äusserem Epithel einfach als Ectoderm aufzufassen sei, eine Ansicht, welcher ich mich vollständig anschliesse.

Heidelberg, 30. Juli 1879.

3. On early stages in the embryology of Limax campestris[1]).

By Edw. L. Mark, Cambridge, Mass., U.S.A.

Some of the results of studies on the early stages of *Limax*, pursued during April and May 1877 and continued in August and September 1878, may be briefly summarized as follows:

1) In the earliest stage which has been studied, — soon after the egg is laid, — the germinative vesicle has been metamorphosed into a centrally situated spindle with stellate figures centering at each pole (Archiamphiaster Whitman).

2) The fibres of this spindle (first maturation spindle) are not at this time easily distinguished from the other radiating lines of the amphiaster.

3) The rays of the two stellate figures are very numerous, not granular, and merge at their central ends into a small, ill-defined, homogeneous sphere (»area«). The diameter of each stellate figure is about one third that of the yolk.

4) The first maturation spindle assumes a radial position, its fibres become more conspicuous than the rays of the stellate figures, and a prominent zone of fibre-thickenings (Kernplatte) appears at the equator. The outline of the superficial aster is more sharply marked than that of the deeper figure.

5) The spindle moves outward along the radius which it occupies, the external aster thus causing a low broad elevation of the yolk surface, and becoming itself somewhat flattened. The poles of the spindle (especially the external) become differentiated into a highly refractive, homogeneous, oval body of considerable size.

6) The spindle continues to move outward until its external pole comes very close to the surface of the yolk. The equatorial zone of fibre-thickenings meantime divides into two lateral zones which move rapidly toward the poles of the spindle, leaving interzonal fibres between them.

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1) The following preliminary account was written early in January 1879 for the Zoologischer Anzeiger, but owing to the author's inability to state where the paper on which it is based would appear, it has been withheld until the present.

The plates are now under way and the paper will appear at an early date in the Bull. of the Museum of Comparative Zoology, Cambridge, or in the Proceedings of the American Academy of Arts and Sciences.

7) The constriction which results in the formation of the first polar globule is completed in 5 or 10 minutes. It passes midway between the two lateral zones and is accompanied (always?) with the formation of a highly refractive disklike structure (Zellplatte Strasburger).

8) The thickenings of the external zone are grouped in a single plane near the centre of the polar globule; those of the internal zone lie at the surface of the large, homogeneous sphere which occupies the centre of the deeper aster. Both stain deeply in carmine.

9) In optical cross-sections of the spindle it is seen that the fibre-thickenings of both equatorial and lateral zones are neither distributed evenly over the circular area of the spindle, nor yet in strictly peripheral position. There is, however, an unmistakable grouping of the thickenings near the circumference of the spindle.

10) The rays of the peripheral aster, modified in their direction, are still to be traced when the polar globule is nearly detached, but ultimately all disappear.

11) After the formation of the first polar globule the deeper aster recedes from the animal pole, and there arises, in a manner not yet discovered, a second archiamphiaster of two complete spherical asters, one of which (the external) is more sharply defined than the other.

12) The second polar globule is formed from the external aster and corresponding half of the second maturation spindle in substantially the same manner as the first polar globule, about an hour after the appearance of the first globule.

13) The polar globules are cells, and their nuclei are formed from the external zone of nuclear fibre-thickenings.

14) During the formation of the polar globules the internal aster sometimes presents a peculiar and, I believe, hitherto unobserved appearance. The radiate filaments in passing from the internal pole of the maturation spindle to near the surface of the yolk, make a grand spiral sweep.

15) This spiral arrangement is in some cases very pronounced, many of the rays traversing upward of 400°; in other cases it is only feebly expressed. The spiral may be either dextral or sinistral. The same phenomenon, though less extensive, has also been seen in the polar globule, or external aster.

16) The rays of the internal aster gradually disappear after the formation of the second polar globule.

17) The fibre-thickenings which constitute the internal zone in the second maturation spindle unite to form the female pronucleus, which is at first small and homogeneous, but soon enlarges and exhibits nucleoli. The female pronucleus is therefore formed in a manner

quite different from that which Bütschli describes for *Limnaeus*. The relation of the female pronucleus to the internal aster is also not the same as is so generally given (e. g. by Hertwig for *Asteracanthion*), in as much as it very late or never comes to occupy the centre of that radiate structure.

18) The male pronucleus appears, usually in the vegetative hemisphere of the vitellus, as a spheroidal structure, and makes its way toward the female pronucleus, near the animal pole. It exhibits an increase in size proportionate to the growth of the female pronucleus, from which it does not differ in any constant manner, save that of position.

19) The male pronucleus does not normally produce in any part of its course, at least with the employment of acetic or osmic acids, any trace of a radiate arrangement in the surrounding protoplasm.

20) Abnormal fecundation, by the entrance of a number of spermatozoa into a single vitellus, has come under observation in one instance.

21) These abnormal male pronuclei induce a stellate arrangement in the protoplasm of the vitellus in their vicinity. Six such stellate figures more or less remote from the female pronucleus, and one or two in close proximity to it, were observed in this case.

22) Both male and female pronucleus (of more than half their ultimate size), often appear with their more pointed ends, directed toward the centre of a faint stellate figure (the interal aster of the second archiamphiaster), which lies intermediate between the two.

23) The pronuclei come into contact very near the surface at the animal pole of the egg. They attain each the size of nearly $^1/_3$ the diameter of the vitellus before uniting, and contain a large number (upward of 50) of nearly spherical nucleolar bodies.

24) The stellate figures of the first cleavage-amphiaster make their appearance before the fusion of the pronuclei; they do not always centre in or near the plane of contact between the pronuclei, but may, one or both, take origin near the surface of only one (which?) of the pronuclei. One of these stellate figures may appear before any trace of the other can be detected.

25) The fusion of the pronuclei and the metamorphosis of the resultant primary cleavage-nucleus into a spindle are, in *Limax*, synchronous events.

26) The central »areas« of the primary cleavage-amphiaster embrace granular differentiations, and the rays of the same show zones of thickenings concentric with the central areas, before the formation of the nuclear disk (Kernplatte).

27) Traces of the primary cleavage-nucleus are still visible between the animal pole and the spindle when the primary cleavage-spindle possesses a nuclear disk.

28) The formation of the nuclear disk is followed by its division into two lateral halves which move toward the spindle poles, and this is quickly followed by the constriction of the yolk, which is first indented at the animal pole.

29) When the depression from the animal pole has reached the interzonal fibres of the spindle, the latter are pushed before the advancing constriction and made to assume a bent direction between the incipient secondary nuclei.

30) The further constriction is accompanied by the formation of thickenings in the interzonal fibres (Zellplatte), traces of which may also be seen in subsequent segmentations.

31) The fibres of the spindles are much more numerous than in most of the hitherto studied cases. The rays of all the asters are very numerous, and are the result of a differentiation in the refractive power of different portions of the clear protoplasm of the yolk. In as much as the yolk-granules are made to assume a like radial arrangement, the radiate figure appears to be composed of granular rays whenever the treatment (with chromic or osmic acid) is such as to make these granules conspicuous.

Cambridge, U. S. A., July 10, 1879.

4. Die periodische Häutung der Amphibien und Reptilien.

Von Dr. Friedrich Knauer in Wien.

Unschwer kann man sich überzeugen, dass der Hautwechsel bei Lurchen und Kriechthieren durchaus kein nebensächlicher Act ihrer Lebensthätigkeit, vielmehr ein ganz unerlässlicher Vorgang im Lebensprocesse dieser Thiere sei, einerlei, ob nun Verhinderung der Häutung die Ursache des bald eintretenden Todes oder die Consequenz vorhergegangener Störung der eigentlichen Lebensthätigkeit ist. Vorbehaltlich eingehenderer Mittheilungen über diesen Häutungsprocess, die ich zu veröffentlichen gedenke, sowie ich über einige Species noch ausstehende Daten gesammelt, will ich an dieser Stelle nur einige Angaben über die Periodicität der Häutung bei einigen heimischen Lurchen und Kriechthieren geben.

Zunächst möge eine Tabelle beifolgen, welcher in den Monaten Februar—Juli l. J. gemachte Beobachtungen zu Grunde liegen, die durchweg an möglichst gut untergebrachten, genügend gefütterten und seit mehreren Jahren in Gefangenschaft befindlichen Thieren gemacht wurden.