Triploid Nauplii of *Calanus finmarchicus*

While examining the chromosomes of developing eggs of *Calanus finmarchicus*, it was noticed that on two occasions a proportion of the eggs of a clutch were triploid with 51 chromosomes, the haploid number being 17. It has been observed also that clutches of eggs of *Calanus finmarchicus* are occasionally seen in which one (rarely more) of the eggs is much larger than sister eggs of normal size. In order to find out whether these large eggs are triploid, one just about to undergo the fourth cleavage was fixed in acetic alcohol immediately the nuclear membranes disappeared, and a squash was made with aceto-carmine. The chromosomes were rather faintly stained; but in one of the divisions, as shown in Fig. 1, 102 chromosomes could be counted in anaphase, 51 on each side.

Most of the outsize eggs developed with their smaller fellows up to about the gastrula stage quite normally, but as a rule they did not hatch with the rest and died later. Up to at least the anaphase of the third cleavage, however, the triploids divided synchronously with their diploid sisters. On a very few occasions the large eggs have actually hatched into nauplii correspondingly large in size. One of these appeared to be quite normal except for its gigantism, but in an attempt to rear it further this specimen was lost. A second specimen which hatched (Fig. 4) was a monster with an abnormal first antenna and the second antenna and mandible united on one side. A normal nauplius is shown in Fig. 5 drawn to the same scale for comparison.

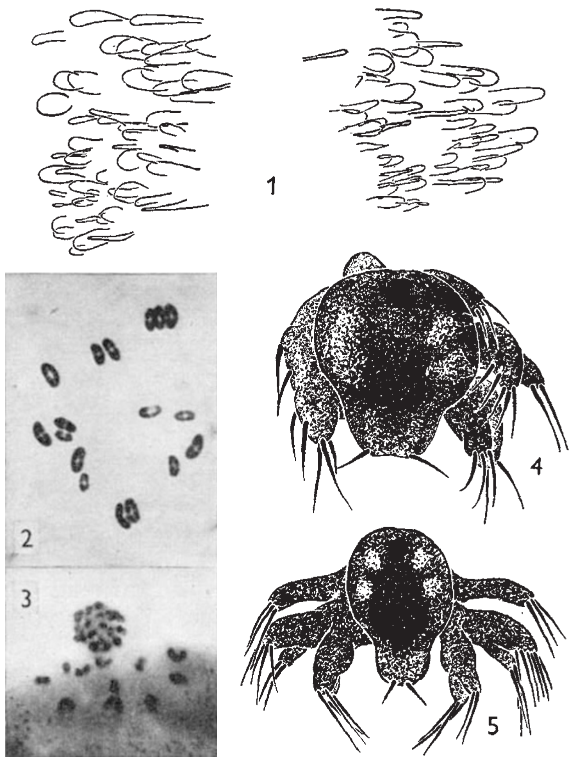

Fig. 1. Fourth cleavage of triploid nauplius showing 51 chromosomes on each side at anaphase. × 530

Fig. 2. Metaphase I from a normal egg immediately after laying, showing 17 bivalents. × 670

Fig. 3. First polar body formation, 5 min. after the egg was laid. × 670

Fig. 4. Triploid nauplius soon after hatching. × 120

Fig. 5. Normal nauplius. × 120

All figures from preparations preserved in the British Museum (Natural History)

There are several ways in which a triploid embryo may arise; but most of them are ruled out here. That large size is often associated with a polyploidy is well known; but in this example the large size of the egg at the time it is laid indicates that the polyploidy must have arisen earlier than the time of laying. A normal egg is laid when the chromosomes are arranged on the metaphase plate of the first maturation division, 17 bivalents, in the form of rings, being clearly discernible (Fig. 2). It is not until several minutes after the egg is laid that the first polar body is produced (Fig. 3). If polyploidy were due to the union of a haploid ovum with a diploid sperm, or with two haploid sperms, this event would take place too late to account for the large size, and it seems unlikely that the large size would be responsible for polyspermy. One possibility which remains is that the triploid has resulted from the union of a normal, haploid sperm with a diploid egg-cell. The most usual way for diploid egg-cells to arise is by failure of reduction at meiosis; but again this would take place too late to affect the size of the egg. A diploid egg could arise by reduction from a tetraploid oocyte, the tetraploid condition resulting from the division of the chromosomes of one of the oogonia without a corresponding division of the nucleus. This, if it occurred sufficiently early, would account not only for the large size of the eggs, but also for the fact that these do not always occur singly in a clutch of eggs. On this hypothesis we might expect to find 1, 2, 4, 8 or some other power of 2 such eggs in a clutch. From one of the two clutches of eggs in which triploidy was first observed a sample of nineteen eggs was examined cytologically; of these eleven were diploid, four were triploid and four uncountable. From the other abnormal clutch sixteen were examined, two being diploid, two triploid and the rest uncountable. Unfortunately, the sizes of these eggs were not noted. On the rare occasions when large eggs have been noticed, they have usually occurred singly. Once there were four larger than the rest; but three of them were smaller than those usually distinguished as 'large'. This hypothesis might also account for the poor viability of the embryos, for with four identical chromosomes of each of the seventeen types, a regular reduction division to 34 bivalents would be a rare occurrence, as tetravalents and trivalents would be formed as well as bivalents. However, on all occasions on which accurate counts have been made of the anaphase chromosomes of a dividing triploid cell, precisely 51 chromosomes have been counted on each side.

Alternatively, the large egg may be a binucleate one, each nucleus undergoing a normal meiosis in which only bivalents would be formed. A triploid embryo would then result from the fusion of the two haploid egg nuclei with one sperm nucleus.

It might be possible to distinguish between these hypotheses if a large egg could be examined at the stage corresponding to Fig. 2; but these eggs are so rare that we have not yet found one sufficiently soon after it was laid to be able to do this.

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