tamerous symmetry, no trace of calcareous structure, no longitudinal muscles and no podia. The radial canal system is utterly unlike the water-vascular system of any known Echinoderm and it is perfectly inconceivable how the fundamental, circumoral ring of a holothurian could disengage itself from the esophagus and migrate to the opposite end of the body.

If *Eldonia* is a holothurian, it becomes virtually impossible to define the class, except in terms of the alimentary canal. Indeed if *Eldonia* is a holothurian, the Echinoderms themselves can be defined in no other terms, for *Eldonia* lacks every single character which justifies the customary view that holothurians are Echinoderms. It is far less of a strain on my credulity to believe that *Eldonia,* whose extraordinary nature I have no inclination to deny, is some sort of a Cœlenterate with a commensal worm inside or under the subumbrella, or even that it represents a hitherto unknown phylum, than to believe that it is a holothurian or is connected, save in the remotest way, with the Echinoderms.

As a final result of my examination of the evidence, I am forced to conclude that there is no sufficient justification for the belief in a Cambrian holothurian fauna. The external form of *Louisella* and *Mackenzia* and the supposed alimentary canal of *Eldonia* can not be considered adequate basis for such a belief. There is no good evidence, either in Dr. Walcott's material or elsewhere, to show that holothurians existed before the Carboniferous. But as wheels, which are certainly of a Chiridota-like form, occur in the Zechstein of Europe, and animals closely allied to our modern Holothuria are found in the Solenhofen limestone, it is not improbable that the holothurians were differentiated about as early as the other classes of Echinoderms, excepting the Pelmatozoa. Evidence however in support of such a probability is still conspicuous by its absence.

Hubert Lyman Clark
Museum of Comparative Zoology,
Cambridge, Mass.,
January 12, 1912

## Biology of Miastor and Oligarces

The general availability of *Miastor,* at least for laboratory work, justifies the following summary account of the biology of this interesting form and the allied, possibly sometimes associated, *Oligarces.*

*Distribution.—Miastor* is probably world-wide in distribution, having been recorded from Europe, Australia, North and South America. We have found this genus ranging in New York from the upper austral Hudson valley to the transition or boreal Adirondack region. These peculiar larvæ have also been found in Connecticut and Indiana.

*Oligarces* has been recorded only from Europe and North America, Albany and adjacent Nassau, N. Y., being the only American localities at present known. This species is probably widely distributed though presumably rarer or less easily detected.

*Larval Habits.*—The moist inner bark of various trees in the incipient stages of decay are likely places for *Miastor* larvæ. Chestnut rails, ties, stumps, the moist bark of maple, oak, birch, beech and hickory indicate no closely restricted food habits. In addition to some of the above, European report *Miastor* larvæ from elm, ash, ironwood and sugar-beet residue.

We have found *Oligarces* only in decaying elm bark, possibly because the larvæ are not so readily detected in nature.

*Distinguishing Characters.*—Large colonies of *Miastor* larvæ are easily recognized by the masses of more or less adherent yellowish or whitish larvæ, and especially by the occurrence here and there of motionless individuals with poorly indicated segmentation and elongate, transparent areas, the developing embryos, or containing young so well developed as to be easily distinguished with a hand magnifier, even the form of the head and the fuscous ocular spot being visible. The head of these larvæ, whether small or large, is flattened, triangular with diverging antennæ and quite different from the strongly convex, usually fuscous head of *Sciara* larvæ. *Miastor* larvæ have transverse incisurial bands of

chitinous spines, best developed on the anterior body segments. These larvæ are 1/20 to 1/8 of an inch long and may occur in small clusters in the bark or form dense masses covering several, if not a number of square inches, frequently more or less clustered and appearing much like a mass of fungous matter commonly seen under bark.

*Oligarces* larvæ are similar in general aspects, though we have yet to find them in any such large masses as described above. Elm bark containing this maggot gives little evidence on the inner surface of their presence, since these larvæ appear to confine themselves mostly to the interstices of the bark.

*Biology.*—The larvæ of both genera reproduce by pedogenesis in the fall and early spring. We have also observed this in the case of *Miastor* in midsummer. Moisture and moderately cool weather appear to be especially favorable. With these conditions we are inclined to believe that pedogenesis may continue indefinitely, since we have kept larvæ healthy and multiplying for nearly six months with nothing more elaborate than a moist piece of decaying wood clamped lightly to an ordinary microscopic slide. A larval generation appears to occupy about 3 to 3½ weeks, though it is evident that much depends upon moisture, food and temperature. We were fortunate in the case of two larvæ to witness the development of the egg in the ovary, its gradual separation therefrom by fission and the growth to an individual nearly ready to escape from the mother larva. This entire process occupied about three weeks. The development of the embryo is at the expense of the mother, the young absorbing their nourishment from her. Pulsations in the mother larva continue so long as a fragment of the dorsal vessel remains; in one specimen observed the dorsal vessel of the mother larva was ruptured in the vicinity of the sixth body segment and the free anterior portion continued violent pulsations and irregular wrigglings till the next day, at which time the movements were much slower and by the following day had disappeared entirely.

Reproduction by pedogenesis continues in the spring till just before the final changes to the adult, the larval colonies displaying a marked tendency to arrange themselves in groups and occasionally form rather striking combinations. This occurs, even in the case of colonies established under artificial conditions. At this season at least there is a marked tendency toward uniformity in the production of larval generations, a considerable proportion of the larva in any one colony containing embryos which may escape at about the same time and migrate to another location before establishing themselves. This removal from the exuviæ of an earlier generation clearly indicates a phytophagic habit and is presumably of value in avoiding natural enemies. In early May, 1911, embryos escaped in large numbers from mother larvæ, established a colony and in a few days showed a well-developed breastbone. The transformation to the prepupa, characterized by a marked swelling and transparent condition of the anterior body segments of the larva, occurred shortly, they remained in this condition two to three days and then changed to the pupa, a stage lasting about six days. These small midges appeared in enormous numbers in our breeding jars during the late morning hours, namely, from about 9 A.M. until noon, the midges swarming over the sides of the jar and behaving much like minute ants. There is comparatively little tendency to take wing. This may continue for several days and the midges may appear in smaller numbers for a period of several weeks. Larvæ collected in the Adirondacks did not produce midges till in early August. There was a marked preponderance of one sex in rearings from a breeding jar one day, followed by an approximate reversal subsequently. This was not sufficiently marked so that we felt justified in attempting to deduce any general rule. The abdomen of the female contains four to six large eggs, each nearly as long as the abdomen. They appear to be well developed and are probably deposited shortly after the appearance of the midges and the pedogenetic generations commenced wherever conditions are favorable.

*Oligarces* behaves somewhat differently. A number of larvæ, probably mostly mother larvæ, containing embryos were found in elm bark March 18, 1911. This material was kept in a warm room, and a week later the interior of the jars literally swarmed with thousands of active, whitish maggots with here and there a yellowish or yellowish-transparent one. Many of these perished upon the walls of the jar, and even those confined between a piece of glass and decaying elm bark soon succumbed. In spite of this a pupa was found April 19 and adults obtained about a week later. These small, white larvæ mentioned above differed from typical *Miastor* larvæ and some, at least, evidently established themselves in the crevices of the bark, transforming to pupæ, and these in turn worked out to the free surface a day or so before the disclosure of the imago. These pupæ appeared to move more readily than those of *Miastor,* and in several instances were observed standing upon the moist surface of the bark, supported only by the somewhat mucilaginous posterior extremity.

*Natural Enemies.*—Both *Miastor* and *Oligarces* larvæ are subject to attack by several predaceous Dipterous larvæ occurring in similar situations. The pinkish larvæ of *Lestodiplosis,* resembling in a general way those of *Miastor* except for a difference in color and more slender structure, may be seen here and there among their prey, and in the case of populous clusters of white *Miastor* larvæ, may give an ornamental touch to the colony. *Itonida pugionis* Felt may also prey on *Miastor.* Two larger predaceous maggots, those of *Lonchæa polita* Loew and a species of *Medeterus* are commonly found in the vicinity of *Miastor* colonies, and it not infrequently happens that they are the only available evidence of the earlier occurrence of *Miastor.* The larvæ of these two latter are voracious forms and are undoubtedly responsible for the speedy destruction of many *Miastor* colonies. The finding of these predaceous larvæ may serve as a guide to the searcher for *Miastor* and suggests investigating the more inaccessible portions of the bark for colonies which may have escaped the predaceous maggots.

E. P. Felt

## SPURRED FLOWERS IN CALCEOLARIA

The *genus Calceolaria,* often popularly called slipperwort, belongs to the Scrophulariaceæ. It may be divided into two sections; first, the herbaceous kind, the one usually employed by florists in this country; second, the shrubby and bedding kinds.

The herbaceous kinds are grown from seeds. When well grown they are very ornamental and serve to decorate the greenhouse in spring, when other plants are through blooming.

The shrubby kinds are serviceable to some extent for indoor decoration. They are extensively grown in Britain for bedding purposes. Owing to the American summers being so hot, they are unsuited for bedding purposes here. They are mostly raised from cuttings.

A little more than a year ago some crossing experiments were conducted by a student in one of the regular undergraduate courses, No. 6, in the department of botany. This course was in charge of Professor Geo. F. Atkinson and Mr. Robert Shore, the head gardener of the department. The student, Miss Margaret C. Graham, performed the experiments under the supervision of Mr. Shore. Since, in public lectures, several unauthorized references have been made to these spurred calceolarias, it seems desirable to place on record the principal facts in connection with the experiments, and to state that the work is still in progress by Professor Atkinson and Mr. Shore.

A shrubby plant was crossed with a herbaceous one. This gave plants of a stronger growth, more profuse bloomers, more compact and more ornamental. Some of these varieties can be propagated from cuttings. These hybrids have been recrossed and the offspring have produced an interesting variety in habit of plants and variation of flowers. Some of the varieties have a number of spurred flowers, one or two spurs on the labellum. These spurred varieties have been cross pollinated and self pollinated, and varieties raised from these seeds have produced several spurred flowers.

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