um at the same point, but the measurements of Richardia show that while the maximum for each dimension occurred between midnight and the middle of the morning, it did not occur at the same time, sometimes there being a difference of 4 or 5 hours between the maximum for length and that for thickness. The curve for length shows that considerable growth took place, but as this is the result of the growth for the entire petiole, which consists of the sum of the increments of growth of its zones, while the growth in thickness is but that of a single zone.

The curves are constructed having the abcissæ represent periods of one hour each, the ordinates representing growth. One division of the ordinates is used as a unit for the curve of length; 3 being used for the curve of thickness that the changes may be seen more readily as they are so minute. The measurements were taken in millimeters, and as the instrument recording growth in length multiplied 8 times, if the number of spaces traversed by the curve be divided by 8, the quotient will be the number of millimeters of actual growth. The instrument for thickness multiplied by 40, and as three spaces were used as a unit, the number of spaces traversed would have to be divided by 120 to give the growth in millimeters.

THE EFFECT OF LIGHT ON THE GERMINATING SPORES OF MARINE ALGÆ. By MELVIN A. BRANNON.

NOTES ON SAPROLEGNIA FERAX. By GEO. L. ROBERTS.

As to the sporangial development in the Saprolegnieæ, two important theories have been presented—that of Strasburger and the more recent one of Rothert.

The former holds that the partition wall of the sporangium, in *Saprolegnia ferax*, forms at a thickened place in the protoplasm. This changes into a cell-plate of varying thickness. The cell-plate is formed from a strong light-refracting substance, yellowish in color, which is apparently the same substance that is distributed in small granules in the protoplasm of the thread. From this cell-plate, after a time, arises the limiting

membrane. Later the partition wall becomes arched from the sporangium contents, and shortly, two membranes are formed, the one belonging to the sporangial portion of the thread, the other to the basal part.

The view of Rothert, confirmed by Berthold, Hartog, and others is, that at the arrest of the apical growth of the hypha, the protoplasm continues to flow in from the base, usually producing an ovoid enlargement. For a time the thick protoplasm of the sporangial part of the hypha passes gradually into the basal part, but the contrast soon becomes abrupt and well-defined. Then the granules disappear from the protoplasm, so as to form a somewhat elongated, transparent plasma ring, which increases at its inner circumference until it forms a transverse disk, that extends across the hypha from wall to wall. It is sharply marked on the basal side, but on the sporangial side passes gradually into the granular protoplasm. Within a very short time (about one-half minute), the transverse septum appears at the base of the disk. This septum is at first pale but soon becomes strongly defined.

Rothert thinks it probable, that the material for the formation of the septum is derived from the Pringsheim's cellulin corpuscles, consisting of a very soluble form of cellulose, that accumulate about the limiting area.

For the purpose of verifying one or the other of these theories, I made many serial cultures of *Saprolegnia ferax* on the bodies of dead flies, wasps, spiders, and crickets. By this means I was enabled to watch the development of the partition-wall. The time at which this was formed, in each instance observed, was in the morning. As to whether any especial significance attaches to this fact in this case, I can not say. In all cases the partition wall was formed as set forth by Rothert, and not as formerly suggested by Strasburger.

Another point first stated by Rothert was also confirmed; namely, that fragments of a healthy culture of Saprolegnia may be cut off and will continue to thrive in the hanging drop and are much more normal than the fly-leg cultures usually used. I found that fragments thus treated continued to grow and develop from day to day.

To make a study of the nuclei, I placed flies bearing *Saprolegnia ferax* in different stages of development, in a one per cent. solution of chromic acid for two hours; washed this material two days in distilled water; placed it in alum-cochineal twenty hours; and after again washing for a short time, brought it gradually into seventy per cent. alcohol, for preservation. By this process the nuclei are stained very nicely, and their

arrangement and development can be determined very satisfactorily.

In the vegetative portion of the hypha, the nuclei are of considerable size and lie in the inner part of the wall-lining of protoplasm. They are united by peculiar plasma threads, that run parallel or obliquely to the long axis of the hypha. The nuclei are ellipsoidal, elongated in the direction of the long axis of the hypha. One can determine the existence of a small nuclear body in each nucleus. In the hypha-ends the nuclei are nearer together. Here they are found somewhat closely connected in pairs, and lying entirely imbedded in the wall-lining of protoplasm. After the formation of the partition wall, they increase in numbers, by division, in the sporangial portion, and in the mature sporangium each zoospore contains a nucleus.

CONTRIBUTIONS TO THE LIFE-HISTORY OF NOTOTHYLAS. By D. M. MOTTIER.

[ABSTRACT.]

This paper embodies the results of a study of the development of the sporogonium and sex-organs of *Notothylas orbicularis* together with that of *Anthoceros*. These results may be summed up as follows:

The capsules of *Notothylas orbicularis* possess a columella varying in size with that of the capsule.

The columella is developed, as in *Anthoceros*, primarily in the young sporogonium with the archesporium and independent of it, and is not a secondary differentiation inside the spore chamber.

The archegonium of *Notothylas* resembles more closely that of the ensporangiate ferns than does the archegonium of *Anthoceros*.

The antheridium arises from an hypodermal cell, thus differing in this respect from all other known *Bryophytes*.

THE ASH OF TREES. By MASON B. THOMAS.

The object for which this investigation was undertaken was to show by chemical analysis the amount of food a tree or shrub takes from the soil in its yearly growth. The method employed was to determine by a quantitative analysis of the ashes of trees and shrubs, the proportion of the mineral constituents of the soil that are found present in them. It seems