Notes on the Shell Structure of the Oyster, *Gryphaea (Ostrea) gigas* from the Akkeshi Lake[1)]

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(*With 2 Text-figures*)

The shell of the oyster is composed of the following several elements; periostracum, prismatic layer, subnacreous layer, hypostracum, conchyolin sheets and chakly deposits. This is a report on observations on the structure of shell, particularly on subnacreous layer and chalky deposits. These two elements constitute the main part of the shell and the remnant seems to be incidental.

The appearance of the chalky deposits varies widely from one oyster to other. It can, however, be pointed out generally that the most plentiful deposits occur on the parts just posterior to the muscle scar (opposite the exhalent chamber) and on the deepest part of the shell-curvature (opposite the labial palps) as observed by Orton, Korringa and others. Figure 1 shows schematically the loci where most plentiful chalky deposits are observed. Chalky deposits are laid down in the summer and are covered later with hard subnacreous layer. But in some cases it is certain that hard layers are deposited with some intervals throughout the deposition of chalky substance in the summer season. As a matter of fact, when observed the cross-section of the shell, it can be seen the presence of several thin hard layers intervening a voluminous chalky deposits. In other words, a thick layer of chalky deposits is separated into several sub-layers by thin hard layers. Chalky deposits and subnacreous layers form so clear stratification in the cross-section of the shell that one would attempt to estimate the age of the oyster in counting the number of chalky layers. In fact Bjerkan attempted to count it in this method. On this point Korringa (1951) reported as, ".... even if we assume with Bjerkan that one chalky layer is produced each year (and never two or none, which remains to be demonstrated), we should remember that deposition of chalky layers beyond the muscle scar only starts at an age 3 to 4 years, and not at the same age in different oysters and in different oyster districts" and that Bjerkan's method is only the best to estimate the age of an old oyster. For *Gryphaea gigas* from the Akkeshi Lake, however, the estimation of age by counting the number of chalky layers seems to be not suitable, since the

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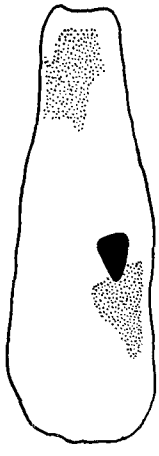

Fig. 1. Schematic sketch of the interior surface of a right valve, showing muscle scar and chalky deposits.

chalky layer is frequently composed of several sub-layers, by the insertion of hard layers as menitoned above, and sometimes it can hardly distinguish two kinds of subnacreous layers.

In the review of oyster biology Korringa (1952) summarized the results of Orton, Ranson, Medcof, Nelson and his own on the biological significance of the chalky deposits as follows, "the chalky deposits are used in smoothing out the shell's interior surface, that they help to maintain certain topographical features of the shell interior, preserve a size relationship between meats and shell cavity and regulate the curvature of the inner face of the shell throughout the oyster's life." The smoothing out of the interior surface of the shell may also provide facilities for the oyster's function since the mantle would be closely attached to the interior surface of the shell. The author agrees entirely with this opinion for the significance of chalky deposits throughout the oyster's life.

In the midsummer in oysters from the Akkeshi Lake a jelly-like substance is very often observed to be present on the interior surface of the shell. It is covered frequently with a very thin layer of hard subnacreous substance, which is easily broken with a slight mechanical force as a light touch of one's finger tip (Fig. 2 a, b.). Different from the chalky deposits the jelly covers wider area of the interior surface of the shell. In many cases the whole interior surface from hinge to posterior edge is covered with jelly deposits.

Several investigators such as Houlbert and Galaine (1916), Orton (1937), Orton and Worsnop (1923), Korringa (1952), who observed the cross-section of the oyster shell, noticed that many oyster shells include chambers filled with sea water or muddy substance. They explained the cause of the formation of these chambers as Orton stated "chambering appears to be due entirely to shrinkage of the body with subsequent automatic secretion of nacreous material by the surface of the shrunken body, destined normally for thickening the shell." And they assumed that the shrinkage of the body is attributable to a rapid rise in salinity or ample spawning. On the other hand, the present author is of the opinion that the formation of chambers is partially due to the deposition of the jelly-like substance. Owing to the shrinkage of the body, there is firstly formed a space between the mantle and the interior surface of shell, and subsequently the jelly-like substance will possibly be deposited there. And then the hard subnacreous layer is secreted over it. Actually, one can frequently confirm the existence of jelly in old chambers laying considerablly distant parts from the interior surface of the shell. Needless to say most old chambers are filled with sea water or bottom

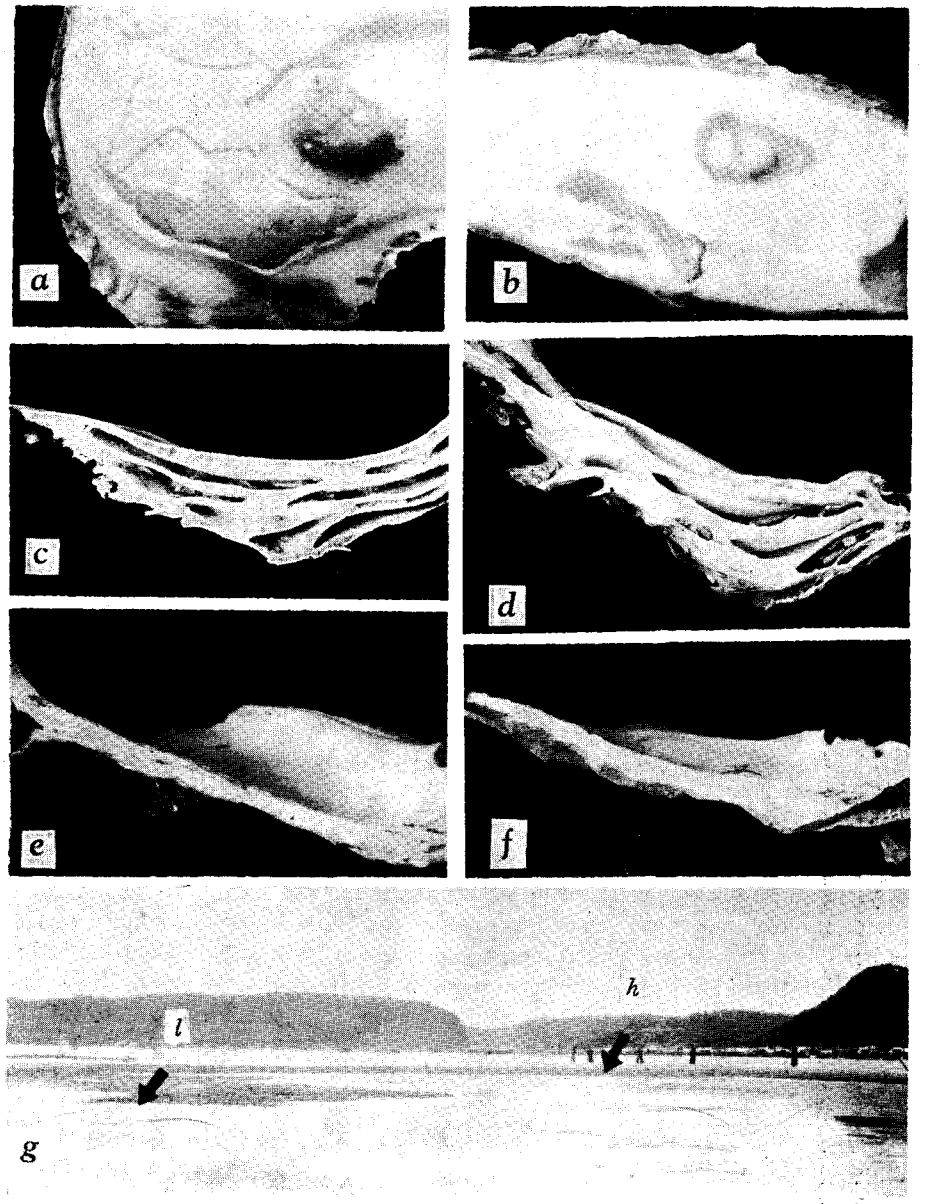

Fig. 2. a, b, showing the condition after breaking of the thin hard layer which covers the jelly-deposits. c, d, sections of shells of the oysters from the station *l*. e, f, sections of oyster-shells from the station *h*. g, oyster-beds in the Akkeshi Lake at the ebb tide.

mud. It is surmised that the peripheral part of the shell becomes accidentally connected with the outer side and then the jelly-like substance was flown out from the chamber which has been again replaced by the sea water or mud.

According to Korringa (1952), the following investigators ; Medcof (1944), Galtsoff and his co-workers (1947) are coincided with each other that the extensive chalky deposits are observed in poor pysters. In specimens from the Akkeshi Lake, the present author observed the quite diverse fact. Two groups of the oysters from two different stations were investigated, one group from the oyster-bed of high-level (Station *h*, see Figure 2, g) and the other from low-level (Station *l*), and Station *h* exposed at median ebb tide, with hard sandy ground including small fragments of shells, and Station *l* exposed at the lowest ebb tide, with soft muddy ground, these two stations beeing distant about 60 meters. The oysters from Station *l* show good shell-growth and are economically valuable. On the contrary, the oysters from Station *h* show very poor growth of shell and are economically less valuable. When examined the shell-structure of the two groups of oysters the remarkable difference could be easily recognized. The results of the investigation on 30 oysters from each station showed that in the group from Station *l* all the shells have copious chalky deposits and prosperous jelly deposits or many large chambers with the exception of 4 oysters having no chambers in both valves, while the oysters from Station *h* have very scanty chalky deposits and no jelly or chamber at all. In Figure 2 (c, d, e, f) are shown some of the shells from these two stations.

Summary

(1) The shell-structure of *Gryphaea gigas* has been studies. The jelly-like substance found deposited on the interior surface of the shell in many oysters seems to partially cause the formation of chambers in the oyster shells.

(2) Oysters showing the good shell-growth have much chalky deposits and jelly-deposits or chambers, while poor oysters have scanty chalky deposits and no jelly or chamber at all.

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