaries, character of the surrounding country, and weather conditions. Under the topic, Biology, are taken up, first, a consideration of the five classes of vertebrate animals represented in the region with a general introductory discussion of each followed by descriptions of the species found, and secondly (in Volume 2) similar discussions of the invertebrates and plants.

Fish naturally receive most attention and 213 pages are given to this group. The account is a useful one, not only for zoologists but for others likely to read or consult the work, since the majority of the 64 species described are very generally distributed in such lakes, and at least two dozen of them are well known to most anglers. The discussions deal with the species found, and for each are given notes on its status in the region and structural details of taxonomic interest, and for most of them facts on behavior, food, enemies, angling, and economic importance are included.

The data on the food of the fish are important. Although these are chiefly qualitative in character, they are of considerable ecological value. Determinations of the percentages of the different food materials in the digestive tracts may still be made, since it is probable that these were preserved. However, no reference can be found concerning the disposition of the food collections or other collections made during the progress of the survey of the Maxinkuckee region. There is a detailed account with list of species of each collection made at each of the many numbered stations; and it would have been important to have stated where these collec-

tions are available for future workers in the region or by specialists on the different groups represented in them.

Preceding the annotated list there is a lengthy general discussion describing collecting methods, conditions for fish life at the lake, migrations and seasonal movements, fishing, fish protection, and fish planting. A three-page table with the results of dredging is of considerable biological interest, and there are two other tables, which are especially unique and interesting. One of the two shows the number of fish taken by a single angler during nine months and the other the number of boats seen on the lake correlated with weather conditions during two summer months. A part of this discussion of fishes is a fifteen-page contribution by Charles B. Wilson on "Food and Parasites of Fishes."

The treatment of the fish of the region is followed by that of mammals. Why the mammals are taken up here is apparently not explained. Thirty species are listed with many notes. The ones having the most direct relation to the life of the lake are muskrats, minks, otters, and raccoons. There is a long account of the muskrat, which is a very positive contribution to its natural history, and the data given on the numbers caught there by trappers will be useful in estimating the value of the small inland lakes as a source of muskrat fur.

The ninety pages of information on the birds include an annotated list of 175 species. At least fifty of these were found to be very directly and closely related ecologically to the fish and other organisms of the lake. The number of aquatic and shore birds is large and the total of their influence upon the life of the lake is considered to be great. Some food studies of water birds contribute to the meager knowledge of the relation of these birds to fish. The twelve pages on the coot are an important addition to the literature of this unique water bird.

The reptiles are treated in about forty pages and they seem to be of little importance in the biology of the lake except the turtles, which were important as scavengers. Detailed shell measurements and weights are recorded for 225 examples of four species of turtles.

The water dog (*Necturus maculosus*) was worthy of more consideration than any of the other 18 kinds of amphibians found, and it is concluded from food studies of the water dog that, of all the animals inhabiting the lake, it was the worst enemy of fish.

The material gathered concerning the invertebrates and plants of the Maxinkuckee region composes the second volume. The slight attention that could be given to a group so abundantly represented and so important causes a disappointment. The May-flies and dragon-flies were found to be of special importance to the fish of the lake. A list of 56 species of dragon-flies with important notes is given, and this was formed through the help of Mr. E. B. Williamson. Notes on life-histories, behavior, and ecology are given on many other forms. A notable contribution showing the value of chironomid larvæ as fish food comes from the finding of "almost a bucketful" of them in a 75-pound buffalo-fish (*Ictiobus cyprinella*).

The mollusks follow the insects but precede the other arthropods, an arrangement which is confusing. Mussels are fully discussed with much attention to the fourteen local forms, with many data on their food, enemies, diseases, and reproduction. The 116 other species of mollusks are listed without notes.

The account of the Crustacea of the lake is based largely on the plankton studies made there by Professor Juday and the investigations on the parasitic copepods by Dr. Wilson and of the crawfish by Professor William P. Hay. The inference "that plankton species of crustaceans constitute a large part, probably nearly all, of the first food of young fishes, and much of the food of some fishes throughout their entire lives" serves to corroborate a similar conclusion concerning the food of fish derived from the study of Illinois fish by Dr. S. A. Forbes.

The eleven species of leeches, which form a "fairly conspicuous part of the lake fauna" are discussed by Professor J. Percy Moore, of

the University of Pennsylvania. They infested fish, turtles, mussels, and snails. One species (*Dina fervida*) appears to be a scavenger only.

Little attention was given to the worms other than the leeches, and these with the sponges and protozoans are considered in only nine pages.

About three fifths of the second volume treats of the plants of Lake Maxinkuckee and vicinity, particularly with the aquatic forms. In addition to annotated lists of species there are important general discussions of such subjects as the uses of water plants to the other organisms of the lake and of the floral regions; the latter were found to be as follows: Beach; lake plains; low woodland; upland clay woodland; upland loamy woodland; gullies; woodland ponds; peat bogs; and shifting sand regions. No reference appears to be made to fungi, although it is well known that some forms like *Saprolegnia* attack fish.

Throughout the treatment of the plants of the region, there is much on their relation to fish and other life of the lake; and it is noted that:

> While the division line between the lake flora and the land flora is in most cases pretty sharply drawn, it is not easy to tell where the boundary line lies between plants having some influence upon the lake and those which have none, if there be such.

The grouping of species in the lists of water plants is puzzling and perplexing till one reads the easily overlooked explanation on page 135, where we are informed that floating plants are first disposed of and then those of the deeper water, proceeding from thence to the shallow water. In this arrangement species of a genus and sometimes subspecies of a species are separated. This is likely to be annoying to the taxonomist but not to students of ecology or plant distribution.

Only the first volume of the work has illustrations, and nearly all of these are of fish, there being a few of frogs, and some general views loaned by the Culver Military Academy. The latter are not numbered or referred to in the list of illustrations. The well-reproduced colored drawings, mostly from Forbes and Richardson's "Fishes of Illinois," give considerable attractiveness to the publication and also add to its scientific value since the fish are very accurately shown.

There is a large folded map in the back of the first volume. This has a scale of 400 feet to the inch and gives bottom contour lines for every difference of ten feet and for the depths 85 and 88 feet, 89 feet being the maximum depth found.

The books are well printed in a large, clear type on good, heavy paper, and there are very few typographical errors. All through the work is evidence of much painstaking. The binding is in good cloth. Withal they make an attractive addition to the naturalist's library as well as a useful publication for his reference and study.

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SPECIAL ARTICLES

AN EXPLANATION OF LIESEGANG'S RINGS

Raphael Ed. Liesegang in 1898[1] published results showing that when silver nitrate solution is placed on a gelatine gel containing potassium bichromate, there develops on standing a series of concentric precipitations of silver chromate.[2] These zones are known as Liesegang's rings. Wilhelm Ostwald[3] published an explanation of the formation of these rings which was accepted until Liesegang,[1] Bechold,[4] and Hatschek[5] cited experiments which showed it untenable. Ostwald's explanation is briefly: Under certain conditions supersaturated solutions are formed, and when solid crystals or nuclei

[1] Liesegang, *Zeit f. Phys. Chemie*, 1907, 59, 444.

[2] For details see Ostwald-Fischer, "Theoretical and Applied Colloid Chemistry," Wiley and Sons, New York, 1918.

[3] Ostwald, "Lehrbuch der Allg. Chemie" (2 aufl.), II., 778.

[4] Bechold, *Zeit f. Phys. Chemie*, 1905, 52, 185.

[5] Hatschek, E., *Kolloid Zeitschrift*, 1911, 9, 97; 1912, 10, 124.