

Phylum Onychophora [Gk. onyx or onychos = claws, phoros = bearer]

Origin:

Early Cambrian period.

Characters:

1. Commonly known as velvet worms or walking worms. [Peripatus. (Gk. Peripatos = walking about; Gk. Peripatein = to walk about, stroller).
2. Bilaterally symmetrical, metamerically segmented and protostomous coelomates.
3. Body soft and Caterpillar-like.
4. Head is not clearly differentiated. Tagmatization is not well pronounced.
5. Body may grow from 5 mm to 15 cm in length (e.g., *Peripatopsis torquatus*).
6. Externally the segmentation is denoted only by the presence of short paired (14-13 pairs) un-jointed stumpy walking legs (lobopods). The legs are terminated into curved claws.
- 7. The head bears 3 paired appendages:**
 - (i) One pair fleshy annulated antennae
 - (ii) A single pair of jaws (2nd pair of appendages) and
 - (iii) a pair of short oral papillae (3rd pair of appendages), situated adjacent to the jaws.
8. Eyes are represented by ocelli rather than compound eyes.
9. Integument is thin and the chitinous cuticle contains varied ring-like striations.
10. Body colouration is blue, green, orange or black with papillae and scales.
11. Muscles are un-striated.
12. A straight gut with an anus.
13. Haemocoelomic body cavity.

14. Respiration is carried by tracheal tubes, open through the small spiracles.
15. Spiracles without any closing device.
16. Slime glands discharge adhesive material through the openings of the oral papillae used for prey capture or defence.
17. Malpighian tubules are absent.
18. Excretory organs are paired segmental coelomoducts.
19. Sexes separate (gonochoristic).
20. Fertilization internal.
21. Usually viviparous but may be oviparous or ovoviviparous.
22. Reproductive and excretory ducts are ciliated.
23. All are terrestrial and are found in moist habitats.

The features of Onychophora have made it difficult to place it within any one of the ten major phyla. The detailed studies of Onychophores have now confirmed that in addition to its own peculiar features it has characters common with three other large groups, Annelida, Arthropoda and Mollusca.

An account of such relationship is given below:

A. Relationship with Annelida:

Similar features (Structural):

1. Segmentation in both is homonymous.
2. Presence of paired nephridia in almost every segment of the body.
3. Reproductive tracts are lined by cilia.
4. Skin is thin and flexible.
5. Dermomuscular body wall like Hirudinea. Body wall musculature smooth and composed of circular, diagonal and longitudinal muscle fibres.

6. True head is absent.
7. Structure of the eye is same as in polychaetes. Simple eyes (Ocelli) rather than compound eyes.
8. Hollow and non-jointed appendages like those of parapodia.
9. Slime glands and coxal glands correspond with the similar glands of polychaetes and oligochaetes.
10. Straight gut with an anus.
11. Vermiform boy.

Embryological similarities:

1. Spermatozoan morphology resembles that of oligochaetes and leeches.
2. Meroblastic cleavage.
3. Gastrula by epiboly.
4. Elongated blastopore.

Dissimilar features:

1. Ventrally placed mouth in Onychophores.
2. Heart and ostia present in Onychophores.
3. Clawed appendages in Onychophores.
4. Presence of antennae in Onychophores.
5. Ladder-like nervous system.
6. Tracheal tube for respiration in Onychophora.
7. Absence of true metamerism in Onychophora.
8. Texture on the skin.

9. Disposition of the gonads and

10. Haemocoelomic body cavity.

Remarks:

In view of the anatomical peculiarities Grube (1874) placed the group under Annelida and it appears that onychophora have evolved from the annelids, if not directly from them, from the ancestral stock from which the annelids have evolved.

B. Affinities with Arthropoda:

Moseley (1874) demonstrated its relation with arthropods by showing the presence of tracheae.

Structural similarities:

Following features show that Onychophora is more related to Arthropoda:

1. The appendages are provided with claws.
2. Locomotion is not annelid-like but takes place with the help of legs having definite musculature.
3. Jaws are modified appendages.
4. Heart dorsal and tubular, perforated by lateral ostia.
5. Body cavity is a haemocoel, not a true coelom.
6. Absence of perivisceral part of coelom.
7. Body is covered with chitinous cuticle and is moulted.
8. Jaws are provided with striated muscles.
9. Presence of antennae.
10. Brain is large and resembles the brain of typical arthropods.
11. Presence of tracheae as respiratory organs.
12. Excretory organs closely resemble the green glands of Crustacea.

13. Salivary glands formed by the modification of nephridia.

14. Pattern of development is same as in other arthropods.

Dissimilarities:

In spite of these similarities, Onychophores differ in many respect from the Arthropods.

1. Arrangement of tracheae is not arthropod-like. Here in each segment there are numerous permanently opened spiracles (no closing mechanism).

2. Jaw is the modification of second appendages and the movements of jaws operate from anterior end and proceed towards posterior end.

3. Formation of skin is not like that of arthropods.

4. Segments behind head are simple and identical.

5. Segmentation not distinct in Onychophora.

6. Absence of malpighian tubules in Onychophores.

7. Simply, un-jointed, numerous stumpy legs in Onychophores.

8. Structure of eye is less complicated.

9. Two ventral nerve cords are widely separated and without true ganglia.

10. Body regions or tagmata are not well developed in Onychophores, which are well developed in Arthropoda, e.g., in most cases the body is divided into head, thorax and abdomen.

Remarks:

According to Sedgwick (1908) there is no doubt that the Peripatus belong to the Arthropoda in all the above mentioned characters which are all of morphological importance. Developmental features of Peripatus confirmed the view.

C. Similarities with Mollusca:

1. Slug-like appearance.

2. Ladder-like nervous system resembling that of chiton and lower prosobranchia.

3. Antennae tentacle-like.

Remarks:

Guilting (1826) first discovered a peripatus and considered to be an aberrant mollusc. But according to many scientists the resemblances with molluscs are only superficial.

Time of origin:

Onychophora evolved from the marine fossil onychophoran-like organism *Aysheaia pedunculata* from the Mid-Cambrian period about 520 million years ago.

Probable views regarding the Origin of Onychophores:

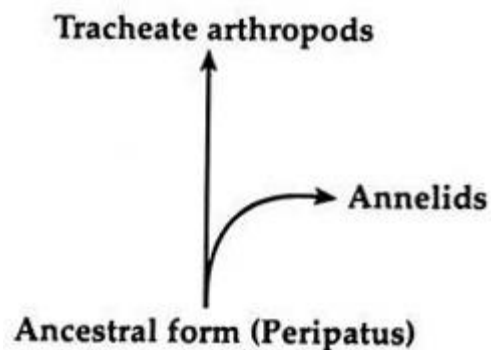
Different zoologists have put forward different views regarding the origin of Onychophores.

1. Hills (1930):

Only known fossil resembling *Peripatus* was found in the Mid-Cambrian period. In the Pre-Cambrian era only fossils of soft-bodied, segmented worms, annelids were found. Then according to Hills, in early Pre-Cambrian some tracheate arthropods underwent specialization while others were less specialized to give rise to the *Peripatus* in Mid-Cambrian.

2. Thomson and Ritche (1944):

Thomson and Ritche (1944) Opined that the *Peripatus* is a survivor of forms that were ancestral to the tracheate arthropods and closely related to the annelids.



3. Snodgrass and Stromer (1944):

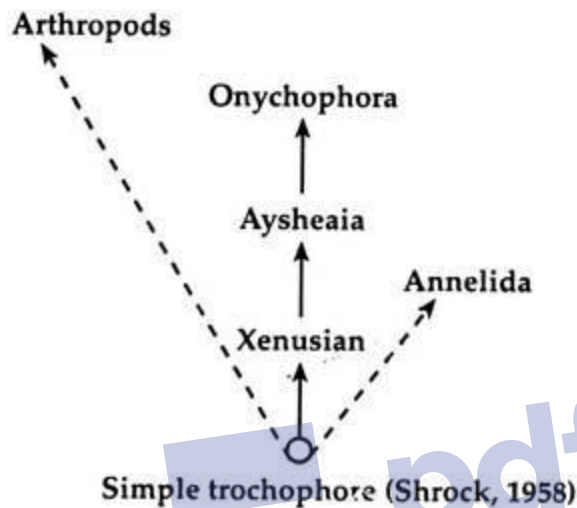
Snodgrass and Stromer (1944)—said that the Onychophora originated from the ancestral form of both annelids and arthropods.

4. Tieggs and Manton (1958):

According to them, Onychophora evolved from generalised lobo-pod ancestor, such as, this line of evolution is not followed by any other arthropod. They have again stated that the Mid-Cambrian *Aysheaia pedunculata* has generally been accepted more or less as a marine ancestor of modern terrestrial onychophorans.

5. Shrock (1958):

Shrock (1958)—remarked that peripatus is not the ancestral form of annelids nor gives rise to modern arthropods but is a separate autonomous isolated group evolving from the ancestral trochophore.



Zoological Importance of Onychophora:

Onychophora show a great zoological importance because:

1. They furnish an example of discontinuous distribution and
2. They represent an example of living connecting link between the two phyla—Annelida and Arthropoda.

Systematic Position of Onychophora:

The characters of Onychophora have made it most interesting from the point of view of evolution. It is an oldest terrestrial group which probably originated from some marine ancestors.

It has attained a number of features for terrestrial life, i.e., internal fertilization, viviparity, semi-solid excretory product, less permeable skin, etc. But at the same time the structure of spiracles speaks about its limitation on land life and thus shows its primitiveness.

The resemblances with annelids are probably the examples of convergence. Onychophorans have a mixture of morphological characteristic features which make them effectively cross between the Annelid

worms and the Arthropods. But our modern understandings suggest they do not represent a missing link between the annelids and the arthropods.

Presence of variously developed specialized characters in Onychophora, such as trachea with open spiracles and the origin of jaws do not support the above view that Onychophores represent a missing link. Instead, like the Tardigrades they are considered as a separate line of evolution and arose independently from some forgotten ancestor.

Again the common characteristic features of Onychophora regard a common relative to annelids and arthropods. Hence, it is regarded as a living connecting link between two phyla and it is undoubtedly an ancient form but not an ancestor of arthropods.

Kaestner (1967) has stated that the Onychophora probably represents an early lateral branch of the evolutionary line terminating in the arthropods. *Peripatus* are also called living fossils because they truly represent archaic animals and have changed little in their body shape for about 500 million of years.

A cladistic analysis which places the Onychophora in an intermediate position between the Polychaeta and the Tardigra-Arthropoda clade. The current view is that the Onychophora represent a sister group to the Arthropods on the basis of morphological, palaeontological and molecular data.

According to Marshall and Williams (1972)-Onychophora can be rightly described as an aberrant arthropods or highly modified annelids and can be placed all the species under twelve genera of Onychophora in a separate subphylum "Onychophora" under the phylum Arthropoda. But absence of jointed chitinous exoskeleton and jointed segmental appendages do not support the inclusion of Onychophora within Arthropoda.

Some peculiar features of Onychophores which support neither annelids nor arthropods, and demand a separate phylum status. Ruppert and Barnes (1994) pass the remark that Onychophorans are not usually considered arthropods rather a phylum animals closely related to arthropods.