

Age-determination by winter rings

by

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According to the remarks by E. FRÖMMING in the preceding article age determination by means of winter rings is not possible, or — to say the least — highly subjective. He there criticizes the views which I had brought forward in my paper "Groeï en oudenom bij *Viviparus costectus* (Millet, 1813) en *Viviparus viviparus* (Linné, 1758)" (VAN DER SPOEL, 1958), and, although being very much obliged for this criticism, I am afraid I cannot agree with him in all points.

Firstly, the "Wachstumsabsätze" are indeed identical with my winter rings and with my intermediate rings; both are stagnations in growth. Secondly the cessation of the taking in of food cannot be the only cause of a ring, because *Viviparus* at times enlarges its shell very rapidly by extending only the outer layer of its shell, building up the lower layers at a later stage. The ring appears only, and this happened also in my breeding experiments, where the outer layer ends, independently of the moment when the ingestion ceased. It is, moreover, very difficult to ascertain just when the feeding stops, as this can take place also through the gills (P. M. COOK, 1949).

According to FRÖMMING the colour-bands do not show the "stop" in every animal, and hence the pigment-glands would have continued to work until the period of rest. This seems to me most improbable and I do not believe it occurs, the more so as an interruption which may be invisible from the outside is quite distinct at the inside and can reach there a width of 2 mm. This is never so in intermediate rings. I know a few cases where only a narrowing of the bands may be noticed in the winter rings. It would therefore have been better if I had said that the activity of the pigment-glands diminishes at the approach of the wintering period.

Against the first point (p. 78 of my article) FRÖMMING raises the objection that the intervals are not regular. The existence of irregularities I had already indicated on the same page, and explained their causes. For clarity's sake I shall here discuss the photographs from FRÖMMING (1956). For lack of space I cannot discuss the illustrations in FRÖMMING (1953) and, besides, they are not sufficiently clear.

Photograph No. 87, p. 254 (1956) shows that the rings lie at regular intervals of one complete whorl (the ring on the left of the lowest whorl is probably an intermediate ring). No. 89, p. 260, the animal on the left, shows two rings close together. Either these belong to one winter, or one is an intermediate ring and the other a winter ring, for the colour-bands do not continue between the rings. It is, therefore, again not necessary to see an irregularity here. No. 90, p. 263 shows in the centre a shell with, on the lowest whorl, two "year rings". These, however, belong to one winter as can be seen from the colour-bands. Above this "one" winter ring lies the last but one, and again above that the previous one. This animal in the centre is about to form a winter ring at the aperture. The animal on the right appears indeed to be slightly irregular, as only a rather small section was added during the last summerperiod (between the winter rings to be assigned to two winters, which appear as nine rings altogether). Growth diminishes, however, with increasing age (VAN DER SPOEL, 1958, graph 2a). Thus we see that the shell also shows regular placing of winter rings. From the photograph nothing can be said of the shell on the left. No. 91, p. 265 shows no colour-bands, so that I can do no more than assuming that the animal on the left is three or four, the one on the right four or five years old.

The second point has already been defended.

As far as the third point is concerned it must be emphasized that winter and spring need not be precise moments in time, but only indicate the beginning of a year. (All the material was collected in the Netherlands.) The meteorological phenomena, such as temperature, light intensity, etc., appearing each year, during winter and spring, make it possible to count the years with the aid of the mark left on the shell by such phenomena. If no winter ring borders the aperture in the winter or in the spring, this means that the shell grew during the winter, without an interruption, so that the wintering period generally accepted for *Viviparus*, has not taken place. This fact and my own observations oblige me to call the exceptions to point 3 sporadic.

In point 4 my opinion was not that only one intermediate ring precedes the winter ring, but that in any case an intermediate ring is formed before the winter ring.

I also wish to point out once more that the pattern of concentric rings on the operculum was used by me only when the corresponding pattern was no longer visible on the shell, and that it was never considered an exact indication of winter rings.

One characteristic of winter rings, on which I laid no emphasis because I was not yet in a position to use it in my investigation, but which came out clearly in the graphs, is the fact that the whorls bulge out before the winter ring, and only there (VAN DER SPOEL, 1958, p. 85).

FRÖMMING justly points out that the animals are born only in the course of the year.

Finally I wish to bring forward a most important fact from my article, not mentioned by FRÖMMING. It would not be strictly proved that the growing rings counted by me are indeed winter rings, had not the graphs 1a and 1b together with 2a and 2b made this evident (VAN DER SPOEL, 1958, p. 80). This correlation is, however, indisputable.

The winter rings, therefore, remain of value in the determination of age in the genus *Viviparus* provided the important distinction between intermediate and winter rings is made. For other genera in the group Gastropoda I do in no way make this contention, but there also the size of the shell must not be taken as the sole criterion of age. This size is usually smaller in animals with more stagnations in growth (sometimes considered year rings) than in animals of the same age with fewer of these.

LITERATURE

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