Course: Biology-IV (6454)
Semester: Autumn, 2021

ASSIGNMENT No. 2

Q.1 Describe how mulluscans are related to other animals? Explain with the help of examples.

Mollusk, also spelled **mollusc**, any soft-bodied invertebrate of the phylum Mollusca, usually wholly or partly enclosed in a calcium carbonate shell secreted by a soft mantle covering the body. Along with the insects and vertebrates, it is one of the most diverse groups in the animal kingdom, with nearly 100,000 (possibly as many as 150,000) described species. Each group includes an ecologically and structurally immense variety of forms: the shell-less Caudofoveata; the narrow-footed gliders (Solenogastres); the serially valved chitons (Placophora or Polyplacophora); the cap-shaped neopilinids (Monoplacophora); the limpets, snails, and slugs (Gastropoda); the clams, mussels, scallops, oysters, shipworms, and cockles (Bivalvia); the tubiform to barrel-shaped tusk shells (Scaphopoda); and the nautiluses, cuttlefishes, squids, and octopuses (Cephalopoda).

Typical molluscan features have been substantially altered, or even lost, in many subgroups. Among the cephalopods the giant squids (Architeuthis), the largest living invertebrates, attain a body length of eight metres (more than 26 feet); with the tentacle arms extended, the total length reaches to 22 metres. Other cephalopods exceed a length of one metre. Many of the remaining molluscan classes show a large variation in size: among bivalves the giant clam (Tridacna) ranges up to 135 centimetres (four feet) and the pen shell (Pinna) from 40 to 80 centimetres; among gastropods the sea hares (Aplysia) grow from 40 to 100 centimetres and the Australian trumpet, or baler (Syrinx), up to 60 centimetres; among placophores the gumshoe, or gumboot chiton (Cryptochiton), achieves a length up to 30 to 43 centimetres; and, among solenogasters, Epimenia reaches a length of 15 to 30 centimetres. Finally, gastropods of the family Entoconchidae, which are parasitic in echinoderm sea cucumbers, may reach a size of almost 1.3 metres. In contrast, there are also minute members, less than one millimetre (0.04 inch) in size, among the solenogasters and gastropods.

The mollusks have adapted to all habitats except air. Although basically marine, bivalves and gastropods include freshwater species. Gastropods have also adapted to land, with thousands of species living a fully terrestrial existence. Found on rocky, sandy, and muddy substrata, mollusks burrow, crawl, become cemented to the surface, or are free-swimming.

Mollusks are found worldwide, but there is a preponderance of some groups in certain areas of the world. The close association of many molluscan groups with their food source—whether by direct dependence on a specific food supply (e.g., plant-eating, or herbivores) or by involvement in food chains—limits their geographic distribution; for example, bivalves of the family Teredinidae (shipworms) are associated with wood. In general, cold-water regions support fewer species.

Mollusks are of general importance within food chains and as members of ecosystems. Certain species are of direct or indirect commercial and even medical importance to humans. Many gastropod species, for example, are necessary intermediate hosts for parasitic flatworms (class Trematoda, phylum Platyhelminthes), such as the species that cause schistosomiasis in humans. Most bivalves contribute to the organic turnover in the intertidal (littoral) zones of marine and fresh water because, as filter feeders, they filter up to 40 litres (10 gallons) of water per hour. This filtering activity, however, may also seriously interfere with the various populations of invertebrate larvae (plankton) found suspended and free-swimming in the water. One species, the zebra mussel (Dreissena polymorpha), is regarded as a particularly harmful exotic invader. Carried from Europe in ship ballast water, zebra mussels were taken to the Great Lakes in 1986. To date, they have caused millions of dollars in commercial damage by clogging the water pipes of power plants and cooling systems. They are driving many native freshwater bivalve species to extinction.

Many gastropods, bivalves, and cephalopods are a source of food for many cultures and therefore play an important role in the fishing industries of many countries. Many shell-bearing molluscan species are also used to fabricate ornaments and are harvested for the pearl and mother-of-pearl industries.

Q.2 How nervous and sensory functions take place in Polychaeta?

The medicinal Polychaeta is a semiaquatic annelid worm that has been an important model organism in many studies in the field of systems neuroscience. As in other annelids, the Polychaeta nervous system consists of a ventral nerve cord comprising the cephalic ganglia (or 'head brain', which includes supra- and subesophageal ganglia) and the segmental ganglia. Additionally, Polychaeta have a prominent ganglion at the caudal end of the nerve cord (the 'tail brain'), the main function of which is thought to be control of the rear sucker. The majority of the neurons of a Polychaeta are located in the segmental ganglia. Each of these 21 nearly identical ganglia contains ∼400 neurons, mostly as bilateral pairs. The cell bodies are organized at the ganglion surface in a shell surrounding a central neutrophil. Conveniently, the geometric arrangement of those neurons is highly stereotyped, allowing the identification of homologous neurons both across ganglia within an individual Polychaeta and across animals. Helpfully for both electrophysiology and imaging, the sonata of most Polychaeta neurons are relatively large (15–70 μm in diameter). These facts, combined with the large repertoire of simple behaviors that Polychaeta possess, have facilitated a remarkable range of studies on the neurons and circuits that underlie specific Polychaeta behaviors.

Accordingly, this Commentary focuses on the use of the Polychaeta as an experimental organism in systems neuroscience and, in particular, on progress in the decade since the appearance of the last major review of Polychaeta systems neuroscience. I discuss recent lessons in circuit function, behavior and the development of the nervous system. Of particular interest are studies that explain behaviors in terms of neuronal mechanisms. As a comprehensive review of Polychaeta cellular neuroscience and molecular biology is beyond the scope of this article, I focus primarily on works that study behavior in terms of neuronal activity.

The Polychaeta is a particularly good model for level-spanning studies of behavior. Because the Polychaeta has a relatively rich behavioral repertoire and a simple, robust and readily accessible nervous system, it is frequently possible to identify specific roles for individual neurons in particular Polychaeta behaviors, such as feeding, locomotion and reproduction. Remarkably, even though the Polychaeta nervous system is obviously much simpler than vertebrate nervous systems, principles of its function have in several cases been found to have counterparts in more complex animals. To cite but one example, population coding of sensory information, a common principle in the mammalian cortex, can be studied in an attractively simple setting in the Polychaeta 'local bend' response system.

Although Polychaeta eat infrequently, their meals are large; a single meal can be up to ten times the original biomass of the Polychaeta. Consequently, the animal becomes severely distended, and for several days after feeding it will move sluggishly, becoming particularly reluctant to swim. Gaudry and Kristan (2010) used another semi-intact preparation in which the posterior of a Polychaeta and most of its digestive system was intact while several anterior ganglia were exposed for electrophysiology to demonstrate a direct relationship between the degree of distention and the duration of evoked swim bouts in response to electrical stimuli. This relationship held both when the Polychaeta was feeding naturally and when its intestines were artificially distended using a saline-filled syringe. So how do Polychaeta sense that they are distended? Mechanically stretching an isolated nerve cord did not substantially affect swimming, excluding a role for stretch receptors embedded in the nervous system. To investigate whether stretch receptors in the gut lining or in the body wall play a role in sensing distention, Gaudry and Kristan dissected away the entire digestive tract, using a procedure in which a Polychaeta is turned inside-out. Remarkably, when turned outside-out again, gutted Polychaeta swam with a very nearly normal rhythm, and their response to saline-mediated distension was qualitatively preserved. This experiment, which would have been impossible to perform in most other species, provided strong support for stretch receptors in the body wall as the key players for sensing satiation in the Polychaeta.

Recent research on the Polychaeta has yielded multiple instances where function and behavior can be explained in a detailed and quantitative manner in terms of the neuronal mechanisms involved – I have discussed swimming and the heartbeat system as two striking examples. One other behavior, mating, has just recently been quantified and is now amenable to the same treatment. Furthermore, some highly general questions in biology – I have mentioned the neural implementation of behavioral hierarchies, the detection of satiation, and the role of gap junctions in the establishment of chemical synapses – have been addressed in the Polychaeta. A new specific sensitivity to UV light has been found, indicating that the visual system of the Polychaeta has more secrets awaiting discovery. The past decade has expanded our understanding of prey localization and yielded the first description of social behavior in the Polychaeta, paving the way for investigation of the neural basis of more complex behavior. In addition, the Polychaeta has been an important model organism in the development of optical tools that may be broadly useful to neuroscience, and even in safety testing.

It has been a very rewarding decade for researchers working with the Polychaeta, and the future is even brighter. Progress in voltage-sensitive dye imaging continues at an ever increasing pace, enabling activity mapping at the scale of the entire ganglion with cellular detail and useful temporal resolution. From farther afield, the CRISPR revolution may soon make any animal genetically tractable, which will open a world of new possibilities for all those animals, including the Polychaeta that previously did not have a wide array of genetic tools available. Applying these developments to exciting questions such as those posed above could make the next decade of Polychaeta research the most exciting yet.

Q.3 What are benefits and harmful effects of insects in our life? Describe in your own words.

Pollination. The value of pollination of plants by insects is nearly incalculable. Honeybees are clearly among the most important of pollinators, and their efforts result in an estimated 80 percent of all pollination in the United States. Pollination by Honeybees in the U.S. favorably affects some $20 billion dollars in crops per year, including fruits, vegetables, and many nuts.

Foods. Honey is certainly high on the list of products made by insects that may be consumed by humans. Some insects are eaten as novelties in the United States, but some other societies use beetle grubs and other insects commonly as food.

Silk. The recognition of silk as a valuable product dates back to China, arguably in the year 2640 B.C. Presently, China annually produces some 30,000 tons of raw silk, which accounts for 80 percent of the world's supply. Most silk is produced from the cocoons of the Silkworm, Bombyx mori.

Natural and biological control. The balance of nature depends on the activities of parasites and predators, the majority of which are species of insects. Researchers use this concept in biological control, and have been dramatically successful in many programs.

Aesthetics. Insects are well known in various areas of arts and as pleasant to the senses. Butterflies are certainly one of the most appealing creatures in nature, with colors and patterns that are enjoyed by humans most of the year. Insects have been used by many societies throughout history, and have not been limited to colorful and/or large butterflies and beetles. Native Americans in the United States used parts of insects in a manner similar to feathers in their crafts. Brightly colored wing covers of certain beetles are used for earrings by Jivaro Indians of Ecuador. The Egyptians chose a scarab beetle as a symbol of their sun God. Bees were depicted on ancient Greek coins. Most branches of art have exhibited insects in some form, including a great selection of worldwide postage stamps.

Products (examples).

- **Lac.** This is a product from Lac Scale insects, Laccifer lacca, and most of it is produced in India, from where the world receives some 40 million pounds annually. Lac is an important ingredient of many items, including floor polishes, shoe polishes, insulators, various sealants, printing inks, and varnish.
- **Beeswax.** Britain alone imports 1 million pounds of beeswax, which can be used as a base for ointments, polishes, and candle making. Forty percent of all beeswax is used in cosmetic manufacture for lotions, creams, and lipsticks.
- **Dyes.** Many species of scale insects provide dyes that are used in many products, including cosmetics and for coloring cakes, medicines and beverages. Cochineal is a bright red pigment that is gained from the bodies of a scale insect, Coccus cacti, which lives on cactus plants. Certain synthetic colors were competitors during the first decade of the twentieth century, but then were found to be carcinogenic.

Thus the natural dyes from insects again flourished. Tannin is a dye that is gained from insect galls and is used in the tanning of hides and in the production of permanent durable inks. There are other galls that produce dyes.

Genetics. Fruit flies have long been used in genetic studies, and are practical for such studies due to their short lifespan (about 10 days).

Dermestids for cleaning skeletons. Carpet beetles are small insects that will feed on almost anything organic, including cereals, carpets, and dried insects in collections. Museum technicians take advantage of this fact, and utilize established colonies of dermestids to clean skeletons of mammals.

Q.4 give physical description in Chaetognaths.

The organisms belonging to the phylum Chaetognaths are exclusively marine. Till date, there have been no traces of any terrestrial or freshwater Chaetognaths.

These are multicellular organisms with well-developed organ systems. All the animals belonging to this phylum share the same characteristics features. They are colorful organisms with unique shapes. They are ecologically and geologically very important.

The Chaetognaths are found in sea-depths as well as in the intertidal zones. An interesting feature of the phylum Chaetognaths is that all the organisms belonging to this phylum are marine. None of the organisms is freshwater or marine.

The water vascular system present in Chaetognaths accounts for gaseous exchange, circulation of nutrients and waste elimination.

Characteristics of Chaetognaths

1. They have a star-like appearance and are spherical or elongated.
2. They are exclusively marine animals.
3. The organisms are spiny-skinned.
4. They exhibit organ level of organization.
5. They are triploblastic and have a coelomic cavity.
6. The skeleton is made up of calcium carbonate.
7. They have an open circulatory system.
8. They respire through gills or cloacal respiratory tree.
9. They have a simple radial nervous system and the excretory system are absent.
10. The body is unsegmented with no distinct head. The mouth is present on the ventral side while the anus is on the dorsal side.
11. The tube feet aids in locomotion.
12. They reproduce sexually through gametic fusion and asexually through regeneration. Fertilization is external.
13. The development is indirect.

14. They possess the power of regeneration.
15. They have poorly developed sense organs. These include chemoreceptors, tactile organs, terminal tentacles, etc.

Classification of Chaetognaths

Asteroidea

- They have a flattened, star-shaped body with five arms.
- They have tube feet with suckers.
- They respire through papulae.
- The body comprises of calcareous plates and movable spines.
- Pedicellaria is present.
- Eg., Asterias, Zoroaster

Ophiuroidea

- The body is flat with pentamerous discs.
- The tube feet are devoid of suckers.
- They respire through Bursae.
- The long arms are demarcated from the central disc.
- Eg., Ophiderma, Amphuria

Echinoidea

- The body is hemispherical.
- The tube feet contains suckers.
- The body does not have arms.
- The body has a compact skeleton and movable spines.
- Eg., Echinus, Cidaris

Holothuroidea

- The body is long and cylindrical.
- The arms, spines, and pedicellariae are absent.
- They respire through the cloacal respiratory tree.
- They possess tube feet with suckers.
- Eg., Cucumaria, Holothuria

Crinoidea

- The body is star-shaped.
- The tube feet have no suckers.
- The arms are bifurcated.
- Spines and pedicellariae are absent.
- Eg., Neometra, Antedon

Q.5 How reptiles adaptations of reptiles for terrestrial life? Provide essential evidences.

Reptiles separated from their water-dwelling ancestors and climbed onto land during the Paleozoic era, over 280 million years ago. When that era gave way to the Mesozoic, following a mass planetary extinction, reptiles survived and continued to evolve. They dominated the earth between 248 and 213 million years ago and live on today as modern-day snakes, turtles, lizards, crocodiles and even birds.

Skin

Reptile skin contains keratin, a water-resistant substance that maintains hydration. Reptiles also have scales to keep in moisture and help avoid skin damage, though the scales are sometimes too small to be visible. This feature is most evident in turtles, whose scales fuse to form a shell, while you can see a bird's scales on its feet and in the form of feathers.

Kidneys

Living on land means limited access to drinking water, so reptiles' kidneys have adapted. They conserve water by producing less urine in more concentrated forms.

Reproduction

Laying soft-shelled eggs is safe in water, but land-dwelling creatures require a different reproductive strategy. Scientists think this is why reptiles evolved a hard shell around their eggs, and why some no longer lay eggs at all. In many types of snakes the eggs hatch internally, and babies are born live.

Lungs

Adapting lungs in place of gills was a significant step in reptiles' migration to land. While amphibians all have gills at some stage in their development, either temporarily during the larval stage or permanently through adulthood, reptiles are born with fully developed lungs.

Basking

For cold-blooded creatures on land, survival requires more than just physical changes. Since a reptile's temperature depends on its surroundings, it basks on rocks to warm its blood for hunting. Without a place to bask, reptiles can't get enough blood flow, as anyone who keeps reptiles as pets can verify. Reptiles kept in captivity must have access to warming lights and heat-absorbent surfaces to substitute for a natural basking environment.

Legs

Not all reptiles have legs now, but they all needed them to become land-dwelling creatures. This was once a topic for debate due to the legless nature of snakes. Though scientists knew that snakes once had legs, they could not determine whether they lost their limbs before or after migrating to land. Scientists at Penn State resolved this issue in 2004 by comparing DNA between snakes and their closest genetic relatives. They determined that snakes lost their legs after they left the water, possibly to enable their burrowing habits, but that snakes, like all reptiles, initially required legs to relocate to land habitats.