CARBONIFEROUS

R. L. Moodie[15] reprints, in his monograph of Pennsylvanian amphibia, descriptions and figures of the remarkable microsaurs from the Joggins coal fields in Nova Scotia, which were published by Dawson between 1860 and 1895.

TRIASSIC

L. M. Lambe[16] has published descriptions of three new fishes, two Paleoniscids and one Crossopterygian, from localities west of Banff. The strata have heretofore been assigned to the Jurassic period[17] but are more correctly correlated with the Upper Banff shale on the basis of invertebrates associated with the fish remains. The Upper Banff fauna, according to Girty and Kindle, represents the horizon of the Lower Triassic Meekoceras beds of Idaho and Wyoming. It should no longer be referred to the Permian.

CRETACEOUS-EOCENE

The geology of the region about Wood Mountain and Willowbunch, adjoining the international boundary south of Moosejaw, Sask., is described by Bruce Rose.[18] The strata exposed range from the Fox Hills and Pierre Cretaceous through the Lance formation to the Fort Union Eocene. The latter contains lignitic coal of value. An excellent description of the Prairie Plains of Saskatchewan and their Quaternary history forms the second chapter of the report.

New types of duck-bill dinosaurs from the Cretaceous of Alberta are described by Brown.[19]

[15] R. L. Moodie, "The Coal Measures Amphibia of North America," Carnegie Inst. Washington, Pub. 238, 1916.

[16] L. M. Lambe, "Ganoid Fishes from near Banff, Alberta," *Trans. Roy. Soc. Canada*, Ser. 3, Vol. 10, Sec. 4, pp. 35–44, 1916.

[17] J. A. Allan, "Bankhead to Golden," Cong. géol. internat., Guide Book 8, Pt. 2, p. 191, 1913.

[18] Bruce Rose, "Wood Mountain-Willowbunch Coal Area, Saskatchewan," Geol. Surv., Canada, Mem. 89, 1916.

[19] Barnum Brown, American Mus. Nat. Hist., Bull., Vol. 35, pp. 701–708, 1916.

MIOCENE

A new species of cyprinid fish, based upon four specimens discovered by Bruce Rose of the Canadian Geological Survey near Kamloops Lake, B. C., is described by Hussakof.[20] It has considerable resemblance to *Leuciscus balteatus* living to-day in the Columbia basin.

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March 5, 1917

SPECIAL ARTICLES

THE VITALITY OF CYSTS OF THE PROTOZOON, DIDINIUM NASUTUM

It is well known that many of the unicellular forms encyst under certain conditions, *i. e.*, become inactive and form a heavy wall about themselves, and that in this state they can endure environmental conditions which are otherwise fatal. For example, the loss of water readily kills didinia when they are in the active state, but when they are encysted desiccation such as is produced by exposure even for months to ordinary atmospheric conditions does not necessarily kill them. This is also true of many other forms. When they are thus dried they may be widely scattered by the wind; encystment consequently may have a twofold function, protection and distribution. Whether or not it functions still further in rejuvenescence in accord with the contention of Fermor (1913) and Calkins (1915) is a question which will be considered at some length in a later paper.

The degree of protection and the extent of distribution that organisms secure by encystment depends upon the vitality of the cysts. The longer they live the greater the protection and the wider the distribution. It is consequently important to know how long organisms can live in the encysted state. This is especially true regarding pathogenic forms, and these forms are the only ones, with the exception of the rotifers, in which the problem has been seriously investigated. Knowledge regarding the endurance of cysts

[20] L. Hussakof, "A New Cyprinid Fish, *Leuciscus rosei*, from the Miocene of British Columbia," *Am. Jour. Sci.* (4), Vol. 42, pp. 18–20, 1916.

may also throw some light on the nature of protoplasm in that it gives information concerning the lower limit of metabolism necessary for life.

In a series of experiments made in connection with other work on *Didinium* described elsewhere, it was found that the cysts live much longer than had been anticipated. On June 11, 1910, several didinia, all derived from the same individual, were put into a 100 c.c. beaker containing 50 c.c. of solution with numerous paramecia. The beaker was then placed in a damp chamber and left until January 15, 1911. At this time many didinia cysts were found in the beaker, and no active organisms except a few rotifers. It is not known just when these cysts were formed, but, judging from what usually occurs under similar circumstances, they were probably all formed within a week after the didinia had been added to the culture of paramecia, *i. e.*, about the middle of June, 1910.

On May 31, 1911, a 10 c.c. vial was filled with solution from the beaker containing about one half the cysts. The vial was then corked, sealed airtight with paraffin and laid away in a dark drawer. The remaining cysts were added to a portion of a vigorous culture of paramecia, and the rest of this culture was retained as a control. Two days later there were several didinia in the portion seeded with cysts, none in the control, showing that the cysts were still viable. A few cysts were removed from the vial and similarly tested on each of the following dates: October 22, 1912; January 23, 1914; December 12, 1914; January 7, 1915; March 1, 1915, and March 4, 1915. In all of these tests except two, December 12, 1914, and January 7, 1915, active didinia were secured from the cysts. No didinia were found in any of the control cultures. This proves conclusively that the cysts of *Didinium nasutum* can live, at least, nearly five years.

In all of the tests observations were made daily. In the test of October, 1912, active didinia were found on the fifth day after adding paramecia, in those of January, 1914, on the second day, and in those of March, 1915, on the sixth and tenth days respectively.

In each of these tests, except the first two and the last, four watch glasses containing cultures of paramecia were seeded with the cysts. In the last test, March 4, 1915, all of the remaining cysts were added to two liter jars containing vigorous cultures of paramecia. In the test of January, 1914, didinia appeared in three of the watch glasses, in those of December, 1914, and January, 1915, in none, although observations were made for more than two weeks; in those of March 1, 1915, active didinia appeared in only one of the four watch glasses; but in the last test of the series they appeared in both jars. In one of these jars only a few small specimens were found and these soon died out; in the other, however, the didinia appeared to be perfectly normal; they developed rapidly and produced a vigorous culture which is still in existence, February, 1917.

It is thus evident that some of the cysts were still viable at the close of our experiment, which extended through nearly five years, but it is not clear how much longer they could have remained viable. However, at the close of the experiment the cysts were much shriveled, only partially filled with protoplasm, and yellowish in color, whereas in the beginning they were well filled with protoplasmic granules and grayish in color. Toward the close of the experiment the proportion of failures was also much larger than at the beginning. All this indicates that the cysts would probably not have lived much longer. On the other hand only a very small proportion of the cysts developed in any of the tests, probably not more than two per cent. Consequently, since the cysts became less numerous as the experiment proceeded the large proportion of failures toward the close may have been due to an insufficient number of cysts rather than to their age.

We have thus demonstrated conclusively that didinia in the encysted state can live nearly five years in a solution from which they probably get nothing in the nature of food. If the cysts are dried they probably

live even longer than they do in a solution as the results of the following series of experiments show.

Early in the spring of 1910 ten eight-liter battery jars nearly full of solution containing numerous didinia were set aside in the laboratory. Eight of these jars were covered and two were left uncovered. The solution of one of these contained much débris, hay, etc., that of the other almost none. The solution in both evaporated gradually, so that on the last day of May there was only a trace of moisture left in either jar. When they were next examined early in August the debris was so dry that it could be readily crumbled between the fingers.

On January 14, 1911, one half of the solution in each of the eight jars was poured off and replaced by hay solution (1 gm. hay to 200 c.c. water boiled ten minutes), and the two empty jars were half filled with the same solution. All of the jars were then examined from time to time until February 10. Active didinia were found in only one of the jars, and this was one of the open jars, the one which contained much debris. Several active didinia were found in this jar January 17 and more later. Numerous colorless flagellates, some vorticellæ and also a few other forms appeared but no paramecia.

The results of these experiments, consequently, clearly indicate that the vitality of dried cysts is greater than that of wet cysts. The number of cultures tested was, however, so small that the siginficance of the results obtained is somewhat doubtful. The tests should be repeated and extended in connection with a study of the histological changes that may occur in the cysts.

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SOCIETIES AND ACADEMIES

THE BOTANICAL SOCIETY OF WASHINGTON

The 121st regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club at 8 P.M., May 1, 1917, with thirty-nine members present. Mr. Burt A. Rudolph, Mr. Glenn C. Hahn and Mr. Horace W. Truesdell were elected to membership.

The regular program was devoted to a symposium on the flora of the District of Columbia. Professor A. S. Hitchcock discussed "The plan of the flora" and traced briefly the history of the flora from Brereton's studies in 1831 to the present time. In 1906 a mimeograph list of the vascular plants was prepared by Mr. P. L. Ricker. The flora is now under the leadership of Professor A. S. Hitchcock and Mr. P. C. Standley. Twenty-five collaborators are now at work preparing the preliminary manuscript which is to be finished by June 1 and the manuscript completed by November 1, 1917.

Mr. Edgar T. Wherry, at the invitation of the society, furnished a paper on "Geological areas about Washington." The paper was read by Mr. Hitchcock. The prominent geological feature is the Fall Line which separates the Piedmont Plateau on the northwest from the Coastal Plain on the southeast. Above this line the valleys are steep-sided, and below broad and open. The Piedmont Plateau consists chiefly of crystalline gneisses of early periods, while the Coastal Plain is occupied by unconsolidated gravels, sands and clays. The soils on the Coastal Plain are acid for the most part while those on the Piedmont are not.

Mr. George E. Sudworth discussed "The distribution of trees in the floral area." Oaks predominate and constitute from one half to three fourths of the upland cover. There are about 140 species of native and naturalized trees of which the broad-leaved trees number about 122 species.

"Humus as a factor in plant distribution" was discussed by Mr. Frederick V. Coville. Mr. Coville exhibited two samples of organic matter—the one a raw, brown and leafy turf found in laurel thickets produced chiefly by the decay of the laurel leaves, and the other a black, fully-reduced, non-structural leafmold formed by leaves high in lime content such as the tulip poplar. The former is acid and the latter alkaline in reaction.

Mr. P. L. Ricker discussed briefly the subject of "Collecting and preparing specimens." Mr. Ricker exhibited several types of portfolios suitable for collecting plants and also suggested the use of corrugated driers and artificial heat, especially where large numbers of plants are being collected on field trips.

The program was followed by an informal discussion by Messrs. Safford, Beattie, Norton, Waite, Lewton, Shantz, Coville, Hitchcock, Sudworth and Ricker.

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Corresponding Secretary