are established when the egg has only forty-eight cells. The rosette cells are very large; and the ciliated prototroch, which consists of sixteen cells, derived from the first set of 'micromeres,' forms a complete girdle around the egg.

A typical trochophore is formed, of which the plane of bilateral symmetry corresponds to a vertical plane bisecting *B* and *D* of the four-celled stage. A postoral circlet of strong cilia appear at a short interval behind the prototroch, and a long tuft of flagella is still earlier developed upon the apical plate. There is no true paratroch. Eye spots are present, and trochophores and larvæ are positively phototactic.

No traces of metameric segmentation manifest themselves throughout the course of development, which was observed continuously until the young worms had reached the age of seven weeks. This and certain other embryological facts seem to indicate that the *Gephyrea* are somewhat more closely related to the *Platyhelminthes* than to the *Annelida*.

Notes on the structure of Alma nilotica, a gilled earthworm from Egypt: P. M. Rea.

Alma nilotica Grube, has been known since 1855, but has never been thoroughly investigated. Its systematic position is uncertain, but the present research shows conclusively that it is an Oligochaete having many of the characteristics of the Geoscolicidae. The possibility of the identity of this form with the genus *Siphonogaster* of Levinsen increases the interest of this remarkable worm. The material available at present is sexually immature, but it is hoped that specimens collected in the spring will determine this point. A pair of ovaries has been demonstrated in segment 13 and testes in 10 and 11, but no evidence of the enormous penial processes of *Siphonogaster*.

The gills, which are the most characteristic feature of the worm, are out-pocketings of the body wall, taking with them the layer of circular muscles but leaving the longitudinal muscles behind. They are provided with afferent and efferent blood vessels. The epithelium of the gills and whole body surface is highly vascular. The dorsal blood vessel extends no farther forward than the seventh segment, where it ends abruptly in the most anterior pair of hearts. There is a supra-œsophageal vessel and two remarkable lateral vessels which will be more fully discussed in a later paper. Connected with the lateral vessels are numerous spherical acini, closely approximated to the inner surface of the body-wall, which appear to be identical with the structures figured by Perrier as occurring on the walls of the œsophagus in Perichaeta.

On the life history of Autolytus cornutus and alternate generation in annelids: P. C. Mensch.

The claim for alternate generation in annelids arises from investigation on the Syllidians, chiefly *Autolytus*. It was first suggested by Quatrefages and Krohn, but for the first time fully described by A. Agassiz for *Autolytus cornutus*. Agassiz regarded the parent stock as distinctly asexual and in this manner described a true alternate generation—the asexual parent stock alternating with sexual stolons.

The asexual condition of the parent stock is, however, not constant and the percentage of parent stocks with sexual products is sufficiently great to strongly indicate that the presence of reproductive products toward the close of the phenomenon of budding is a constant stage in the life-history of this Syllid. This being the case there would be, not an alternation of generation but at most only a sexual dimorphism.

Another aspect of this question is presented by the morphological characters of the stolon itself, in that the stolon does not

attain the value of a distinct individual, as compared with the fission in other annelids (*Dero*, *Aeolosoma*), but the entire process is more like the sexual fragmentation described for the Palolo worm.

Metamerism of the Leech. W. E. CASTLE.

Following Gratiolet, most students of leech metamerism regard the annulus which bears the metameric sense organs as the first (most anterior) annulus of the somite. Careful study shows, however, that the sensory annulus is really the *middle*, not the most anterior ring of the somite.

The true limits of the somite are indicated by the distribution of the metameric nerves, all the annuli of a somite being innervated from one and the same ganglion. This is shown by the following facts:

1. In somite abbreviation rings innervated from the same ganglion fuse together.

2. In somite growth (multiplication of annuli) new rings appear chiefly at the limits of the somite (as defined), usually first at the posterior, then at the anterior end of the somite.

3. An abnormal animal, in which a somite is wanting in either half of the body, shows that the missing rings form a somite, limited as stated above.

The multi-annulate structure of the leech somite is correlated with the restricted number of somites in the body (thirty-four both in the Rhyncobdellidæ and in the Gnathobdellidæ). Increase in length of body and complexity of structure has been brought about not by multiplication of somites, as in the Chætopoda, but by elongation of existing somites and multiplication of their annuli.

Whitman and Bristol have established the derivation of the five-ringed type of somite from the three-ringed type; several facts indicated the probable earlier derivation of both from a one-ringed type of somite. Among these may be mentioned the manner of somite abbreviation and the structure of the somite in Branchiobdella and related forms.

The development of the pigment and color pattern in Coleoptera: W. L. TOWER.

The object of this research was to find out if possible: (I.) the way in which the colored patterns developed, and the sequence of the colors in ontogeny, (II.) the origin of the pigment and its development, (III.) something of its composition.

I. In Coleoptera two types of colorations are found.

(1) Unicolorous, where the whole animal is of one color.

(2) Multicolorous, where there is a color pattern of two or more colors.

I have studied the development of the color pattern in several forms of each type.

After the larva transforms to a pupa it is white or pale yellow. Color first appears on the cuticula of the future beetle about the opening of the spiracles, *i. e.*, where the spiracular muscles are attached to the cuticula. Color next appears upon the prothorax as two bands laterad of the median line, then a more or less broken band laterad of the first two appears, and last of all two spots at the anterior and posterior outer angles. The places where color first appears is over the attachment of the muscles to the cuticula. These spots may all become united as in the unicolorous, or remain separated as in multicolorous type forms. Color next appears upon the head, over the attachment of the cranial muscles to the cuticula, and then color appears upon the ventral abdominal surface over the muscular attachments.

The color as it first appears is pale yellowish brown which rapidly darkens, becomes very dark brown or black. This dark or black color is, according to Hagen, dermal pigment: There are some beetles that have a unicolorous type of color