wood, mostly fragmentary, is also present. During a visit made with Mr. Wolfe and a large party late in March last, further armor fragments of the cycads were found. The conditions indicate that the general specimen level is undisturbed for some distance along the slope, and that more good material must be present. The exact position of this level measured in feet above the more basal of the "pack sands" can not long remain in doubt if this noteworthy cycadeoid locality, the finest so far known in the Trinity beds, is marked with care. A simple, tasteful, appropriately inscribed monument should here be set up. It would be doubly commemorative of discovery and distribution in the case of such a splendid fossil type, as again seen with such a near certainty in the Black Hills 900 miles north.

Taking the foregoing species and collections from the Trinity beds in fuller view, a group resemblance to the cycadeoids of the lower Lakota is at once discerned. The parallel extends to both simple stemmed and branched species—is, in fact, so close as to become outstanding for all North America. Whatever similarity the Maryland types may have is less evident, as little is known of their fruiting, and branching does not occur. So far as inference may rest on the cycadeoids, by now a most imposing group, the lower Greensand of the Isle of Wight, the lower portion at least of the Lakota carrying the great group of specimens at the Cycad National Monument in the southern Black Hills, and the Trinity beds, are all of quite the same age. It may still be asked whether the Arundel is recent as the Trinity, or old as the Como taken as the equivalent of the Wealden. The Trinity was a flat, subsident, river and bayou, cycad-dinosaur-conifer, forest land, swept by the shallow edges of the sea.

Most of the Trinity cycadeoids are not nearly so well petrified as the Lakota and Como specimens. Finer details of structure are seldom clear. Yet the series as a whole has the finest beauty and value, and often affords singularly handsome polished surfaces. The *Cycadeoidea Barti*, as found at Comanche and at Fredericksburg, has an appearance suggesting original calcification in whole or in part, with subsequent siliceous replacement.

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EFFECT OF H-ION CONCENTRATION ON THE DIVISION RATE OF PARAMECIUM AURELIA

EXPERIMENTS on the effect of hydrogen-ion concentration on the division rate of *Paramecium aurelia* have been performed, feeding the animals on a pure line of bacteria instead of the "mixed culture" of bacteria heretofore used in such experiments. The *Paramecium* used were from Professor Woodruff's pedigreed strain. The bacterium used was a strain of *Erythrobacillus prodigiosis* which has been kept for several years in the Department of Bacteriology of Yale University. The medium consisted of 1.493 gr. of powdered, desiccated lettuce leaves in 1.0 liter of distilled water. To this was added in the first group of experiments KH_2PO_4 buffer salt to form a M/600 solution. In the second group M/300 buffer was used. The animals were kept in isolation in depression slides, and changed daily under sterile conditions. No bacterial contamination was observed at the end of the experiments, but a very few yeast cells were observed at the end of one experiment. The temperature was controlled by a thermostat.

The lines were carried for ten days each at several different H-ion concentrations, produced by titrating with HCl or NaOH, with the following results:

GROUP 1. M/600 KH_2PO_4. Temperature 28° ± 0.5° C.

pH	No. of lines	Average division rate per 10 days
5.9	6	21.7
6.9	6	18.8
7.2	6	20.0

GROUP 2. M/300 KH_2PO_4. Temperature 26.5° ± 0.8° C.

pH	No. of lines	Average division rate per 10 days
7.0	6	14.0
7.7	6	14.0

It will be seen from the above that the division rate is practically unaffected by change in pH between the limits of pH 5.9 and 7.7. This is in striking contradiction to the very thorough work of Darby ('29),[1] who found a very marked variation in division rate with pH, using the same strain of *Paramecium aurelia*. The author believes that the discrepancy in results lies in the fact that Darby used a mixed strain of bacteria as food for the *Paramecium* as opposed to the pure line of bacteria used in the present work. It has been shown Hargitt and Fray ('17)[2] that over 30 species of bacteria may be represented in ordinary hay infusion. It has also been shown that these species differ greatly in their value as food for *Protozoa* (Hargitt and Fray,[2] Phillips,[3] etc.). It is well established that many of the common bacteria are stenionic and are greatly influenced in their growth

[1] H. H. Darby, *Arch. f. Protistenk.*, 65: 1, 1929.
[2] G. T. Hargitt and W. W. Fray, *Journ. Exp. Zool.*, 22: 421, 1917.
[3] R. L. Phillips, *Journ. Exp. Zool.*, 36: 135, 1922.

rate by changes in pH. Therefore it is logical to assume that the ecological balance among the bacteria will be greatly altered by changes of pH, and that where a large number of bacterial species are living together, as in a hay infusion, different species will predominate at different H-ion concentrations.

From the above it is concluded that the difference in division rate of *Paramecium* at different H-ion concentrations, between the limits of pH 5.9 and 7.7, at least, is due to a qualitative change in available bacterial food, and not to direct action of the pH on the Protozoa.

Further work is being carried on to determine the behavior of *Paramecium* in a pure culture of bacteria at higher and lower H-ion concentrations than those used in the present experiments.

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INDUCED AUTOTOMY IN THYONE

THE holothurian, *Thyone briareus,* has long been known to exhibit unusual autotomy. During this process it casts off the extreme anterior end including the ring of tentacles, calcareous lantern, water vascular ring, nerve ring and throws out with these organs the oesophagus, stomach and intestine.

A. S. Pearse,[1] by injecting strychnine into the body cavity of 20 Thyone, produced such evisceration in seven individuals. J. W. Scott,[2] induced autotomy in 40 out of 65 individuals by "allowing Thyone to stand in stagnant water until the water became foul" and then following with a "treatment with running water. Alternating these processes produced as high as 65 per cent. self-mutilated individuals."

During this summer's work at Woods Hole I have found that ammonia water will invariably bring about evisceration. Seven N ammonium hydroxide was used in the proportion of one part ammonia to 800 parts of sea water.

When the animal is placed in this solution there is usually a brief period of muscle relaxation and an expulsion from the cloaca of the water which filled the respiratory trees. Within 15 seconds the longitudinal and circular body muscles contract strongly, reducing the animal to minimum size. A few seconds of such contraction is followed by a gradual elongation of the anterior end of the body into which lantern, stomach, intestines and the fluid content of the body cavity are forced. As the pressure increases, the body wall about ¼ of an inch behind the tentacle ring becomes greatly distended. There are no strong circular muscles in this region. The body wall tissue in the distended region thins out and soon bursts allowing the body fluid to gush out carrying along with it part of the viscera. At this point in the procedure the Thyone is transferred to fresh sea water. Most of the viscera are tangled around the lantern, which is partly covered over with the small portion of the body wall anterior to the break. The strong circular muscles just posterior to the break contract so as to close tightly the body cavity at the anterior end. The whole procedure to this point occupies about 30 seconds. The original break in the tissue becomes gradually more extensive until within several hours the eviscerated parts are free from the body.

The hydroxides and carbonates of sodium and potassium have been used with some success. Electrical stimulation applied to the muscles of the body wall will also produce autotomy.

One hundred and fifty Thyone were eviscerated by the ammonia water method. Of this number five Thyone did not live. In each of these cases the body wall broke at places other than at the customary anterior point. One hundred and forty-five Thyone lived until they were killed for the study of the regenerated organs.

Under the conditions outlined, autotomy is regular and uniform in occurrence. In 96 per cent. of the possible cases it was favorable for continued life and the regeneration of lost parts. A study is being made of the regenerated tissues.

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[1] A. S. Pearse, "Autotomy in Holothurians," *Biol. Bull.*, vol. xviii, 1909.

[2] J. W. Scott, "Regeneration, Variation and Correlation in Thyone," 1914.

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