

There was a marked cyclical change in the sex ratio during the year. In the March collection there were 20 males to 14 females, in June 20 males to 37 females, in September 36 males to 10 females, and in November 12 males to 10 females. This suggests that the males differentiate later than the females but mature more quickly.

MORPHOLOGY OF THE HETERONEREID

Three stages in the metamorphosis of *N. aestuariensis* are illustrated in Plate 1. The process of metamorphosis appeared to be the same as has been described in other Nereids (see reviews by Fauval (1959: 135) and Clark (1961: 201)) and the heteronereid is similar to other three part heteronereids. The anterior section is little modified, the middle section has foliaceous parapodia bearing flattened swimming setae, while the posterior section remains unmodified.

Genital products first appeared in worms from 10 to 12 centimetres long as a small white mass in the ventral part of parapodia in the middle of the body. The eggs or sperms spread into anterior and posterior segments and completely filled the coelom before external morphological changes began. An 18 centimetres long worm at this stage is illustrated in Plate 1, fig. 1.

Plate 1, fig. 2 shows an intermediate stage in which the parapodia have begun to elongate, and the setal lamellae and the lamellae at the bases of the dorsal and ventral cirri are developing. The setae are unchanged. The eyes have begun to enlarge and the colour of the animal has changed with the development of a network of blood-vessels in the bodywall.

The modification of the parapodia spreads anteriorly and posteriorly but in the mature heteronereid (Plate 1, fig. 3) there are from 20 to 26 segments left unchanged anteriorly and from 20 to 60 posteriorly. Mature heteronereids were only 2 to 4.5 centimetres long, while the immature worms had a length of 20 to 25 centimetres. This reduction was due to longitudinal compression, as no segments were lost. The normal setae have been replaced by flattened, paddle-shaped natatory setae. The palps and antennae are now directed ventrally, bringing the much enlarged eyes into an anterodorsal position. The dorsal and ventral cirri of the first seven setigers are enlarged in the usual way, but the males do not have the crenulate dorsal cirri found in many species. This has a bearing on the swarming behaviour, which is discussed below. Male heteronereids are distinguished by the presence on the pygidium of a rosette of hollow papillae through which the sperm is emitted, and by their brighter colour.

The head and the first four or five setigers of male heteronereids are greenish, as in the atokous worms, while the rest of the unmodified segments are pink (red blood-vessels over white sperm) with a conspicuous dorsal blood-vessel. The parapodia of the modified segments are red-orange in colour, due to their extreme vascularisation, but there are few capillaries in the body wall between the bases of the parapodia and the dorsal blood-vessel. This forms a striking pattern with a glistening white stripe between the dorsal blood vessel and the parapodia on each side. The females have the same pattern but the eggs are pale green in colour, so the anterior and posterior regions tend to be pale green and the middle region is not so red as in the male. The difference is sufficient to allow the sexes to be distinguished in the field.

SWARMING PERIODICITY

At maturity the heteronereids swim to the surface where the gametes are released into the water. This aggregation (swarming) increases the concentration of gametes and therefore the efficiency of fertilisation. The swarming of *N. aestuariensis* was found to show a fortnightly or semilunar periodicity.