rosette-like. I have never succeeded in observing ova in the act of being discharged, but there can be no doubt that they pass out in the same manner as the spermatozoa — their passage through the rather narrow canal being favoured by their extreme viscosity. In specimens of *Polynoë perclara* with ripe sexual products the parapodia are beset at their bases with rows of long cilia so arranged as to drive anything discharged from the segmental organs upwards towards the cavity beneath the scales, where, as is well known, the eggs undergo the earlier stages of their development. This arrangement would have no meaning were it not intended for the transportation of the eggs from their points of discharge at the ventral surface to their brood-pouch beneath the elytra. In *Lepidonotus oculatus* this special arrangement of cilia is absent; and it is to be remarked that in this species, of which I have examined many specimens with ripe sexual products, the eggs do not seem to be hatched beneath the elytra, which are small, not covering the whole back.

Apertures have been described in the walls of the parapodia and through these it has been supposed that the ripe ova and spermatozoa are discharged. I have never found any such apertures in the species examined by me; rows and circlets of cilia frequently occur; these are set in rectilinear or circular slits in the cuticle, the cilia being prolongations of the subcuticular layer, and this arrangement may in the case of the circlets give rise to the appearance of circular apertures. It must be added, however, that those species in which I have made certain that no such apertures exist were examined only during the breeding-season. It may be that apertures, open at other seasons, are closed at that time to prevent the sexual elements from escaping through any but the proper channels. Be this as it may, it does not affect the main question with which this paper is concerned — viz. the position and relations of the true segmental organs.

2. Variation in the Yolk-cleavage of Renilla.

By Edmund B. Wilson, assisted by H. L. Osborn and J. Meredith Wilson.
(Note from the Marine Laboratory of the Johns Hopkins University.)

During the months of May and June the ripe eggs of *Renilla reniformis* Cuv., were obtained in abundance at Beaufort, N. C., and I have been able to make a full study of the phenomena of segmentation. When studying a number of eggs it was found that the segmentation was not of a uniform character but presented a surprising and unprecedented amount of variation.

This observation appeared of such importance as to render desi-

rable a careful study of many eggs in order to determine the number and relative frequency of the various forms of development; and for this purpose the co-operation of other observers was needful. Dr. J. Meredith Wilson and Mr. H. L. Osborn, two of my associates in the laboratory, kindly offered their assistance; and the results here recorded were attained through our joint labors.

The eggs were in most cases kept under constant observation from the time of fertilisation until the occurrence of the first cleavage and were always carefully isolated in small glass vessels and raised to a stage which proved them capable of full and normal development.

Five well marked modes of segmentation may be distinguished though these are to some extent connected by intermediate forms. They are as follows:

1) In the most usual case the egg divides at once into 16 spheres which may be of equal size or may show considerable inequality. In succeeding stages the egg divides with more or less irregularity into 32, 64, etc. spheres, each stage of activity being followed by a period of rest during which the spheres become closely pressed together and their outlines sometimes become indistinguishable. As a rule, one of the spheres divide into two equal parts at each cleavage but it sometimes happens that one or more of the spheres may pass over one of the periods of activity without dividing. In such cases the division, when it occurs, is into two parts.

2) In about one third of the eggs studied the first cleavage resulted in the formation of 8 instead of 16 spheres. As in the first case these spheres may be equal or unequal. The subsequent development agrees in all respects with the first case.

3) The third mode of development was observed in five or six eggs only. At the first cleavage four or five small spheres are formed at one pole of the egg, the remaining portion being undivided. The egg is now closely similiar to a true meroblastic egg like that for instance of *Pyrosoma*. It then passes usually into a marked period of quiescence, but this is sometimes suppressed. At the second cleavage the remainder of the egg divides into spheres which are usually somewhat unequal in size. The egg now consists of 16 spheres and cannot be distinguished from those which divide directly into 16 at the outset.

4) In a single case observed by Dr. Wilson the egg divided directly into 32 spheres which were slightly unequal in size. The subsequent development was normal and indistinguishable from the first mode.

5) In a single case observed by myself the egg divided at first into two equal parts. Each of these was then imperfectly divided into four

parts, but the egg passed into a marked resting stage before the furrows were completely formed. At the next cleavage the egg divided into 16 spheres, and in succeeding stages into 32, 64 etc. wich great regularity.

Besides these modes of development one very aberrant form was observed. In the earliest stage observed the egg consisted of three large spheres and four much smaller ones. These spheres then divided in somewhat irregular succession, the inequality in size remaining for a long time very marked. The spheres ultimately became, as usual, nearly equal, the larvae acquired cilia and developed as well as the others.

Besides the above-described forms I have observed eggs divided into four equal and sharply defined spheres, but unfortunately did not prove them capable of further development. In view, however, of the great variations which certainly exist, there is little reason to doubt that these eggs were normal and capable of full development.

In all the foregoing cases the first cleavage was definite and clearly defined. It sometimes happened, however, that the first cleavage was only imperfectly carried out and the egg passed into a resting stage before the spheres were fully formed. The egg was in several instances observed to divide imperfectly and irregularly into 8 spheres, but a well defined cleavage did not occur until the next active stage, when 16 distinct and regular spheres were formed.

In a larger number of cases the egg underwent considerable changes of form, but without the occurrence of any cleavage, some time before the first actual division of the vitellus. This appears to represent a kind of attempt at cleavage which does not go further than the division of the nuclei within the egg.

I have made many series of sections through the egg before cleavage and have been able fully to establish the fact that the nucleus divides regularly, as in some Crustacean eggs, during the period which precedes the cleavage of the vitellus, so that when the first cleavage does occur each sphere contains one of these nuclei.

The variations in the segmentation appear therefore to depend in part upon the period at which division of the vitellus follows that of the nuclei. If at an early period the vitellus may divide into two, four or eight spheres. If at a later period cleavage may not take place until 16 or 32 nuclei have been formed.

In some cases the vitellus divides completely (so far as external features go) with the nuclei, in other cases only incompletely, and in still other simply changes its form without the occurrence of any actual division.

These various forms of development will be fully described and

discussed in a forthcoming paper by the writer on the development of *Renilla*, in which the internal phenomena of segmentation, as determined by sections, will also be described.

Beaufort, N. C., July 31st, 1882.

3. Zur Physiologie des Eies.

Von M. A. Schulgin.

Während meines einjährigen Aufenthalts am Ufer des Mittelmeeres hatte ich Gelegenheit in Villefranche-sur-mer unter Anderem auch speciell den *Vermetus* zu studiren. Wegen vollständiger Undurchsichtigkeit der Eier kann deren ganze Entwicklungsgeschichte nur an Schnitten studirt werden; jetzt werde ich nur über die Ernährung ganz junger Eier einige Mittheilungen machen.

Die Eier werden auf der inneren Seite der Schale, nicht weit von der Öffnung, in doppelten Kapseln befestigt. Ich öffnete eine Kapsel die vor Kurzem abgelegt wurde und fand darin zwei bis drei ausgebildete Eier; die ganze Kapsel aber ist von ganz kleinen Körperchen ausgefüllt, die ich unter dem Präparirmicroscop nicht als Eier erkennen konnte, die aber bei genauerer Betrachtung unter dem Microscop als sehr kleine Eier sich erwiesen. In einigen anderen Kapseln, die früher abgelegt worden waren, fand ich die Eier in Furchungsstadien, aber die kleinen Eier in viel geringerer Menge vorhanden.

Überhaupt je früher die Eier abgelegt werden, desto mehr findet man kleine Eier, und desto weniger entwickelte Stadien. Endlich sind in den Kapseln, wo die Embryonen vollständig ausgebildet sind, die kleinen Eier nicht mehr vorhanden.

Ein solches regelmäßiges Verhältnis zwischen dem Vorhandensein kleiner Eier und der Zahl der entwickelten Embryonen hat mich zu genaueren Untersuchungen veranlasst, deren Resultate ich hier mitzutheilen beabsichtige.

Die betreffende Litteratur steht mir nicht zur Disposition, weshalb ich auf mein Gedächtnis angewiesen bin.

Blochmann, der vor Kurzem in seiner vorzüglichen Arbeit über *Neritina fluviatilis* dieselben viel genauer beobachtet und beschrieben hat als Leydig, nimmt an, dass nur ein Ei befruchtet wird, die übrigen aber als Nahrungsmaterial demselben dienen.

In den Kapseln des *Vermetus*, welche nur von Lacaze-Duthiers beobachtet wurden, der aber die physiologische Seite der Frage nicht berührt hat, befinden sich mehrere befruchtete Eier, aber noch mehr unbefruchtete, die dazu bestimmt sind, den ersteren als Nahrungsmaterial zu dienen.