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 pattern but are yellow or orange in color. Yellow and orange are hypodermic colors according to Hagen. These beetles are few in number. I have not yet been able to get material to study one of these forms.

In all the beetles that I have studied color appears first over the origin or attachment of the body muscles to the cuticula. No color appears upon the wings until they are out of the pupa case and the wings are fully expanded. Then color appears first between the nervules as longitudinal bands which may become confluent, remain as bands or break up into rows of spots.

The pupa becomes first white (*i. e.*, a yellowish white), then yellow or ochre yellow, then the special adult colors develop so that the sequence of development is yellowish white (due to the color of hæmolymph), yellow, ochre yellow, yellow brown, brown, dark brown and black.

II. The pigment forms, first as a waxy transparent layer upon the surface of the cuticula. This waxy layer is excreted from hypodermal gland cells having openings upon the surface. This waxy secretion forms a secondary cuticula which is the pigmental cuticula; the primary (embryonic) cuticula is unpigmented.

After the waxy layer has attained a considerable thickness, it becomes darkened over the places where dark pigment is to develop. This layer is homogeneous without lamellæ or pore canals. Only dark, *i. e.*, black brown or dark red color appears to be formed in this secondary cuticula layer. Yellow is always formed from the precipitation of solids from the hæmolymph in or among the hypodermal cells.

If the hæmolymph is allowed to dry in the air, it becomes yellow brown in color, and when some quantity is allowed to dry it appears very dark or even black by reflected light. If hæmolymph is precipitated by heat, a yellow mass is thrown down, leaving an ochre yellow fluid, which can be decanted off. The yellow precipitate in sealed tubes bleaches on exposure to light. It also darkens on exposure to air. If O_2 be passed through the yellow liquid, it rapidly becomes dark brown, and on concentration by evaporation, leaves a waxy residue.

If the hæmolymph be mixed with .1% $HClHC_2H_3O_2$ or almost any acid, it becomes red, but the yellow color is restored by an alkali as .5% NH_4OH.

III. I have been unable to determine the composition of the pigment, owing to the difficulty of isolating it. I have made some tests upon the hæmolymph and have demonstrated Fe, Na, Mg salts, albumen, fibrin, globulin, xanthophyl to be present.

IV. Summary of results:

(*a*) On the body color (dark) develops first over the attachment of the muscles to the cuticula.

(*b*) The multicolorous type of color pattern is the least specialized; the unicolorous type having dark color is the most specialized, and the unicolorous yellow type is the most primitive of color pattern in Coleoptera.

(*c*) The pigment is situated in a secondary cuticular layer external to the primary cuticula which is unpigmented.

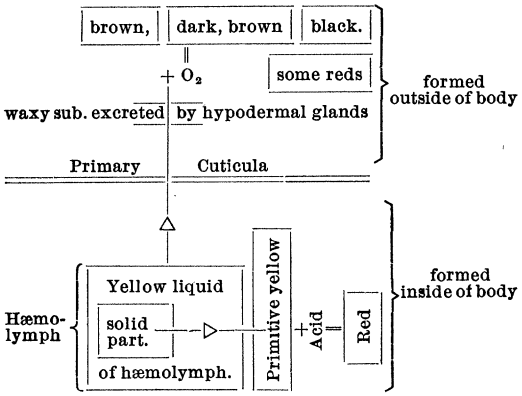
(*d*) The pigment is derived from the hæmolymph of the pupa. The dark pigments, black, brown and some reds are derived from the oxidation of a substance, elaborated from the more liquid part of the hæmolymph by the hypodermal gland cells. Yellow is due to the precipitation of the solid parts of the hæmolymph among the hypodermal cells.

(*e*) Yellow and red are the neutral or alkaline, and the acid modification of the same substance. This substance I believe to be like litmus in its reaction to acid and alkali.

Yellow is the more primitive color, while red is the acid differential of the yellow pigment. Acid may come from acid formed by metabolism (uric acid) or secreted by special cells.

Brown, dark brown and black are due to the oxidation of the yellow waxy pigment.

I may express the relation of these pigments in the following diagram :



Notes on mammalian embryology: CHARLES S. MINOT.

The author exhibited drawings, wood engravings made in Germany, and lantern slides illustrating the development of the pig. The work has been done in connection with the preparation of an 'Introduction to Embryology' for the use of students, intended for practical work. It is proposed to study a few of the most typical stages in a series of carefully selected typical sections, and to connect the descriptions of these sections with explanations of the relations of the embryonic organs to the adult anatomy on the one hand, and to the germ layers on the other. The principal engravings are being made by Probst in Brunswick, the author believing that the German method of wood engraving is better adapted to the representation of sections of embryos than are either the 'process' methods, or the American style of wood engraving.

On the spermatogenesis of Peripatus: THOS. H. MONTGOMERY, JR.

The spermatogenesis of *Peripatus balfouri* Sedg. is interesting, first, because it has essentially the type of that of Insects (as distinct from that of Crustacea as known for the Copepoda), and second, because the character of its cells is very favorable for the determination of the stages which occur in the synapsis stage (an anaphase of the last spermatogonic division). The reduction of the number of chromosomes (from 28 to 14) takes place in the early synapsis by a fusion end to end of every two chromosomes, those ends of the chromosomes joining together which are situated nearest that point of the cell where the centrosomes lie. Each resulting bivalent chromosome has the form of a U or V, whereby the bend or angle of the U or V is the point of union of two univalent chromosomes; this point of union is effected by a band of linin which appears to be a remnant of that continuous linin spirem thread present in the preceding prophase of the spermatogonic division. Later the two arms of each bivalent chromosome become longitudinally split. The chromosomes appear to preserve their separateness (individuality) during the following rest stage. In the first spermatocytic division each bivalent chromosome becomes transversely split (through the linin band joining its two component univalent chromosomes); in the second spermatocytic division each (now univalent) chromosome becomes longitudinally split. This account serves merely as a brief preliminary note to observations which will be soon published *in extenso.*

Palæmonetes and salinity; an experimental study in evolution: ROSWELL H. JOHNSON and ROBERT W. HALL.

A common shrimp on our Atlantic coast, *Palæmonetes vulgaris,* is provided with small spines on the beak or rostrum. These