OOGENESIS OF CAMPELOMA RUFUM, A PARTHENOGENETIC SNAIL.¹

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With 30 figures in the text.

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It has been previously shown (Van Cleave and Altringer, 1937) that males are wholly lacking in Campeloma rufum. The present writer undertook a series of investigations to determine the details of the reproductive process in this species. Since protandry and hermaphroditism are so commonly found in the Mollusca, the writer was at first inclined to believe that functional male gonads might occur in the snail at restricted seasons of the year. A study of the morphology of the reproductive and excretory systems (Mattox 1938, in press) has given absolute proof that male germ cells are wholly lacking at all seasons of the year. A study of the ovary and eggs in Campeloma rufum was therefore undertaken to determine the cytological details of oogenesis. This problem has particular significance since no other instance of parthenogenetic reproduction has been satisfactorily demonstrated for any mollusc except Hydrobia jenkinsi (Rhein 1935).

Little is known of the intimate details of the reproductive process in members of the family Viviparidae. Leydig (1850) briefly described the egg of Viviparus (=Paludina) viviparus and Popoff (1907) working on the same species outlined the development of the ova. Later Ankel (1925) presented a much more critical study of the egg of V. viviparus and the process of fertilization in that species. Fragmentary information on other members of this family has been recorded by Annandale and Sewell (1921) for V. bengalensis and by Alonso (1930) for V. angularis. For the characteristic North American genus Campeloma there is no detailed information on the germ cells available for any of the numerous species.

Nearly 2,000 individuals, of which 700 have been critically examined, have been studied over a period of four years. These individuals, most of which came from the Salt Fork River near Homer, Illinois, were taken at all seasons of the year.

In this study Bouins picric-acetic-formalin fixative, an alcohol-formalin-acetic acid solution (86 parts 70% alcohol, 10 parts 40% formalin and 5 parts glacial acetic

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acids) and Flemmings chromic-acetic-osmium fixative were employed. The stains most extensively used were HEIDENHAIN's Iron Haematoxylin, DELAFIELD's Haematoxylin and Safranin with counterstains of Orange G, Eosin and Light-green. Dioxane was used to replace the alcohol-benzol series for dehydration, and found to give satisfactory results.

**Ovarian Cells.**

The ovary of *C. rufum*, as previously described by the writer (1938), is a small, indistinct, tube-like organ lying on the columellar surface of the digestive gland. The basal cells, ANCEL's layer, make up a fibrous layer which supports the indifferent germinal epithelium. GARNALD (1889) found the germ cells of *Helix* arising from indifferent epithelium as did ANCEL (1903) for *H. pomatia*. ANCEL showed that the oogonia, spermatagonia, nurse cells are supported by the fibrous layer which GATENBY (1917) refers to as ANCEL's layer. CRABB (1927) likewise found the oogonia, spermatagonia, nurse cells and Sertoli cells of *Lymnaea stagnalis appressa* all arising from this indifferent epithelium. GATENBY (1922) states that the impulse for the transformation of the indifferent epithelial cells into the germ cells is not definitely known; that nutritive conditions are probably not the real causal factors, and that the age and state of maturity probably govern the maturation of the germ cells of snails more than any other factor. In the uterine embryo of *C. rufum* the germ cells are undifferentiated and, as previously mentioned (MATTOX 1938) arise as proliferations of the pericardium. When *C. rufum* reaches a size of from between 9 and 10 mm. the germ cells begin proliferation from the indifferent epithelium. The nurse cells (Fig. 6) also arise from this same epithelium. The terminology used in this discussion is that of SHARP (1934).

**Oogonia.**

The oogonia (Fig. 1), when first distinguishable as such, are about 10 microns in diameter. The nuclei of these cells are reticulated and in an interphase with a single nucleolus and a loose network of chromatin. Following this stage there is a period of slight growth and formation of a fine spireme network (Figs. 2, 3) in the nucleus. The network becomes visibly segmented with the disappearance of the nucleolus to form a pachytene stage (Fig. 4). Each segment presents a dense, basophilic chromatic appearance with numerous small remnants of the spireme network appearing as irregular points on these early chromosomes. The chromosomes (Fig. 5) contract further and take on a crescentic shape near the center of the cell, the nuclear membrane disappearing. Few studies of the development of the primary oocytes from the oogonia have

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