when they are older. Asynchronous hermaphrodites again have two forms: protandrous form, in which case the fishes first function as males and then as females; protogynous forms, wherein the fishes first function as females and then as males. An interesting characteristic of asynchronous hermaphrodites, whether protandrous or protogynous, is that the juveniles possess both testicular and ovarian tissues.

Hermaphroditism is found in 13 families of fishes belonging to 5 Orders. The majority belongs to the Order Perciformes and Cyprinodontiformes. A few belong to the Order Mycotophiformes. An Alaskan population of the stickleback, *Gasterosteus aculeatus*, also exhibits synchronous hermaphroditism.

Asynchronous hermaphroditism is more prevalent than the other type. Protandrous forms belong to the family Sparidae and the protogynous forms to the Sparidae and Serranidae families. The swamp eel of India, *Monopterus alba*, found in south-east regions of Asia, is an asynchronous hermaphrodite fish belonging to the Order Symbranchiformes. In all families which have hermaphroditic forms, there are bisexual species also.

The extreme case of hermaphroditism is exhibited by the toothed carp *Rivulus marmoratus* of Florida and some of the Caribbean I stand. This fish shows the ultimate in hermaphroditic breeding. Like *Serranus subligerus*, it has testis and ovary which develop at the same time although a few individuals may start and remain as females, while others become males after first acting as hermaphrodites. This toothed carp is unique in the sense that it is able to fertilise itself and apparently does so in nature. The offsprings are genetically identical to each other and to their single parent which has been proved by grafting experiments, for there is no rejection of the transplanted tissue.

The physiological and genetic bases of sexuality in hermaphrodites are not clearly understood. Differen' histological patterns of gonadal development have been described. The process seems to be an orderly transition from one gonadal type to another. There is evidence, however, that sex transformation in asynchronous forms may not always be completed and also that all individuals of a given species may not inverse sex in sequence. In the asynchronous forms, transition from one sex to the other may be viewed as an ordinary histological differentiation; a decrease in the cell numbers of cells of the other type. An intermediate intersex stage may be presented in some cases.

Genetically, complete selfing is the most intense form of inbreeding. Self-fertilisation would cause reduction in genetic variability within a lineage, by one half in each generation. On the other hand, selfing permits selection of highly adapted genotypes and prevents their breaking up which would normally occur with gene crossing.

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The gordian worms

KNOWN from fourteenth and fifteenth centuries, the gordian worms named after the Gordian knot which they resemble are long, slender, snakelike worms whose life cycle is interesting. They elude our attention as they appear like a piece of wire and suddenly start moving if disturbed.

The gordian worms, popularly known as horse hair worms or hair worms, are long and slender resembling a piece of wire, hence are also known as wire worms. The name horse hair worm comes from a myth that these worms develop out of horse hair that fall into water. The genus name *Gordius* to which they belong originated with Linnaeus, which is derived from the popular "Gordian knot"(A Greek legend says that King Gordius of Phrygia tied a knot (Gordian knot) which according to prophecy will be undone by the future master of Asia. Alexander the Great, failing to untie it, cut it with his sword.) as the worms twist their bodies into complex knots when they are disturbed. These worms were placed in the group Nematoda (thread worms) but were later separated under the name Nematomorpha by Vezdovsky (1886). These interesting organisms are not familiar to those that specialise in their study, although they are considered to be distributed everywhere.

Two gordian worms were collected at 2743 m hight in Tawang valley of Arunachal Pradesh (NEFA). In this area they are known as thread snakes, apparently a misnomer, as they are not snakes but undoubtedly resemble the true thread snakes belonging to the family *Leptotyphlopidae*. The adults are free and the larvae lead a parasitic life on arthropods and reproduce in soil or water. Occasionally they are accidentally swallowed with drinking water and are usually promptly vomited, much to the surprise and horror of the victim.

The adult gordian worms are excessively slender, elongated and wire-like measuring between half to one meter. The colour of the worm is tannish to dark brown. The males are shorter than the females and sometimes dwarf individuals are also found. The worms have nearly uniform diameter throughout their length. The anterior or head end can be recognised by the presence of a white patch at the tip bounded by a dark ring below. This is called 'Calotte'. The mouth is situated in the region of calotte. The posterior end is rounded in the female. In the male it is slightly cleft into two lobes and there is a characteristic crescentic cuticular fold behind the cloacal aperture.

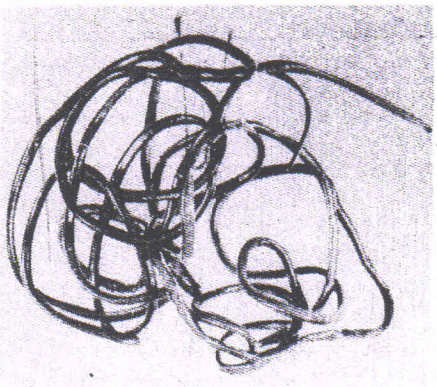

Fig.1 Gordian worms

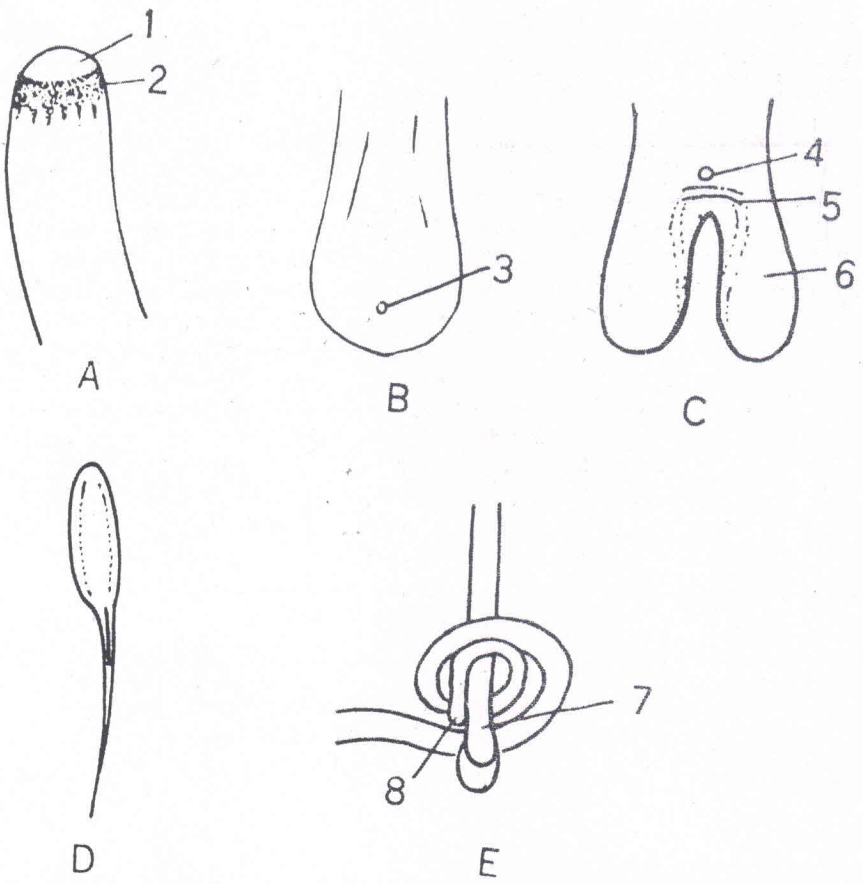

Fig.2. (A) Anterior end of *Gordius* 1.Calotte 2. Pigment Ring; (B) Posterior end of Female *Gordius* 3. Anus; (C) Posterior end of male *Gordius*, 4. Anus, 5. Postanal Crescent, 6 8. Cacudal Lobe; (D) Sperm (E) Gordian worms in copulation, 7. Rear end of Female, Rear end of male

The body is covered by a thick cuticle below which is the epidermis and a muscular layer. The cuticle has an outer homogeneous layer and an inner fibrous layer. The epidermis is single layered, made up of cuboidal or columnar cells. The muscle layer is similar to that of nematodes consisting of longitudinal fibers. The body cavity is a pseudocoel filled with mesenchyme cells and tissue so that only limited spaces remain. The disposition of mesenchyme arround digestive tube and gonads resembles mesenterial arrangement.

Digestive tra.

The digestive tube is more or less degenerate in all nematomorphs in juveniles as well as adults. The juveniles which are parasitic are supposed to extract nourishment through their body surface from their host. In *Gordius* the anterior part of the digestive tube is represented by solid cord of cells. The intestine or middle part is a simple tube, but histologically resembles the malpighian tubules of insects and it is doubtful if it serves any excretory function. The posterior part of the digestive tube receives the genital ducts and forms a cloaca lined with cuticle.

Nervous system and sense organs

The nervous system is primitive, consists of a brain in the form of a cerebral mass in the calotte surrounding the digestive tube. There is a mid-ventral nerve cord. In the region of the brain there are giant nerve cells and perhaps nerve ganglia are absent. There is a nerve thickneing in the region of cloaca.

The epidermis contains a number of sensory cells which act as tangoreceptors. It is presumed that various epidermal structures on the cuticle may also have sensory function. It is also suspected that photosensitive cells are present in the region of calotte.

Reproduction and development

The gonads in both sexes are a pair of cylindrical structures occupying the length of the body. In males each one enters the cloaca through a duct and there are bristle like structures which help during copulation. The spermatozoa are simple, elongated bodies. In the early stages the male and female gonads cannot be distinguished, but in the later stages the ovary puts in numerous lateral diverticulae.

Adult worms move towards water and even swim in water by serpentine movements. Copulation occurs when the posterior ends of a male and female entwine. Eggs are laid in long strings.

After cleavage and development a larva hatches out in water which has got an armed proboscis. The body is divisible into an anterior presoma and trunk. The larva then penetrates into the body of a suitable Arthropod host. In the case of *Gordius* the host is usually an insect like grasshopper, cricket, cockroach, beetle and sometimes a centipede or millipede. The larva can get into such hosts that frequent the edges of aquatic habitats. Infection of the host is caused either by the larva penetrating through the epidermis with the help of its proboscis or by being swallowed by the host along with food.

The larva enters the pseudocoel of an insect and grows into a juvenile. The larval presoma develops into the adult calotte. The ventral nerve cord originates in the ventral epidermis. The larval intestine develops directly into that of the adult and remains blind anteriorly. Two longitudinal strands of cells develop into gonads. Molting takes place discarding their larval characters in the process. The juvenile worms leave the host practically after reaching adult condition, and lead a free life.

Biology and relationships

Males are said to be more active than females. They are capable of

Swimming in water by undulating movements of the body. Experiments revealed that males can sense the presence of females from a distance and can also distinguish virgin and gravid females. The adults do not take food. They lie like a piece of wire or a dry twing usually near water. When disturbed they instantly tangle themselves like animated wire into apparently complex knots, whence their name. When the tow specimens were collected (Fig.1.) they were placed in a glass jar. They tried to come out of the jar by climbing the sides in a serpentine movement. They survived for a few days and died.

For a long time the Nematomorpha were grouped along with Nematodes because of their close resemblance. The nematomorphs also resemble kynorhynchs and priapulids in their nervous system and larval characters. The nemotomorphs are undoubtedly pseudocoelomate organisms and that is why they are included in the phylum Aschelminthes. They are however treated as a class separating them from Nematoda.

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