out and take no further part in subsequent divisions. The spindles that form after this time are very small and resemble the central spindle described by R. Hertwig for other echinoderm-eggs. The experiment shows that the additional sodium chloride added to the sea water acts as a stimulus on the nucleus, starting in it a series of changes leading to a division and separation of the chromosomes. The effect lasts through a long series of subsequent divisions. The artificial asters, as long as present, seem to act as centers towards which the chromosomes move. The rays of the astrospheres that come in contact with the chromosomes change their structure in very much the same way as do the rays that form the spindle in the ordinary karyokinetic figure.

Centrosome and Sphere in the Fertilized Egg of Unio. F. R. LILLIE.

STARTING with the typical structure of the aster in the metaphase of either maturation spindle, viz.: A small centrosome with the radiations inserted in it, and surrounded by inner and outer strata of microsomes forming inner and outer spheres, it was shown that by fusion of the stratum of microsomes bounding the inner sphere and by peripheral accumulation of its ground substance, the inner sphere is converted into a vesicle during the anaphase and telephase of both maturation divisions. This vesicle is now the central area of attachment of the radiations; and the centrosome proper is attached to the wall of the sphere by fibers, which are not part of the general system of radiations.

It was shown further that the central spindle of the second maturation division is formed within the inner sphere, and that during the prophase the centrosomes increase greatly in size and *fragment* into a number of *centrosome granules*, one of which remains as the centrosomes of the later stages (mother-star and later), while the others form in part the stratum of microsomes bounding the inner sphere, and in part become resolved into the ground substance of the inner sphere.

Combining these results with those announced before the Society in the winter of 1896 (SCIENCE, V., 114, March 5, 1897), the study of the maturation and fertilization of the egg of *Unio* was stated to offer the following evidence against the theory of the permanence and uniqueness of the centrosome:

1. A sperm amphiaster is formed, but it disappears utterly at the time of the metaphase of the first maturation spindle.

2. Entirely independently of the sperm and egg asters, there arises in the egg of *Unio* at the time of the metaphase of the second maturation spindle an accessory aster, in the center of which is a minute centrosome. This centrosome divides and a small amphiaster is formed, which entirely disappears at the beginning of the telephase.

3. After the formation of the second polar globule the egg centrosome goes the way of its kind (*i. e.*, disappears).

4. The two cleavage centrosomes arise independently of any of their predecessors, and apparently separately.

5. Fission products of the centrosomes become cytomicrosomes.

Thus the egg of *Unio* furnishes evidence, in the first place, that the centrosomes are not genetically continuous; in the second place, that a centrosome may arise *de novo* (accessory aster); and, in the third place, that products of division of the centrosome may become other formed elements of the cell.

A somewhat fuller statement is to appear in the *Zoological Bulletin*

The Fertilization of the Egg of Molgula Manhattensis. H. E. CRAMPTON, JR.

Upon deposition, a series of changes is inaugurated leading to the formation, entirely from the germinal vesicle, of a barrel-shaped maturation spindle. *This spindle is devoid*, as far as can be ascertained, *of centrosomes, asters, centrospheres*, etc., at both ends. The spindle moves as a whole to the periphery, the sixteen chromosomes divide, the daughter chromosomes diverge to the head of the barrel, and the first polar body is extruded. The spindle fibers withdraw from the chromosomes and condense at the middle of the extent, forming a dense Zwischenkörper. A second maturation spindle is formed, a counterpart of the first, except that eight chromosomes pass into the second polar body, while eight remain in the egg. A vesicular nucleus is formed by these latter. The polar bodies arise at the area destined to be the vegetative pole.

The sperm enters at or near the future animal pole. The sperm-head is preceded by a double centrosome, surrounded by a distinct aster. The centrosomes diverge, as they progress inwards, each surrounded by an aster, but without any fibers passing between them comparable to the 'central spindle' of the annelid, mollusk and other types. After the asters have taken up their positions for the future cleavage-figure the now vesicular sperm-nucleus and the egg-nucleus take up their positions side by side midway between the asters.

A *barrel-shaped spindle*, precisely similar to that of the maturation stages, is formed *entirely from the segmentation nucleus*. The presence of an aster and a double centrosome at either end of the figure gives the appearance of a continuous spindle passing from center to center. Such, however, is not the case. After division of the chromosomes the daughter products diverge only to the heads of the barrel, not one-half the distance to the centrosome. There they become vesicular and ultimately fuse, while the spindle-fibers withdraw from them to form a 'Zwischenkörper,' as in the maturation stages. Only then does the cell divide. And only after the formation of the vesicular daughter-nucleus do the two centrosomes in each cell move apart. When they do, the daughter-nucleus moves up between them, and the series is repeated. A comparative independence, then, of the processes undergone by the nucleus on the one hand, and the centrosomes and asters on the other, is indicated.

The Asters in Fertilization and Cleavage. E. G. Conklin.

In *Crepidula* and several other genera of marine gasteropods there is a well-marked centrosome and sphere in both polar spindles. In the metaphase this centrosome is a single densely-staining body; in the anaphase it greatly enlarges, and the center of the body does not stain; in the telephase it becomes a large sphere with an extremely thin surface layer, containing a large number of coarse granules. During the metamorphosis the centrosome has changed its staining reactions; in the prophase and metaphase it takes only nuclear stains; in the telephase it takes only plasma stains, while in the anaphase it takes both.

Though the spermatozoon frequently enters before the first polar body is formed no sperm aster appears until the metaphase of the second polar spindle. This aster is large and conspicuous, though not as large as the aster of the second polar spindle which remains in the egg; it frequently contains several dark-staining granules. At the same time one or more accessory asters appear in the egg; these are much smaller than either the egg or sperm aster, and no centrosome could be found in them. The sperm and egg asters become very large and have the same structure and staining reactions, the radiatio nsfrom them proceeding for some distance through