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.

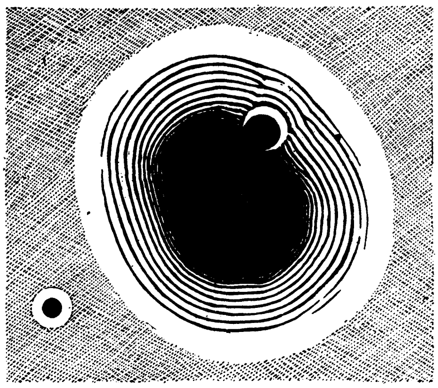
2 For details see Ostwald-Fischer, "Theoretical and Applied Colloid Chemistry," Wiley and Sons, New York, 1918.

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.

of precipitation are excluded, this supersaturated condition may persist for a considerable time without the spontaneous development of a solid phase. Such solutions he calls metastable. By the diffusion of the silver salt into the chromate gelatine, a solution is formed which in relation to the silver salt is supersaturated. A precipitate is formed only after the metastable limit has been exceeded. This precipitate occurs naturally in zones concentric with the drop. On the precipitate that is formed the silver supersaturated



The smaller figure (A) shows the sphere of influence of the silver nitrate. The larger figure (B) shows the effect of the smaller when included in the larger. Note that the smaller sphere has removed the chromate so that the rings in the larger are interrupted.

chromate in the region lasts until all the soluble silver is precipitated. Then the silver salt wanders out over the ring into the chromate gelation until a new supersaturated region is formed and the precipitation process is repeated.

The main objection to Ostwald's explanation is that a supersaturated condition has been shown unnecessary for ring formation; also that there are other factors involved in the ring formation.[4] Since no explanation has been accepted, I wish to present one which seems adequate.

The chromate in the gelatine is relatively fixed and diffuses very slowly; when $AgNO_3$ is added, there is an immediate formation of silver chromate not only under the silver solution but there is a sphere of influence which can be seen with the aid of a hand lens (see A figure). The silver attracts the chromate from this area and leaves it sharply demarcated. This demarcation could be due to the withdrawal of the chromate or it might be due to the influence of the potassium nitrate formed in the reaction. However, the amount of potassium nitrate that could be formed has no such influence on the gelatine chromate; and an experiment can be devised to show that there is no chromate, or very little of it, in this zone. The experiment is as follows: Place a minute droplet of silver nitrate on a gelatin plate until the zone of influence is distinct. Then at a short distance from it place a large drop of silver nitrate (B) sufficiently large so that when the Liesegang rings are formed they will include the smaller drop. After a time a condition develops as shown in figure where the larger circles are interrupted by the zone of influence of the smaller particle. This shows that there is not enough chromate to precipitate; it has all been attracted by the first silver nitrate. The explanation of Liesegang ring formation then is as follows:

Silver chromate is formed and a clear zone results in the gelatine by the attraction of the chromate to the silver. Beyond this zone of influence, the chromate is fixed and remains so unless an attraction force is exerted. The silver nitrate now wanders out through the ring into the clear zone until it approximates the chromate gelatine sufficiently close to exert an attraction force which again draws the chromate and forms another ring and clear zone. At the same time the chromate exerts a pull on the silver and the ring is formed where the forces are balanced. Again it may be presumed that to start the chromate moving, will require a greater force than to keep it moving after the start is made, consequently the second ring is separated from the first.

With each succeeding ring the concentration of the silver is less and this will also operate to remove the succeeding rings farther and farther apart. Ring formation by these or by other reagents depends on or is modified by other conditions which are however of secondary importance. As a requisite, the precipitate formed must be permeable to the liquid solution used; in this case the silver nitrate. If for example, lead acetate be used instead of silver nitrate no ring formation occurs, because the lead chromate under these conditions is impervious to lead acetate. Not only is it impervious to lead acetate but if silver nitrate replace the solution of lead acetate after the precipitate of lead chromate is formed, silver nitrate will not penetrate the lead chromate wall, and no ring formation will occur. For the same reason if the silver nitrate and potassium bichromate solutions are reversed, no ring formation will occur.

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THE NORTH CAROLINA ACADEMY OF SCIENCE

The twentieth annual meeting of the North Carolina Academy of Science was held on April 29 and 30, 1921, at Wake Forest College, Wake Forest, N. C., with about 50 members present, and the following program was carried out.

Presidential address. The age of insects, Professor Z. P. Metcalf, State College.

PAPERS

The genus Raspaillia and the independent variability of diagnostic features: H. V. Wilson.

Current research in organic chemistry at the University of North Carolina: A. S. Wheeler.

Judgments of length, mass and time: A. H. Patterson.

A photometric study of the fluorescence of iodine vapor: W. E. Speas.

Some fungi new to North America or the South: W. C. Coker.

Breeding results from overwintering cocoons of the Polyphemus moth: C. S. Brimley.

On the polyembryonic development of the parasite, Copidosoma gelechiae Howard: R. W. Leiby.

New North Carolina gall types: B. W. Wells.

The Lorentz transformation in Einstein relativity: Archibald Henderson.

Solid culture media with a wide range of hydrogen and hydroxyl ion concentration: F. A. Wolf and I. V. Shunk.

Notes on the ecology and life history of the Texas horned lizard: J. P. Givler.

Ionizing potentials of gases by negative electrons: A. A. Dixon.

An interesting anomaly in the pulmonary veins of man: W. C. George.

The inheritance of economic qualities in cotton: R. Y. Winters.

Questions arising from the discovery of occasional vertebrate hermaphrodites, with a demonstration of a case in a pig: Harley N. Gould. (Lantern.)

The artificial incubation of turtle eggs: Bert Cunningham. (Lantern.)

Effects of desiccation on cotton seeds and the seed-borne element of cotton anthracnose: S. C. Lehman.

The anatomy of Angiopteris: H. L. Blomquist. (Lantern.)

The electron, its measurements and applications: J. B. Derieux. (Lantern.)

Further studies on the pure culture of diatoms: Bert Cunningham and J. T. Barnes. (Lantern.)

Aphidius, a parasite of the cotton louse: H. Spencer.

From egg to frog in two months: H. V. Wilson.

Some considerations in defense of the general biology course: J. P. Givler.

Some questions concerning the teaching of physics in North Carolina: C. W. Edwards.

Notes on the salamanders of the Cayuga Lake Basin, N. Y., with reference to eggs and larvæ: Julia Moesel Haber.

A more remarkable shoot: William F. Prouty.

Relationship of temperature and relative humidity to the distribution of cockroaches: V. R. Haber.

Recent views on the nutritive properties of milk: J. O. Halverson.

Notes on recently discovered Miocene whale: William F. Prouty.

A method of differentiating mucous and serous cells: Miss E. G. Campbell.

DEMONSTRATIONS

Metamorphosed frogs (Chorophilus), reared from artificially inseminated eggs in two months: H. V. Wilson.

New North Carolina galls: B. W. Wells.

Shells of Raleigh turtles: C. S. Brimley.

Examples of Fulgoridæ: Z. P. Metcalf.

At the business meeting President Metcalf announced that affiliation with the American Association for the Advancement of Science has been completed except for official notice from the Permanent Secretary of the Association.

The following officers were elected for the ensuing year: president, Jas. L. Lake, professor of physics, Wake Forest College; vice-president, Dr. J. H. Pratt, state geologist; secretary-treasurer, Bert Cunningham, professor of biology, Trinity College; additional members of the Executive Committee, H. R. Totten, University of North Carolina, R. N. Wilson, Trinity College, and F. A. Wolf, State College.

C. S. Brimley,
Acting Secretary