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A GUIDE TO THE FRESHWATER FAUNA OF CEYLON

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INTRODUCTION

SCOPE OF THE PUBLICATION

FRESHWATER animals are of importance in the economy of most countries. In recent years the scientific cultivation of freshwater fish for food has been spreading throughout South-East Asia and the Far-East. New and useful species of fish have been introduced into many countries including Ceylon where the older system of trapping any variety of fish that is available is being replaced by scientifically planned management with a view to increasing the production of good quality fish. Considerable quantities of food mainly in the form of fish are being taken from our freshwaters, providing a cheap source of much needed protein in the diet of the villager. More recently large quantities of freshwater fish are being consumed by the urban population.

To evaluate the productivity of inland waters it is essential to study its fauna and flora.

One of the remarkable features of animal life in freshwater is its great diversity. The animals range in size from microscopic protozoa to fish, reptiles and mammals which may measure several feet in length. The interrelationships between the various types of animals and plants have an important and intimate bearing on fish productivity. Fish feed on some of the smaller animals and plants while they themselves are food for predators.

For a faunal study of our freshwaters it is necessary to enlist the services of as many workers as possible. This publication is offered to them as a guide to the species of freshwater fauna recorded from Ceylon. It is written in as simple a form as possible and provided with sufficient keys and illustrations for the easy identification of recorded freshwater animals down to at least its family. The illustrations have been made from freshly collected or preserved specimens. In the absence of such specimens, illustrations have been adopted from other published material.

In this publication the authors have endeavoured to collect the previous work on the subject whilst adding their own findings in the field. The species of freshwater animals recorded so far from Ceylon have been included except those insects such as dragonflies, mayflies, stoneflies, mosquitoes &c., which are present in water only in their larval and pupal stages. However keys, diagrams and descriptions are provided for the identification of such larvae. This publication will be useful to the research biologist as well in that he will have a complete listing of the freshwater faunal species hitherto recorded from Ceylon.

The authors appeal for specimens of freshwater animals from all those in a position to collect them. The specimens should be immersed in rectified or methylated spirits or formalin (10 per cent.)

contained in a bottle. A label, written in pencil, indicating the locality and date of collection should also be placed inside the bottle. The label could contain any additional information regarding the type of habitat and other observations. The bottle containing the specimen could be handed over to the nearest fisheries office (from where bottles and formalin could be obtained) or mailed to the Freshwater Division, Fisheries Research Station, P. O. Box 531, Galle Face, Colombo.

ACKNOWLEDGEMENTS

An attempt has been made to bring the nomenclature in line with recent work and in this task the authors are deeply indebted to the help received from Dr. L. B. Holthuis, Rijksmuseum van Natuurlijke Histoire, Leiden (Caridea); Dr. W. S. S. Benthem Jutting, Zoological Museum, Amsterdam (Mollusca); Prof. H. B. Hungerford, University of Kansas (Hemiptera); Prof. G. E. Hutchinson, Yale University (Corixidae); Mr. R. A. Crowson, Glasgow University (Coleoptera); Mr. J. Balfour-Browne, British Museum (Natural History), London (Coleoptera); and Dr. E. L. Bousfield, National Museum of Canada (Natural History), (Amphipoda). However, these specialists are in no way responsible for any errors or omissions that may occur in this publication.

Material for this publication has been freely drawn from other workers but they have not always been individually acknowledged. The illustrations adapted from those in other publications have been acknowledged under the explanations to the respective illustrations. The authors are indebted to Mr. G. D. Kariyawasam, the artist attached to the Fisheries Research Station, for the great care and pains taken in illustrating this publication.

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THE FRESHWATER HABITATS IN CEYLON

THE centre of the southern half of Ceylon is mountainous, ranging from about 3,000 to 8,000 feet and is referred to as the hill-country or up-country (page 10). This is surrounded by an upland belt sometimes called the mid-country of 1,000 to 3,000 feet. The rest of the land stretching to the coast is called the low-country. This coastal plain broadens out to a vast tract in the North, and is narrow elsewhere.

During the South-West Monsoon (May to September) the central hills cause precipitation in the form of rain in the South-Western sector of the Island, while the rest of the Island receives little or no rain at all. During the North-East Monsoon (November to February) the precipitation is to the North-West, North and East of the hills, with frequent afternoon thunderstorms in the South-West. In the inter-monsoon periods winds are light, and rains are mainly due to the depressional activity either in the Bay of Bengal or the Arabian Sea. These depressions are most frequent in October and November. The South-Western sector of the Island receives, in a well distributed manner, an average rainfall of over 75 inches per annum and is termed the wet zone (page 10). The rest of the Island is called the dry or arid zone as it receives under 75 inches rainfall per annum. The dry zone may be said to consist of the entire coastal plain (except the South-Western sector) and the Eastern slopes of the hill-country.

The rivers in Ceylon flow in a radial pattern from the central hill country (page 10), where there are numerous water falls, the rivers flowing to the West, East and South being shorter than those flowing to the North, North-West and North-East. Several streams and tributaries join these rivers. Some of the streams in the hill-country and mid-country are quick flowing and are referred to as torrential streams.

Irrigation reservoirs or lakes have been formed by damming small rivers and streams or by channelling the water from larger rivers. The larger irrigation reservoirs (or tanks as they are commonly called in Ceylon) are perennial and rarely dry up. There are hundreds of smaller reservoirs scattered throughout the country, particularly in the dry zone. They are rain fed and fill up during the rainy season. With the advent of the drought they dry up and are therefore called seasonal lakes or ponds depending on their size. After heavy rains some of the larger rivers overflow their banks into large tracts of low lying land from which the flood waters are not drained for several months after the rivers subside. These flood lakes called " Villus " are very large, some of them being over a hundred acres in surface area.

Freshwater habitats can be classified in various ways using different criteria such as size, depth, rate of flow, type of bottom and so on. A simple classification of habitats found in Ceylon is as follows :—

Rivers (S. Ganga T. Aru).[1] (Page 5, Fig. 1). Large with flowing water, generally deep and perennial. The bottom may be muddy, sandy, stony, or rocky. Rivers have very little plankton (floating plant and animal life). Many local terms are used for intermediate sizes (S. Oya) is one of them.

Streams (S. Ela, T. Aruvi). (Page 5, Fig. 2). Smaller than rivers but similar to them. They vary greatly in speed of flow from torrential or relatively fast flowing (S. Dhola T. Tiravaka Aravi) (Page 5, Fig. 4), to more or less stationary types in the low country.

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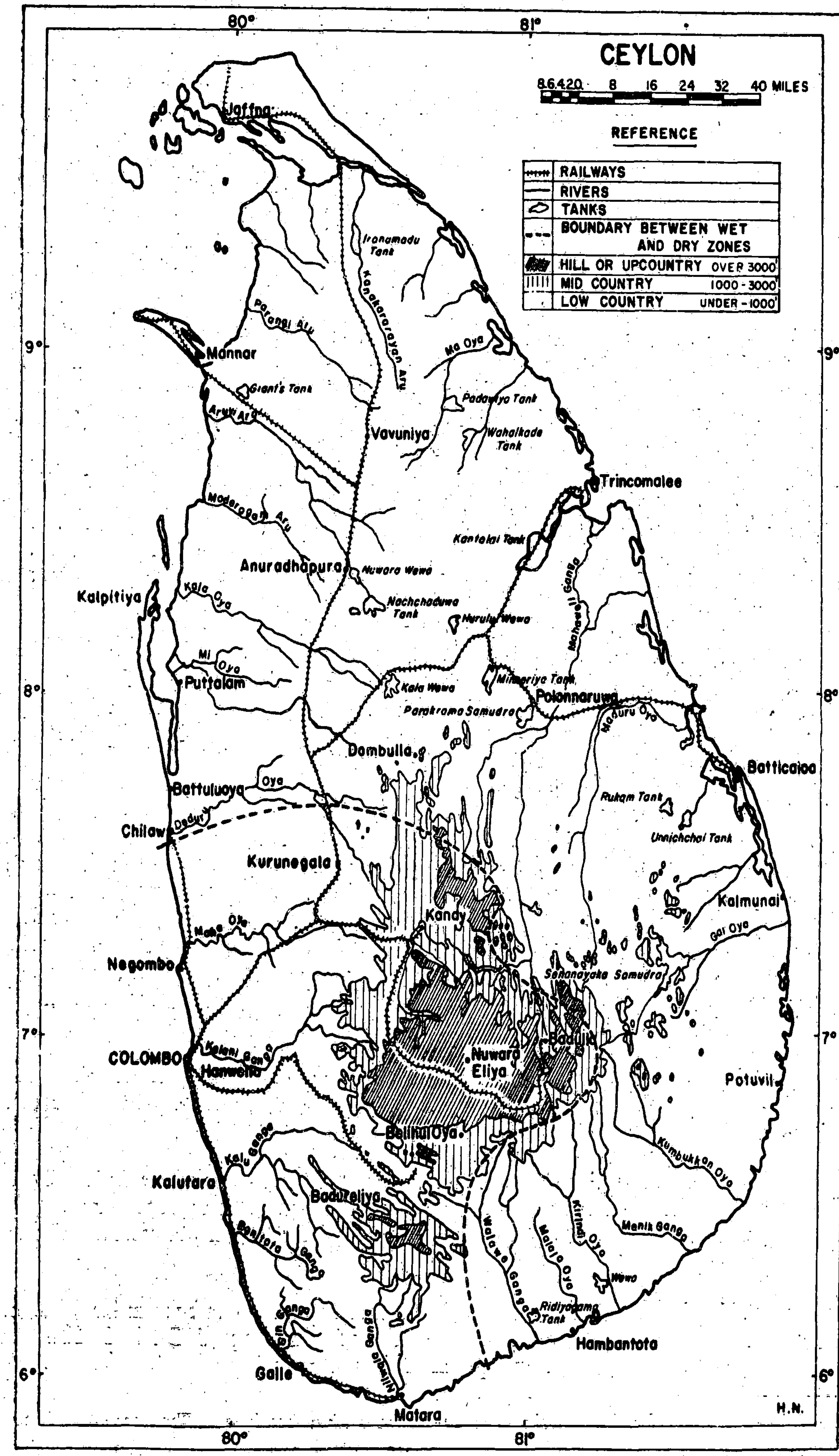
[1] The Sinhalese (S) and Tamil (T) local names are given within brackets. The format will be repeated throughout this publication.


CEYLON
8 6 4 2 0 8 16 24 32 40 MILES
REFERENCE
RAILWAYS
RIVERS
TANKS
BOUNDARY BETWEEN WET AND DRY ZONES
HILL OR UPCOUNTRY OVER 3000'
MID COUNTRY 1000-3000'
LOW COUNTRY UNDER-1000'
80°
81°
9°
8°
7°
6°
Jaffna
Iranamadu Tank
Mannar
Giant's Tank
Vavuniya
Padawiya Tank
Wahalkade Tank
Trincomalee
Kantalai Tank
Anuradhapura
Nuwara Wewa
Nachchaduwa Tank
Kalpitiya
Kala Oya
Mi Oya
Puttalam
Kala Wewa
Minneriya Tank
Polonnaruwa
Parakrama Samudra
Dombulla
Batticaloa
Rukam Tank
Unnichchai Tank
Battuluoya
Chilaw
Kurunegala
Kandy
Kalmunai
Gal Oya
Negombo
Senanayake Samudra
COLOMBO
Kelani Ganga
Hanwella
Nuwara Eliya
Badulla
Potuvil
Bellhul Oya
Kalutara
Kalu Ganga
Kumbukkan Oya
Menik Ganga
Walawe Ganga
Kirindi Oya
Malala Oya
Ridiyagama Tank
Hambantota
Galle
Gin Ganga
Nilwala Ganga
Matara
H.N.

Lakes (S. Wewa, T. Eri). A natural lake could be defined as a body of confined water situated in a depression of the ground, without direct communication with the sea. The majority of the lakes in Ceylon are irrigation reservoirs (tanks) constructed several hundred years ago by building bunds (dams), (Page 5, Fig. 3). A few have been constructed for hydro-electric power (Page 5, Fig. 6). Lakes in Ceylon are therefore artificial ones in that the water is confined by means of bunds and are not mere depressions of the ground. Lakes are usually very rich in small animal and plant life. Higher plants are often abundant only at the shallow edges of lakes.

Ponds (S. Pokuna, T. Phadakam), (Page 5, Fig. 5). These are very small shallow "lakes" in which varying quantities of higher plants are present within it.

Flood Lakes or Villu (S. Pitaravila, T. Perukkeri, Villu). They may be ephemeral or have a long life. Some of the flood lakes are very large in extent and support fisheries of considerable importance, particularly around the Manampitiya area in the Polonnaruwa District and the Hanwella area of the Kelani Ganga.

Paddy fields (S. Kumbura, T. Nell Vayal), (Page 5, Fig. 8). A very widespread habitat which is temporary in the sense that all the water is drained off when the paddy begins to ripen (Page 5, Fig. 7). They are very rich in animal life especially of the smaller sizes.

ADAPTATIONS OF THE FAUNA TO HABITATS

The life-history of an animal is generally divisible into a period of development, followed by a period of rapid growth when the animal has a voracious appetite. In the final period as an adult the animal breeds at regular intervals and continues to grow slowly.

Most freshwater animals breed during or after the monsoonal floods when plenty of water is available for the young to spread over a wide area where crowding is less and there is a plentiful supply of food in the form of minute plants and animals. Some animals take advantage of the abundance of food and breed again shortly afterwards. The small cyprinid fish *Puntius vittatus* (Day) (S. Bandi Titteya) breeds many times in a single period between the monsoonal rains and the onset of the drought, but this is rather unusual. Some like the beetles lay their eggs during the drought and the larvae survive in moist places till the arrival of the rains. The young animals utilise the abundant food to grow rapidly and the adults build up their reserves for adverse conditions to come.

With the advent of the dry season, conditions in temporary habitats become less and less favourable for aquatic animals. Those cut off in small habitats are quickly killed off, others in larger habitats survive longer. During this period food becomes scarce and the water area diminishes in size. The animals become weakened or diseased and die or are eaten by larger animals which find them easy prey. Even in the larger bodies of water like rivers, tanks and large ponds which are perennial the competition for food and shelter may become severe.

Many species of aquatic animals have developed adaptations to survive drought conditions. The "air-breathing" fishes *Anabas testudinius* (S. Kavaiya), *Ophiocephalus* spp. (S. Loola, Mada Kanaya), *Clarias teysmanni* (S. Magura), and *Heteropneustes fossilis* (S. Hunga) have developed special respiratory organs connected with the gill chamber which can utilize atmospheric air unlike gills which utilize oxygen dissolved in the water. These species can survive under conditions of severe drought in water which has been seriously depleted of oxygen by the decay of organic material.

The spiny eels *Macrognathus aculeatus* and *Mastacembelus armatus* (S. Theliya) and the freshwater crabs *Paratelphusa* spp. can utilize atmospheric oxygen as long as their gills are kept moist. These species are found burrowing in the mud close to the water level during the drought.

Certain species such as *Puntius vittatus* and *Macrones vittatus* (S. Ankutta) survive drought conditions in ways not well understood.

The smaller crustacea, namely the Copepoda, Cladocera and Ostracoda, produce eggs with a hard resistant covering, capable of surviving even a severe drought. The Protozoa encyst and are thus protected during the drought. These cysts are blown by wind and the species is dispersed.

Freshwater crabs and prawns carry their eggs until they hatch out, while leeches carry the young in a pouch as protection from the rigours of the drought.

Every rainy season animals colonize the newly available habitats. Different animals accomplish this in different ways. Some fishes move with the expanding water bodies and reach very shallow water whilst others remain in deeper waters. Most aquatic insects can fly to new habitats where they lay eggs. Species with resistant eggs or cysts emerge with the onset of the rains and develop rapidly.

FISHES, THEIR HABITATS AND THEIR BIOLOGY

A few notes are included on the observations and studies that have been made so far in the biology of the freshwater fishes of Ceylon. No group of freshwater animals has been so extensively studied in Ceylon as the fishes. This is partly because of their large size but mainly because of their use as food.

If we study the normal range of a fish species in the various types of habitats it is quite clear that some species are restricted and others have a wide range. The following chart will illustrate this.

	Tanks	Rivers	Large streams	Small streams and Ponds	Paddy Fields
Wallago attu (S. Valaya) ..	P	P	B		
Labeo dussumieri (S. Hiri kannaya) ..	P	P	P	B	
Ophiocephalus striatus (S. Loola) ..	P	P	P	P	P
Macrones vittatus (S. Iri ankutta) ..	P		P	P	P
Puntius vittatus (S. Bandi titteya) ..				P	P

P Indicates presence.

B Indicates presence for breeding only.

The chart indicates that *Wallago attu* is present only in rivers and tanks and that it enters large streams for breeding. *Labeo dussumieri* is common in rivers, tanks and large streams, entering small streams and ponds to breed. *Ophiocephalus striatus* is common in all types of waters. *Macrones vittatus* is not generally found in rivers. *Puntius vittatus* is present only in streams, small ponds and paddy fields. Some species are confined to a very limited type of habitat. This study could be extended to the other species of fish. The factors that limit the range of a species provide interesting problems for further study.

A few species of fish which are surface feeders are found near the surface of the water while the majority of species live at all depths and move freely from one level to another. Some species like *Puntius vittatus* are found only in relatively shallow water and others like *Wallago attu* live at considerable depths. Bottom feeders generally live at the bottom of their habitats. Among such species are the spiny eels (Mastacembelidae), the catfishes of the families Clariidae, Heteropneustidae and Bagridae, the loaches and the goby *Glossogobius giuris*.

In the early stages, all larval fishes feed on minute plants (diatoms and desmids) and minute animals (cladocerans, copepods). Later different species diverge into herbivores, omnivores and carnivores. Some of the smaller species like *Puntius vittatus* feed on algae (such as *Spirogyra*). Others like *Etroplus, Osphronemus* and *Tilapia* feed on larger aquatic plants. Some species like *Anabas* live on a very mixed diet of plants, small animals and fishes. A few species like *Ophiocephalus* and *Wallago* become carnivores. Many species are capable of varying their diet considerably according to circumstances. During severe droughts most species eat mud and utilize the decaying organic matter and small animals found in the mud.

Some species assume brilliant colours during the breeding season. Among these are *Puntius nigrofasciatus, P. titteya,* and *P. vittatus.* Most fishes lay their eggs in large numbers without protection for them. A few species make nests of various sorts where the eggs are deposited. The giant gouramy makes use of dead leaves, fibres and soft debris for building its nest. *Opiocephalus striatus* builds a nest by making a clearing in the vegetation at the edge of the habitat. *Tilapia* excavates the pond bottom to make a saucer like depression in which the eggs are laid. This latter species protects the young in its mouth for a time after they are hatched and is commonly called " mouth breeders ".

Protective mechanisms play an important part in determining the abundance and therefore the distribution of species. Loaches and various cyprinids have protective colour patterns. The behaviour of the fish is also a very important protective mechanism. When *Etroplus suratensis* is disturbed it lies flat on the mud thus reducing the chance of it being captured by its enemies. Some species of carps such as *Puntius dorsalis* and *P. sarana* have a stiff dorsal spine which may act as a protective device. Anabantids and cichlids have erectile spines on the dorsal and anal fins. The catfishes have stout lateral spines near the head which can be erected. Some catfishes like the bagrids have in addition a dorsal spine.

REFERENCES

The following references are of a general character and cover the introduction and many sections of the publication. Other references which deal only with a particular section (phylum) of the freshwater fauna of Ceylon are given at the end of the corresponding section.

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THE FRESHWATER FAUNA OF CEYLON

EACH member of the fauna can be classified into one of several groups or phyla. These phyla are divided into progressively smaller groups, namely classes, orders, families and finally genera and species. Each animal species is usually given two names. The first name is the generic name and the second the specific name. This is followed by the name of the author who first described the species. For example, *Agraptocorixa hyalinipennis* (Fabr.) is the name given to a species of hemipteran water insect of the genus *Agraptocorixa*. This species was first described by Fabricius. Whenever the name of the author is given within brackets it shows that the generic name of the species has been subsequently altered from that originally assigned by the author. In each family the species are arranged in alphabetical order. Wherever possible the common English, Sinhalese and Tamil names are given. In some instances short ecological notes are also included.

To facilitate the identification of the freshwater fauna, keys based mainly on external characters are provided. The characteristics of each member of the fauna will conform with one of two opposing descriptions provided under each serial number in each set of keys. In this publication keys are provided to " trace " an animal up to its family level.

HOW TO USE THE KEYS

The method for using the keys is best illustrated by following the identification of an animal. A " Water boatman " which is a hemipteran insect is used as an example below.

The first task is to determine which phylum the animal belongs to. For this purpose it will be necessary to follow the set of keys given on page 15.

1. With a vertebral column.. Vertebrata 12
   Without a vertebral column.. Invertebrata 2

In the introductory note on page 15 it is said that unless the animal in question is a mammal, reptile, bird, amphibian or fish it could be safely assumed that the animal is an invertebrate. The animal under discussion is an invertebrate and therefore leads to serial number 2 which states:

2. Each individual of one cell only..Protozoa, page 17
   Each individual of several cells.. 3

Since the animal is made up of several cells it directs attention to 3 which states:

3. Anterior end of animal with a " corona ", which besides other structures has long vibrating whorls of cilia.. Rotifera, page 32
   Does not possess a ' corona ' 4

The animal under discussion does not have a "corona", indicating reference to 4, which states

4. The animals (they are always colonial) form encrustations on submerged stones, plants, twigs and other objects.. Porifera, page 24
   Do not form encrusting growths 5

Since the animal under discussion does not form encrusting growths and since it is not colonial attention is directed to 5:

5. With jointed (arthropodous) limbs..Arthropoda, page, 60
   Limbs if present are not jointed 6

The animal in question has jointed limbs and reference has therefore to be made to the set of keys on page 60. The first set of characters in this key states :

1. Three pairs of legs........................Insecta, page 72
   More than three pairs of legs 2

The animal has three pairs of legs indicating that page 72 should be referred :

1. Hind end of insect with a forked organ with which it can spring in the air (Page 95, Fig. 16)........................Collembola, page 93
   Do not have such an organ 2

The insect does not have such an organ. Attention is therefore drawn to 2 :

2. Head prolonged into a proboscis (beak). Forewings not hardened........Hemiptera, page, 74

   Head not prolonged into a proboscis. Forewings shiny and hardened to form a protective covering (elythra) for the hind wings....................Coleoptera, page 83

The animal under discussion has no proboscis and the forewings are not hardened. The latter character signifies that the insect is a hemipteran. Since the example under discussion does not have a conspicuous proboscis the indication is that it could also be a coleopteran. However, the footnote on page 73 states that the insects belonging to the family Corixidae do not have a conspicuous proboscis. The insect is therefore taken to be a hemipteran and attention is drawn to the set of keys on page 74:

1. Live beneath the water surface. Antennae shorter than the head.................... 2
   Live on the surface of the water. Antennae prominent and are longer than the head 8

The insect under discussion lives beneath the water surface and its antennae are shorter than the head. Reference must be made to

2. Head has no pointed proboscis (beak)........................Corixidae, page 79
   Head with a sharp pointed proboscis (beak)........................ 3

The insect has no pointed proboscis and hence belongs to the family Corixidae.

The characteristics of the insects belonging to the family Corixidae are given on page 79. Eight species of corixid hemipterans have been recorded from Ceylon. A diagram (Page 77, Fig. 5) is given of one of these species.

KEY TO THE FRESHWATER FAUNA OF CEYLON

Before using the key the animal has to be identified as a vertebrate or invertebrate. This can be done by dissecting the specimen to find out whether it possesses a vertebral column. However it is sufficiently well known that mammals, reptiles, birds, amphibians (frogs, toads, caecilians and their tadpoles) and fishes are vertebrates and nearly all the other animals are invertebrates. The first set of characters in the key below refers to the vertebral column and if the specimen in question is not one of the vertebrates mentioned above it is safe to assume that it is an invertebrate.

1. With a vertebral column........................Vertebrata 13
   Without a vertebral column........................Invertebrata 2

2. Each individual of one cell only........................Protozoa, page 17
   Each individual of several cells........................ 3

3. Anterior end of animal with a "corona" which besides other structures has long vibrating whorls of cilia.......Rotifera, Page 32
Does not possess a "corona" 4

4. The animals (they are always colonial) form encrustations[1] on submerged stones, plants, twigs and other objects.......Porifera, page 24
Do not form such encrusting growths 5

5. With jointed (Arthropodous) limbs[2]....... Arthropoda, page 60
No jointed limbs....... 6

6. With a non-flexible shell.......Mollusca, page 51
Without a shell....... 7

7. With a segmented (vermiform) body[2].......Annelida, page 44
Body not segmented....... 8

8. Body with cilia.......Gastrotricha, page 28
Body without cilia....... 9

9. With tentacles around the mouth 10
No tentacles around the mouth 11

10. Solitary individuals with 4–8 tentacles each. (Sometimes one or two young individuals in the form of "buds" may be present, attached to the parent)....... Coelenterata, page 25
Colonial forms in which each individual has a circlet of more than eight tentacles .... Ectoprocta, page 26

11. Typically worm-like cylindrical animals 12
Dorso-ventrally flattened animals.......Platyhelminthes, page 40

12. Worms in extricably coiled masses giving the appearance of entangled cotton. Body surface sculptured or bear warts.......Nematomorpha, page 43
Not as above.......Nematoda, page 42

13. Provided with hair on skin.......Mammalia, page 146
No hair 14

14. Animal covered with feathers.......Aves, page 137
No feathers 15

15. Scales absent.......Amphibia, page 126
Scales present[3] 16

16. Gills and gill covers (operculum) present. Equipped with both paired and median fins ....Pisces, page 101
Gills and gill covers absent. No paired fins. (Limbs should not be confused with fins.).......Reptilia, page 132

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[1] The Ectoproct colonies sometimes give the appearance of encrustations on submerged plants, &c. Individuals of a Ectoproct colony possess tentacles and could easily be separated from the Porifera which have no tentacles. Ectoprocta come lower down in the key.

[2] Some of the (arthropod) insect larvae particularly those of the Diptera do not have jointed legs and have segmented vermiform bodies and are liable to be mistaken for Annelids or Nematodes.

[3] Scales of freshwater eels (Family Anguillidae) are inconspicuous. Their gill openings are narrow vertical slits. They could easily be mistaken for water snakes (reptiles) but close examination will reveal the gill slits and the paired pectoral fins indicating that they are fish.

INVERTEBRATA

PROTOZOA

PROTOZOA are microscopic animals which always consist of a single cell each and are therefore referred to as unicellular organisms. They are also called non-cellular organisms since some members possess several nuclei within the cell. Protozoa are abundant in both running and stagnant waters and are common in the body fluids and tissues of other animals where many exist as parasites. Only a fraction of the species present in Ceylon have been recorded in scientific literature ; students of zoology would have seen live specimens of unrecorded species such as *Paramoecium*, *Euglena*, and *Vorticella*.

Protozoa are important as food for the smaller animals like water fleas (Cladocera). Together with bacteria they cause decomposition of the organic matter on which they feed.

The non-parasitic protozoa have been recorded from three orders : (1) Sarcodina, (2) Mastigophora, and (3) Ciliata.

1. Do not have cilia or flagella ; locomotion by means of temporary extensions of protoplasm termed pseudopodia................Sarcodina, page 17

   Possess either cilia or flagella................ 2

2. Provided with one or more slender whip-like flagella generally found only at one end of the animal................Mastigophora, page 20

   Provided with numerous short hair like cilia which are, generally, evenly distributed on the body surface ....Ciliata, page 20

SARCODINA

These protozoans move about by means of temporary extensions of protoplasm termed pseudopodia. Some of the Sarcodina are naked while others are provided with a protective covering or shell varying in form and composition depending on the genus and species. The shell may be secreted by the animal itself or it may consist of fragments of debris and sand firmly cemented together. The sarcodine protozoans are found in diverse habitats and within wide ranges of climatic and topographical conditions. They feed by engulfing solid particles of food which consist of smaller unicelluar plants and animals and decomposing matter.

The following sarcodine protozoans have been recorded from Ceylon :—

Actinophrys sol (O. Fr. M.), (Page 19, Fig. 1)

Amoeba verrucosa Ehrb. (Page 19, Fig. 8)

Arcella discoides Ehrb.

Arcella vulgaris Ehrb. (Page 19, Fig. 7)

Explanation to figures on page 19

1. *Actinophrys sol* 120 μ [1]
2. *Centropyxis* 80 μ
3. *Trinema* 100 μ
4. *Euglypha* 100 μ
5. *Lequereusia* 110 μ
6. *Difflugia urceolata* 100 μ
7. *Arcella vulgaris* 130 μ
8. *Amoeba verrucosa* 60 μ
9. *Euglena* sp. 150 μ
10. *Peridinium tabulatum* 50 μ
11. *Volvox aureus* 850 μ

All the above illustrations are after various authors.

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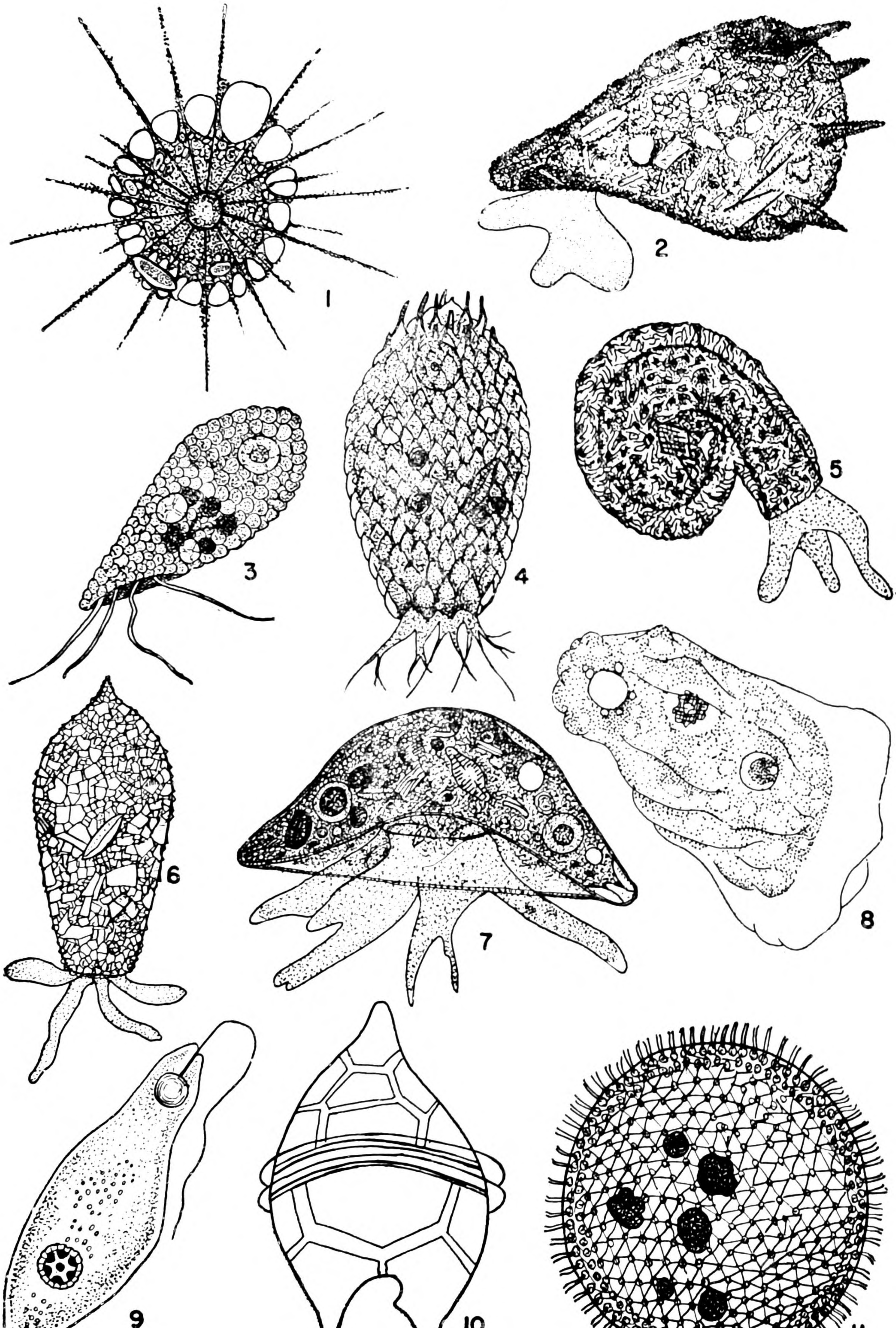
[1] 1 μ = 1/1000th of a millimetre.



3——R 19576 (9/61)

Centropyxis aculeata (Ehrb.) (Page 19, Fig. 2)

Clathrulina elegans Cienk. (Page 23, Fig. 4)

Difflugia acuminata Ehrb.

Difflugia arcula Leidy.

Difflugia constricta (Ehrb.)

Difflugia corona Wall.

Difflugia globulosa Duj.

Difflugia lobostoma Leidy

Difflugia pyriformis Perty.

Difflugia urceolata Cart. (Page 19, Fig. 6)

Euglypha alveolata Duj. (Page 19, Fig. 4)

Euglypha ciliata (Ehrb.)

Hyalosphaenia elegans Leidy

Hyalosphaenia papilio Leidy

Lequereusia spiralis (Ehrb.) (Page 19, Fig. 5)

Pelomyxa quarta (Grub.)

Sphaenoderia lenta Schlumb.

Trinema enchelys (Ehrb.), (Page 19, Fig. 3)

MASTIGOPHORA

These are considered to be the most primitive among the protozoans. Some forms are closely allied to plants and live by photosynthesis. Some of them like *Volvox aureus* are colonial. Mastigophora possess one or more slender, flexible whip-like processes termed flagella which are usually located at one end of the body. The locomotion or movement of these protozoa is by the vibratory movement of flagella.

Only a few have been recorded from Ceylon, although several more have been observed in our waters :—

Ceratium hirudinella (O. Fr. M.), (Page 23, Fig. 5)
Euglena sp. (Page 19, Fig. 9)
Peridinium tabulatum (Ehrb.), (Page 19, Fig. 10)
Volvox aureus Ehrb. (Page 19, Fig. 11)

CILIATA

These protozoans, sometimes referred to as Infusoria, are characterised by the possession of numerous cilia which are short hair-like processes. Cilia originate almost at the surface in contrast to the deep seated nature of flagella. Usually, cilia are evenly distributed over the body surface and their waving movements propel the animal. The current so created also carries food to the "mouth". Sometimes the cilia are concentrated in particular areas or even united together to form vibrating organs in the form of stiff bristles or cirri which may be used for locomotion in the fashion of "legs" of higher animals. Some forms are permanently fixed onto a substratum.

Codonella lacustris Entz.

Colpoda cucullus O. Fr. M. (Page 23, Fig. 6)

Cyclochaeta domerguei Wallengren (Page 23, Fig. 8)

Epistylis anastatica Ehrb. (Page 23, Fig. 1)

Ichthyophthirius sp.[2]

Oxytricha mystacea Stein.

Paramoecium sp. (Page 23, Fig. 7)

Stylonchia pustulata O. Fr. M. (Page 23, Fig. 3)

Tintinnopsis ovalis Daday

Vorticella sp. (Page 23, Fig. 2)

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BATIA, B. L. 1936. *The Fauna of British India including Ceylon and Burma.* Protozoa : Ciliophora. London 493 pp.

DADAY, E. VON 1898—Microskopische Susswasserthiere aus Ceylon. *Termeszetr. Fuz.* 21 : 1–123.

[1] The parasitic protozoan *C. domerguei* was found on the body surface of fish fry in the nursery ponds at the Fisheries Research Station in Colombo. They were present in very large numbers on the skin, fins and gills of the fry of common carp and giant gourami. The attachment ring surrounding the "mouth" of the protozoan had twenty-three anchors. Around the "mouth" were two rings of cilia. A third ring of cilia was present at the opposite end of the animal.

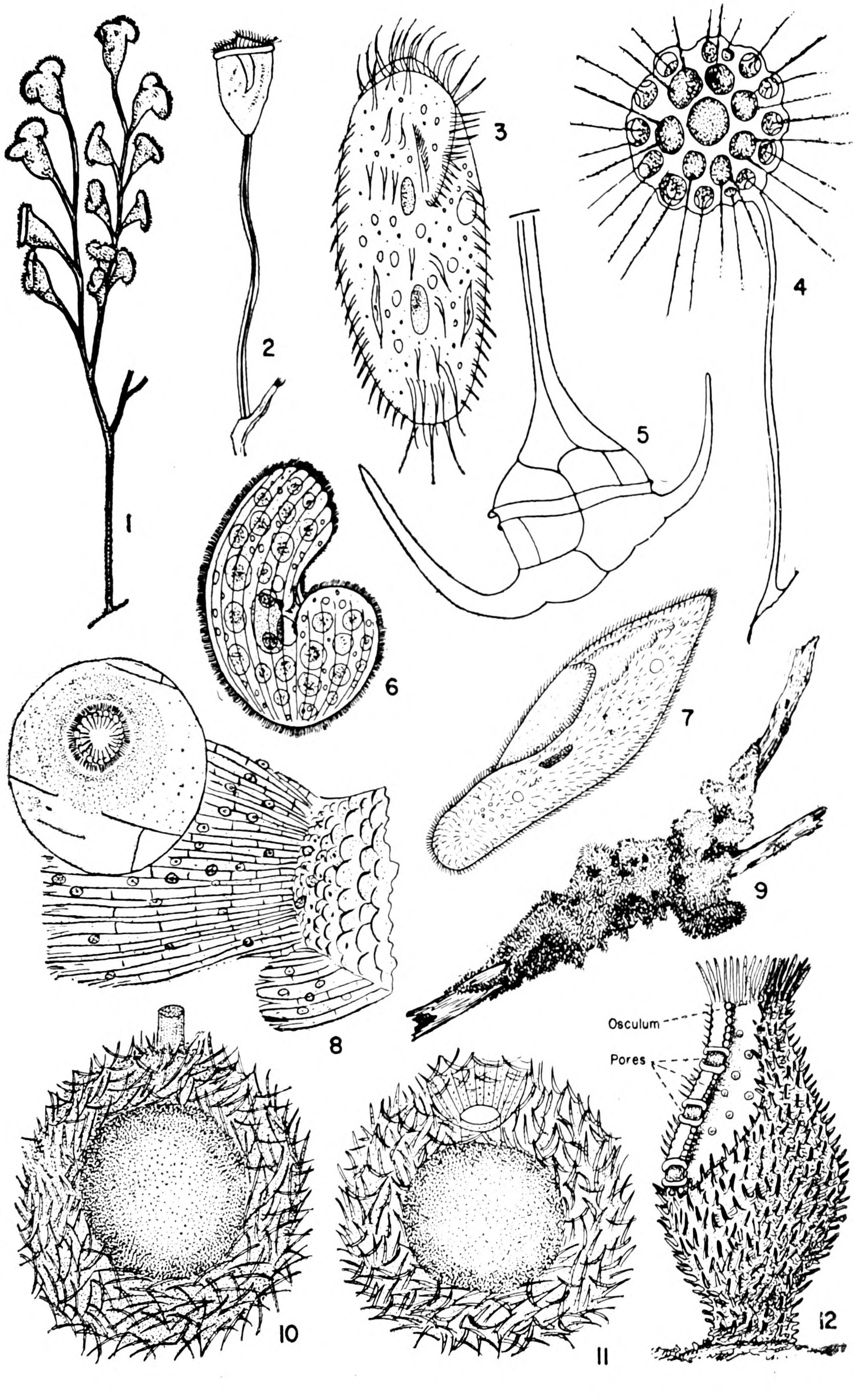
The fry, infected with *Cyclochaeta* appeared to be sluggish in their habits and did not feed well. Some of the infected fry had white blotches on the head and on the dorsal surface of the body. The fry were freed of infection by treating with a dilute solution of kitchen salt (NaCl). There were only a few deaths among the infected fish fry.

[2] The fish fry and fingerlings in the nursery ponds at the Fisheries Research Stations in Colombo and Polonnaruwa have been attacked by *Ichthyophthirius* sp. in epidemic proportions. This usually occurred when there was a sudden change in the weather. *Ichthyophthirius* is a moderately large protozoan visible to the naked eye. They usually live just beneath the outermost layer (epidermis) of the skin of fish, thereby causing the fish to produce an excessive supply of slime. The infected areas appear as white spots on a cursory examination of the fish. When the condition of the fish deteriorates *Ichthyophthirius* begins to leave the host and form cysts at the bottom of the habitat. Each cyst gives rise to hundreds of young ones which infect new fish. *Ichthyophthirius* is unable to live on dead fish and the young ones emerging from a cyst would also die if they are unable to find a host fish quickly.

Explanation to figures on page 23

1. *Epistylis* sp. Length of zooid 90 μ
2. *Vorticella* sp. Length of zooid 50–150 μ
3. *Stylonchia* sp. Body length 70–150 μ
4. *Clathurlina* sp.
5. *Ceratium* sp.
6. *Colpoda* sp. Body length 40–12 μ
7. *Paramoecium* sp.
8. Caudal (Tail) fin of a Giant Gourami fry infected with *Cyclochaeta domerguei*. Inset—A single specimen much enlarged.
9. Encrustation of the sponge *Spongilla carteri* on a twig. Encrustation 15 cms. long.
10. Gemmule of *Spongilla proliferens* ·35 mm.
11. Gemmule of *Spongilla carteri* ·35 mm.
12. Diagrammatic representation of an individual of a sponge to show its structure.

Figures 1 to 6 are after various authors, 10 and 11 are after Annandale.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Osculum
Pores
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PORIFERA

(Sponges)

PORIFERA are multicellular animals with very little or no differentiation of cells into organs. The surface of a simple sponge is covered by a delicate membrane formed of flattened cells and pierced by several small pores which lead into a single central cavity (Page 23, Fig. 12). This cavity is lined by cells (choanocytes) each bearing a flagellum whose combined movement sucks water into the central cavity through the small pores. The water leaves the central cavity through the large opening at the top termed the osculum (Page 23, Fig. 12). The current of water brings along with it food particles and takes away any undigested material and excreta. As growth proceeds the sponge forms an encrustation (Page 23, Fig. 9) on some object such as a leaf or stem of a water plant, or a dead twig or similar structure. On careful examination it will be seen that such an encrustation has several oscula which communicate with each other by way of the central cavities.

Between the outside membrane of flattened cells and the special cells lining the central cavity there is a structureless substrate containing various types of other cells and a supporting framework or skeleton. This skeleton is made up of spicules of calcium carbonate or silica bound together by a horny, unreactive substance termed spongin. The cells in the substrate perform different functions. Digestion is performed by particular individual cells and the products of digestion are passed on to other cells for absorption. If the need arises the cells can change their functions. Thus the cells which are digestive in function can when necessary serve as absorptive cells.

Sponges reproduce in three ways: (1) by means of eggs which are fertilised by spermatozoa, (2) by means of buds which appear and break off giving rise to new individuals, and (3) by means of structures called gemmules (Page 23, Figs. 10 and 11) which are living cells enclosed by a firm chitinous coat or shell. An outer crust of air cells, make the gemmules bouyant and help in their dispersal. Gemmules are capable of withstanding unfavourable conditions such as seasonal drought.

Only one family of sponges, namely Spongillidae with monaxon spicules, is found in freshwater. Two species have been recorded from Ceylon.

Spongilla carteri Bowerbank (Page 23, Fig. 9). As a rule this sponge is large with smooth and rounded surfaces occasionally bearing ridges. It has a particularly strong and an offensive odour. The spicules are smooth, pointed and nearly straight and are less than twenty times as long as they are broad.

Spongilla proliferens Annandale. This is a sponge forming soft shallow cushions, rarely more than 10 cms. in diameter on the leaves of water plants, or small irregular masses on their roots and stems. The colour of the sponge is green, the shade depending on the amount of sunlight available. The spicules are long, smooth and sharply pointed and are at least twenty times as long as they are broad. This species is found in ponds that do not dry up.

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BOWERBANK, J. S. 1863. A monograph of the Spongillidae. *Proc. zool. Soc. Lond. pp.* 440–472.

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COELENTERATA

(Hydra, Jellyfishes, Corals.)

COELENTERATES are radially symmetrical animals. The body wall is composed of two layers of cells, the ectoderm on the outside and endoderm on the inside with a structureless jelly-like substance termed the mesogloea in between. The body wall surrounds a central cavity called the enteron which serves as a digestive cavity. The enteron communicates with the outside through a single aperture at the top which serves as the mouth and also as the exit for any unwanted and undigested material. The mouth is surrounded by a ring of hollow tentacles which are usually constant in number for any particular species.

The Coelenterata include marine forms such as corals, sea-anemones, sea-firs and jelly-fish and a few freshwater species belonging to the division Hydrozoa. This division is represented in Ceylon freshwaters by *Hydra.*

Hydra exist as solitary individuals, often attached to water plants, &c., by their base. They are sometimes found floating on the surface of the water with their tentacles and trunk hanging down below the water level. They can also crawl with considerable rapidity in leech-like fashion. If conditions are favourable they could remain in one spot for quite a long time. *Hydra* is generally attracted to light but repelled by heat. A sudden rise in temperature, lack of aeration and growth of bacterial scum on the water surface can kill *Hydra.* They feed on small animals like cladocerans, copepods and even the larvae of chironomids. Two species of *Hydra* have been recorded from Ceylon.

Hydra vulgaris Pallas (Page 31, Fig. 1). They are usually found in stagnant water in ponds containing plenty of aquatic vegetation. The colour of individuals of this species varies from pale to deep orange and dull brown to dark green depending on the quantity and kind of food material they have consumed. When hungry the tentacles are greatly extended and may exceed the length of the trunk. The body is slender and cylindrical but takes on the shape of a wine glass when gorged with food or when it contracts on being disturbed (Page 31, Fig. 2). They have 4 to 6 tentacles but occasionally an individual may be found with 8 tentacles. Reproductive organs are confined to the upper part of the body and occasionally produce eggs with a protective shell so that they can withstand adverse conditions. Usually, reproduction takes place by budding. A small bud appears as a protusion of the body wall of the adult. At the terminal end of this bud is the mouth. The enteron of the bud communicates with that of the adult. After a time a constriction occurs at the base of the bud which has taken the form of a small individual (Page 31, Fig. 1) and eventually separates off from the parent.

Hydra zeylanica Burt. These *Hydra* are similar to *H. vulgaris* but are smaller in size. They live in slightly acid water. The colour varies, some individuals being almost transparent while others are light brown in colour. This difference in colour is correlated with the food supply. There are typically 4 hollow tentacles which may be extended to more than twice the length of the body. Propagation takes place both sexually and by budding, the latter being the more frequent and commoner method.

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ECTOPROCTA

(Moss animalcules)

ECTOPROCTA are a small group of animals which are sedentary and often colonial. The records of their occurrence are few. The Ectoprocta are exceedingly delicate though attractive looking creatures. The ectoproct animals are somewhat transparent and almost the entire structure of each animal could be made out under the microscope. The freshwater species are all colonial. On casual examination a colony of ectoproct animals looks like an aggregation of several *Hydra* but under the microscope the complex nature of each individual of the colony is revealed. The colonies take the form of branching threads spread on the surface of stones, sticks and submerged plants in the water.

Each individual of an ectoproct colony consists of a living, transparent jelly-like cage termed the zooecium in which is enclosed a contractile portion termed the polypide. At its base each zooecium is attached to another zooecium or to some sort of supporting structure. Each zooecium is open to the exterior by an aperture or orifice which lies opposite the base.

The polypide with its fully extended tentacles appears to be similar in structure to a *Hydra*. Certain portions of the polypide could be extended out from the aperture in the zooecium but when disturbed, the entire polypide withdraws into the zooecium. A characteristic feature of the polypide is the tentacle-bearing "lophophore" which in most species is horse-shoe shaped. The tentacles are not so contractile as in *Hydra* but they are covered with cilia which are in constant motion.

Most of the ectoproct species are hermaphrodites, both male and female sex organs being present in each individual. They reproduce in three ways (1) by means of fertilised ova or eggs, (2) by budding which as a rule does not produce independent organisms but add to the colony, and (3) by means of special asexually produced bodies called "statoblasts" (Page 31, Fig. 5). These statoblasts are present only in the freshwater Ectoprocta. The statoblasts consist of masses of cells containing abundant food material, enclosed in a capsule with a thick horny resistant wall and are capable of lying dormant under unfavourable conditions for months and sometimes years without losing their vitality. In many species the statoblasts are provided with a mass of horny walled chambers filled with air sacs giving bouyancy to the entire statoblast. The shape and form of the statoblasts are important features in the identification and classification of the ectoproct species.

Very often other animals are associated with the colonies of Ectoprocta. It is not uncommon to find oligochaete worms, sponges, insect larvae and even snails within the ectoproct colony.

Three species of Ectoprocta have been recorded from Ceylon.

Pectinatella burmanica Annandale (Page 31, Fig. 3). A colony of *Pectinatella burmanica* is circular and measures nearly 2·5 centimeteres. The statoblats are relatively large measuring over 1 mm. in diameter. The statoblasts are almost circular but one side is slightly flattened. The only recorded occurrence in Ceylon is a specimen obtained by Dr. Willey and reported by Annandale from a pool by the roadside between Maradankadawela and Galpitigalle at the foot of Ritigala in the North-Central Province.

Plumatella emarginata Allman (Page 31, Fig. 5). A colony of *Plumatella emarginata* covers a considerable area of flat surface and very often they are entirely recubment. Each individual is of a dark brown or almost black colour but it has a conspicuous white marking which gives the colony a stippled appearnace. Each individual has 40 tentacles. The presence of statoblasts of this species in the plankton of the Colombo Lake as reported by Apstein (1907) is the only record of it in Ceylon.

Plumatella (*Hyalinella*) *longigemmis* Annanadale. This species is commonly found attached to rocks and stones. Each individual in the colony is short and stout and attached to the substratum. Specimens in Ceylon were obtained in the Maligakande waterworks reservoir in 1912. They were found to be floating freely in the water. A colony consist of elongate, slender, cylindrical stems and branches, more or less entangled together, and forming masses comparable to those formed by many filamentous algae.

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APSTEIN, C. 1907. Das Plankton in Colombo see auf Ceylon. *Zool. Jb.* (*Abt. Syst.*) 25, 201–224.

KRAEPELIN, K. 1887. *Die Deutschen Susswasser-Bryozoen.* Pt. I, Anatomisch-systematischer Teil, Hamburg, 168 pp.

GASTROTRICHA

GASTROTRICHA are a group of free-living microscopic animals which live among algae and debris. The largest species however, may grow upto 2 mm. in length. They are generally common in the company of rotifers and protozoans.

In shape the Gastrotricha are elongate animals with a flattened ventral surface. They could very easily be mistaken for rotifers but for the absence of a corona. Some forms look like nematode worms but the possession of cilia, shows that they are an entirely different group. In addition to the cilia, parts of the body of gastrochians are covered with wasty protruberances in the form of scales The tail end is generally forked and bear adhesive organs.

Two species have been recorded from Ceylon :

Chaetonotus larus Ehrb. (Page 29, Fig. 1)

Ichthydium podura Ehrb. (Page 29, Fig. 2)

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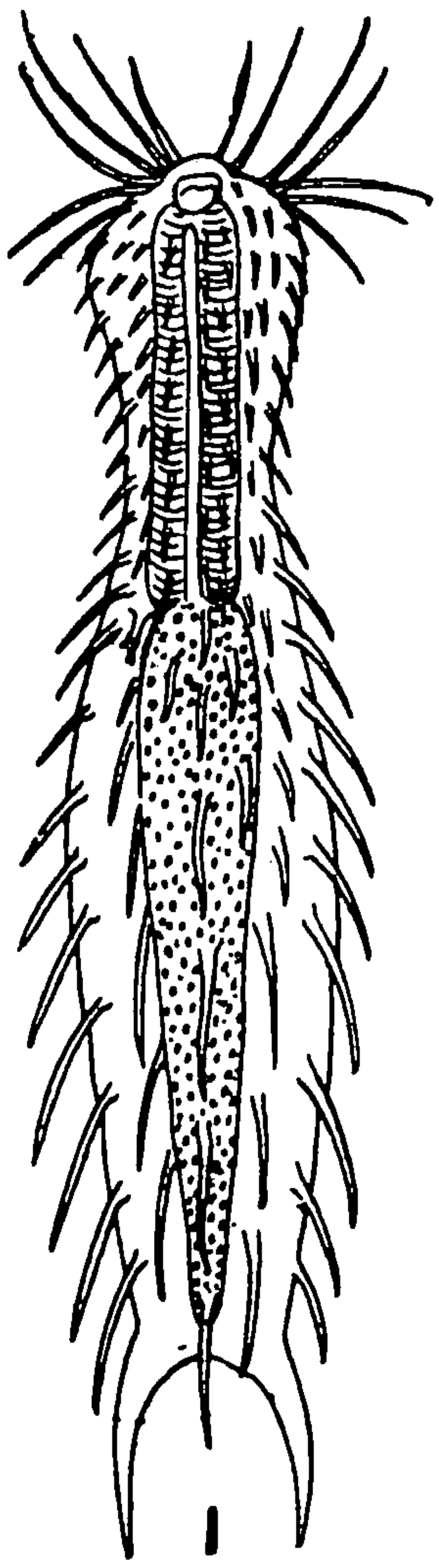
HYMAN, L. H. 1951 *The Invertebrates*, Vol. 3 Acanthocephala, Aschelminthes, and Entoprocta. The pseudocoelomata Bilateria. McGraw-Hill, New York 572 pp.



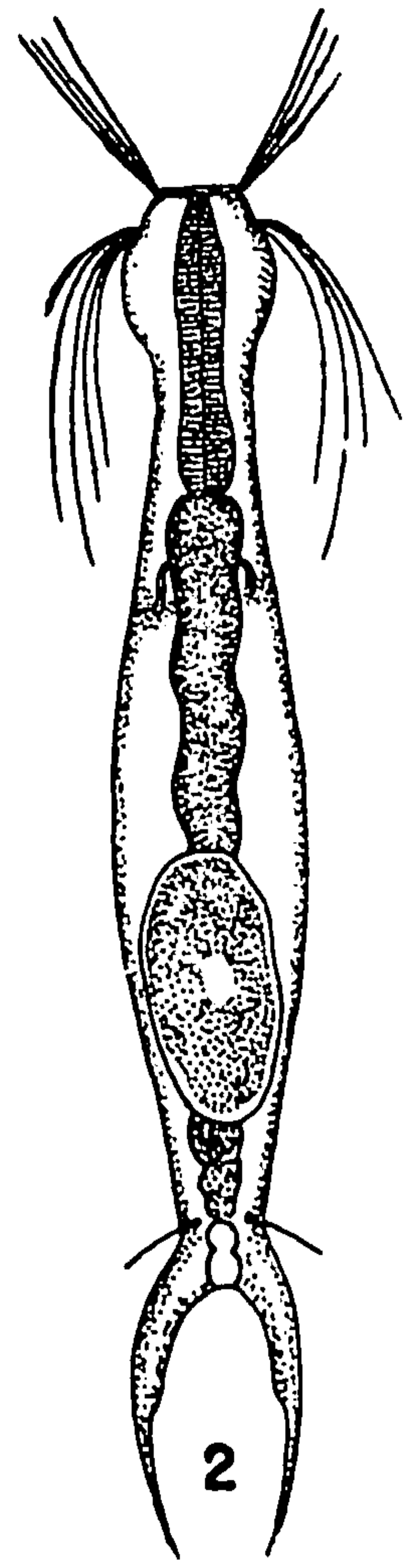


Fig. 1 *Chaetonotus* **sp. after Hyman 0·5 mm.**

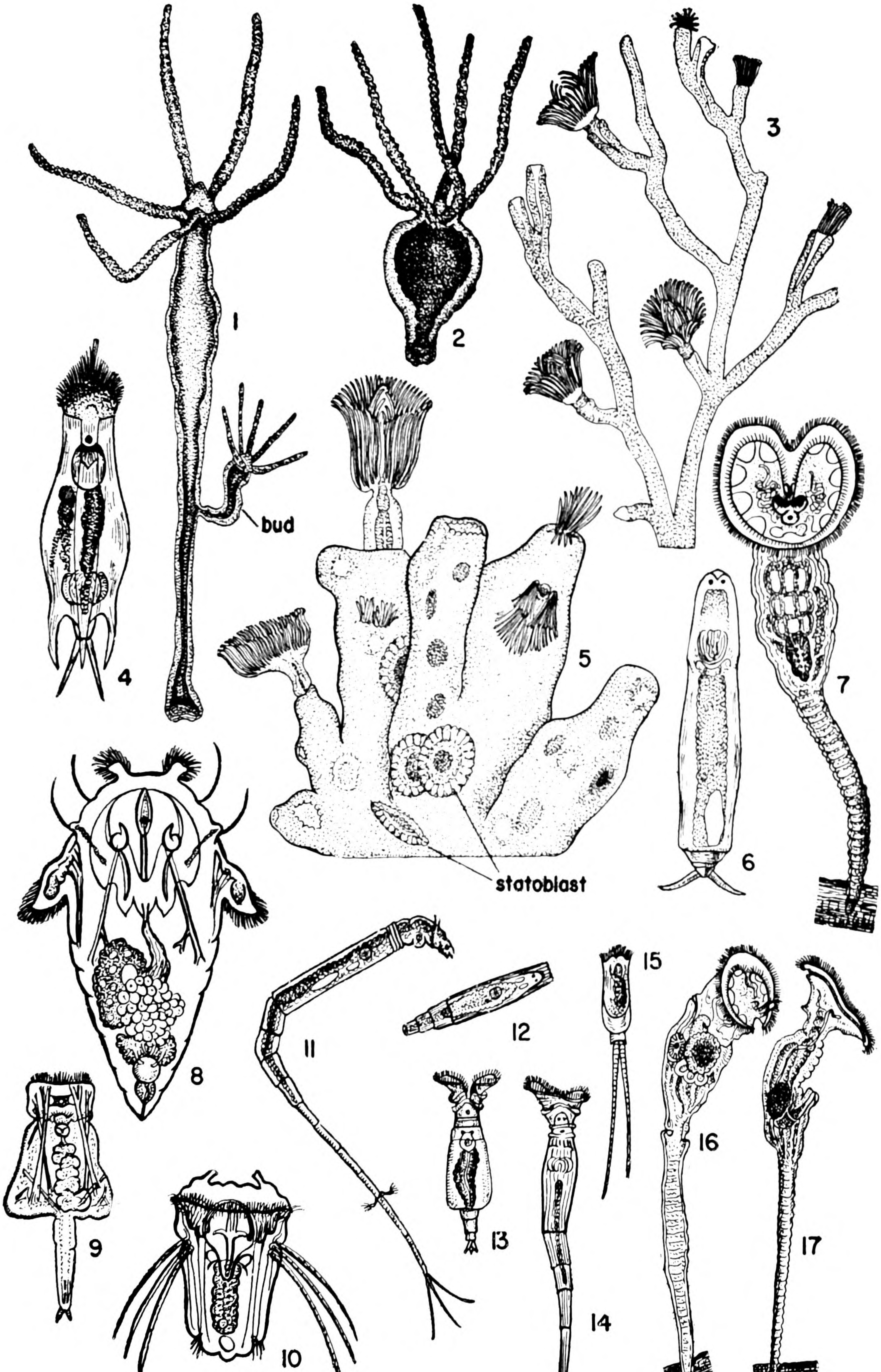
Fig. 2. *Ichthydium* **sp. after Hyman 0·5 mm.**

Explanation to figures on page 31

1. *Hydra vulgaris.* 5 mm. long
2. *Hydra vulgaris* (contracted). 2 mm. long
3. *Pectinatella burmanica*
4. *Salpina macracantha* 300μ
5. *Plumatella emarginata*
6. *Diglena forcipata* 280μ
7. *Megalotrocha* sp. 2 mm.
8. *Synchaeta pectinata* 350 μ
9. *Notops branchionus* 420μ
10. *Polyarthra platyptera* 125μ
11. *Actinurus neptunius* 1140μ
12. *Actinurus neptunius* with segments telescoped 350μ
13. *Philodina citrina* 500μ
14. *Rotifer vulgaris* 500μ
15. *Furcularia longiseta* 250 μ
16. *Conochilus volvox* 630μ
17. *Lacinularia socialis* 2 mm.

Figures 3 and 5 are after Kraeplin, 4 and 6 to 17 are from Hudson and Gosse.

[1] 1 μ = 1/1000th of a millimetre.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ROTIFERA

(Wheel animacules)

ROTIFERA are usually microscopic freshwater animals, the largest species attaining a length of 2 mm. They are present in both stagnant and running water. It is only rarely that they are encountered in saline water.

The rotifers are distinguished by the presence of a complicated feeding and locomotor organ called the " corona " which consists of long vibrating cilia variously arranged in the different families. The rest of the body, except in a few species, is without cilia. The corona lies at the anterior end of the animal. The movement of the coronal cilia creates a current of water towards the mouth.

The bodies of most rotifers are elongated. The posterior end of each animal is extended in the form of a stalk termed the " foot ", which may be used for attachment and sometimes for locomotion. The skin of a rotifer is generally flexible but in species belonging to certain families the skin is hardened to form an outer shell termed the lorica or shield. Most rotifers provided with a lorica have a definite shape and are therefore not difficult to identify. The sexes are distinct but the males in most species are very much smaller than the females and are so degenerate that they even lack an alimentary canal. The males have a much shorter life span than the females. Some rotifers are able to encyst during adverse conditions and live for long periods within the cyst till the return of normal conditions.

The species recorded from Ceylon are grouped in fifteen families.

KEY TO THE ROTIFERA

1. Fixed onto some object. Foot not retractile but wrinkled and ending in a sucking disc..........Melicertidae, page 33
   Free swimming..........2
2. Unwrinkled foot which is wholly retractile within body (telescopic)....Philodinidae, page 33
   Foot not wholly retractile or foot may be wanting..........3
3. Foot replaced by two appendages ending in ciliated expansions........Pedalionidae, page 35
   Foot may or may not be present but no ciliated appendages replacing foot..........4
4. Lorica[1] present..........5
   Lorica[1] absent..........12
5. Foot when present transversely wrinkled and wholly retractile..........6
   Foot not transversely wrinkled nor is it wholly retractile..........8
6. Foot ending in a ciliated cup..........Pterodinidae, page 39
   Foot when present not ending in a cup..........7
7. Lorica box-like and generally symmetrical. Foot absent........Anuraeidae, page 38
   Lorica depressed and dorsally arched. Foot when present forked........Brachionidae, page 38
8. Lorica of a single piece..........9
   Lorica made up of two or more pieces..........11

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[1] Lorica is the term given to the hardened outer skin of rotifers.

9. Lorica hardened on all sides 10
Lorica not hardened on ventral surface .... Coluridae, page 35

10. Lorica cylindrical without angles .... Rattulidae, page 35
Lorica vase-shaped, sometimes faceted .... Dinocharidae, page 35

11. Lorica depressed and of two dissimilar pieces .... Euchlanidae, page 34
Lorica compressed and appears to be formed of three or four pieces .... Salpinidae, page 34

12. Ciliary wreath of corona[1] interrupted 13
Ciliary wreath of corona[1] not interrupted 14

13. Ciliary wreath consists of interrupted curves and clusters .... Notommatidae, page 33
Ciliary wreath of a single interrupted marginal curve .... Synchaetidae, page 34

14. Ciliary wreath single, foot absent .... Asplanchnidae, page 38
Ciliary wreath of two parallel curves, foot present .... Notopsidae, page 34

FAMILY MELICERTIDAE

The rotifers in this family are either fixed on to some object (usually water weed) by their " feet " or live inside tubes. The foot is transversely wrinkled, not retractile into the body and ends in a sucking disc. The corona is a large disc having round its outer edge two transverse rings of cilia placed parallel to one another. Most of them are hardy individuals and are prolific breeders. Four species have been recorded from Ceylon.

Conochilus volvox Ehrb. (Page 31, Fig. 16)

Lacinularia socialis Ehrb. (Page 31, Fig. 17)

Limnias annulatus Bail.

Megalotrocha simibullata Huds. (Page 31, Fig. 7)

FAMILY PHILODINIDAE

The bodies of these rotifers appear to be divided into several segments some of which telescope into each other when the animal contracts (Page 31, Figs. 11 and 12). The foot is wholly retractile within the body. The corona is in the shape of two transversely placed lobes or wheels. They swim with the aid of the coronal cilia and also creep in leech-like fashion. They can remain for long periods in a dried up condition and recommence an active life as soon as a small quantity of water becomes available. Three species have been recorded from Ceylon.

Actinurus neptunius Ehrb. (Page 31, Figs. 11 and 12)

Philodina citrina Ehrb. (Page 31, Fig. 13)

Rotifer vulgaris Schrank (Page 31, Fig. 14)

FAMILY NOTOMMATIDAE

Externally these small sluggish rotifers give the appearance of being segmented. The corona which is narrower than the rest of the body, has a ring of cilia round its edge in some forms while

[1] The corona is the complicated feeding and locomotor organ which is characteristic of rotifers. This organ consists of vibrating cilia.

in others the cilia are uniformly arranged all over its surface. The short slender "foot" which is not sharply marked off from the body, ends in two toes. Two species have been recorded from Ceylon.

Diglena forcipata Ehrb. (Page 31, Fig. 6)

Furcularia longiseta Ehrb. (Page 31, Fig. 15)

FAMILY NOTOPSIDAE

They are fairly large cylindrical rotifers. Corona is provided with two parallel curved rings of cilia. The "foot" ends in two small toes. Two species have been recorded from Ceylon.

Notops branchionus Ehrb. (Page 31, Fig. 9)

Notops macrurus Barr. et Daday

FAMILY SYNCHAETIDAE

They are powerful swimmers with cone-shaped bodies which are at times furnished with spine-like structures which aid in locomotion. The corona is very large, much flattened and provided with a single ring of cilia. The foot is reduced while in some forms it is absent altogether. Two species have been recorded from Ceylon.

Polyarthra platyptera Ehrb. (Page 31, Fig. 10)

Synchaeta pectinata Ehrb. (Page 31, Fig. 8)

FAMILY SALPINIDAE

The lorica (outer shell) which is well defined has three or four longitudinal furrows and gives the rotifer a definite shape. The lorica appears to be formed of three or four plates. The corona and foot can be partially withdrawn into the lorica. Five species have been recorded from Ceylon.

Diplax ornata Daday

Salpina brevispina Ehrb.

Salpina macracantha Gosse (Page 31, Fig. 4)

Salpina macracantha var. *ceylonica* Daday

Salpina spinigera Ehrb.

FAMILY EUCHLANIDAE

These rotifers are common among aquatic vegetation. The lorica consists of two plates one of which is larger than the other. Sometimes a lorica may be lacking and the body is soft. The larger one is curved over the back of the animal while the shorter one is flat. Seven species have been recorded from Ceylon.

Cathypna luna Ehrb.

Cathypna macrodactyla Daday

Cathypna ungulata Ehrb.

Euchlanis dilata Ehrb. (Page 37, Fig. 1)

Monostyla bulla Gosse (Page 37, Fig. 2)

Monostyla lunaris Ehrb.

Monostyla quadridentata Ehrb.

FAMILY **COLURIDAE**

They are common among aquatic vegetation and debris. Lorica is of one piece but is usually soft on the ventral surface. A portion of the lorica extends over the head as a hood. Five species have been recorded from Ceylon.

Colurus bicuspidatus Ehrb. (Page 37, Fig. 8)

Colurus unicinatus Ehrb.

Metopidia lepadella Ehrb.

Metopidia ovalis Ehrb.

Metopidia triptera Ehrb.

FAMILY **RATTULIDAE**

Usually present among aquatic vegetation. The lorica is of one piece and is more or less cylindrical, but curved. One " toe " is greatly extended to form a spine while the other toe is absent or vestigeal. Six species have been recorded from Ceylon.

Coelopus tenuior Gosse (Page 37, Fig. 7)

Mastigocerca carinata Ehrb.

Mastigocerca elongata Gosse (Page 37, Fig. 3)

Mastigocerca rattus Ehrb.

Mastigocerca scipio Gosse

Rattulus tigris Müll. (Page 37, Fig. 4)

FAMILY **DINOCHARIDAE**

The lorica is vase-shaped but sometimes flattened and often spinous. These rotifers skip about by making powerful strokes with their prominent foot and toes. Two species have been recorded from Ceylon.

Dinocharis pocillum Ehrb. (Page 37, Fig. 6)

Scaridium longicaudum Ehrb. (Page 37, Fig. 5)

FAMILY **PEDALIONIDAE**

The rotifers belonging to this family have six limbs which are apparently jointed limbs, (some authors refer to them as arthropodous limbs), which help them to make skipping or jerky

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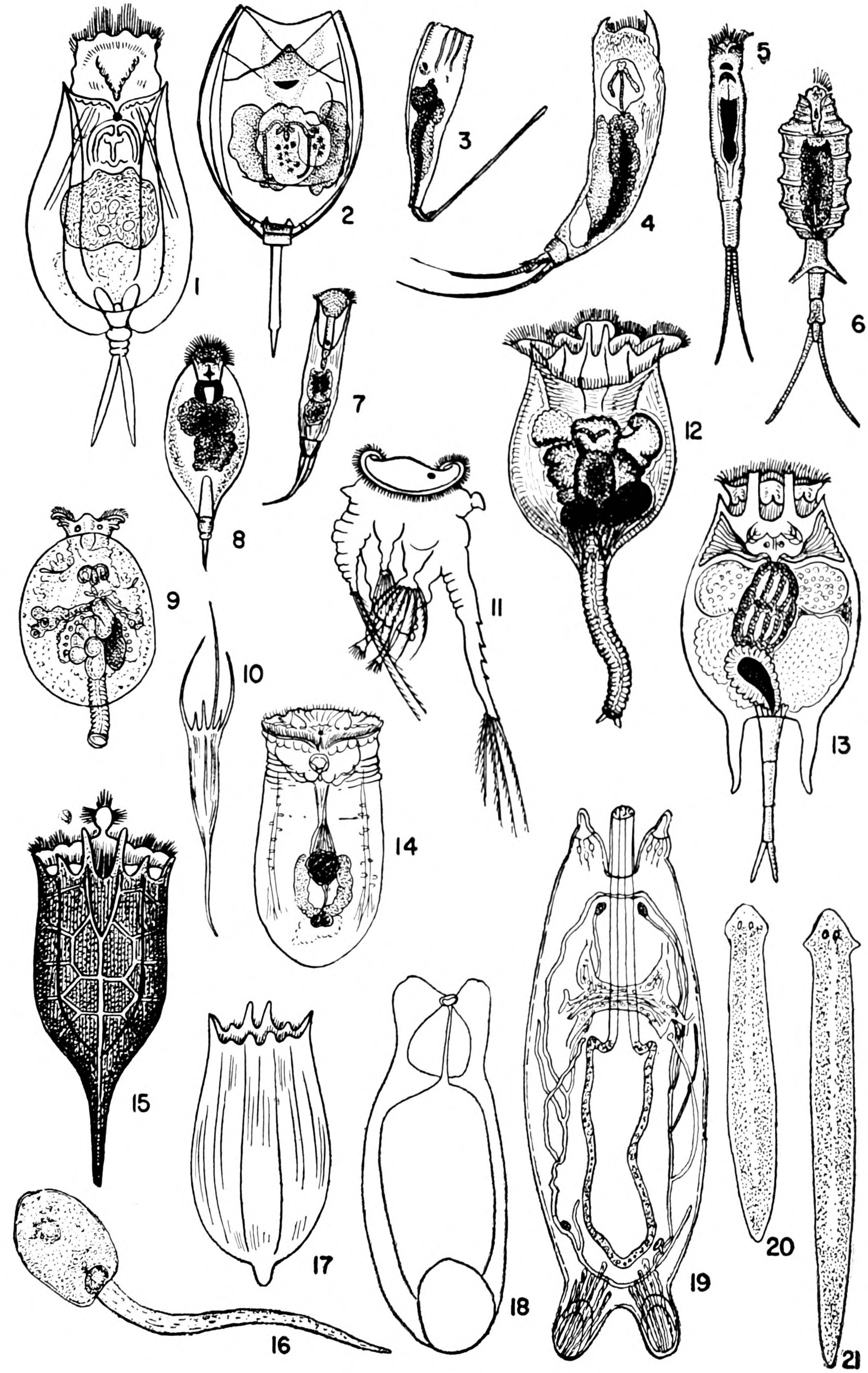
Explanation to figures on page 37

1. *Euchlanis dilata* 360μ[1]
2. *Monostyla bulla* 230μ
3. *Mastigocerca elongata* 500μ
4. *Rattulus tigris* 1200μ
5. *Scaridium longicaudum* 420μ
6. *Dinocharis pocillum* 310μ
7. *Coelopus tenuior* 250μ
8. *Colurus bicuspidatus* 80μ
9. *Pterodina elliptica* 120μ
10. *Notholca* after various authors 210μ
11. *Pedalion mirum* 210μ
12. *Brachionus rubens* 280μ
13. *Noteus quadricornis* 360μ
14. *Asplanchna brightwelli* 500μ
15. *Anuraea* after various authors 310μ
16. Free living trematode larva (Cercaria).
17. *Notholca* after various authors 250μ
18. Outline drawing of *Monodiscus macbridei* after Fernando 0·285 mm. long.
19. *Caridinicola* after Hyman.
20. and 21. Triclad turbellarians after various authors.

Figures 1 to 9 and 11 to 14 are from Hudson and Gosse.

[1] 1μ=1/1000th of a millimetre.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movements. The corona is in the shape of two transversely placed lobes or wheels and has two rings of cilia round the edge. One species has been recorded from Ceylon.

Pedalion mirum Huds. (Page 37, Fig. 11)

FAMILY **BRACHIONIDAE**

The lorica is made up of two plates, one of which is flattened and the other curved. The foot which is very prominent has ring-like markings on its surface. There are two small "toes". Surrounding the mouth *Brachionus* has three prominences which stand high above the general surface of the corona. Nine species have been recorded from Ceylon.

Brachionus amplicerus Ehrb. var. *levis* Apst.

Brachionus caudatus Bär et Daday

Brachionus falcatus Bär

Brachionus forficula Wierz var. *levis* Apst.

Brachionus melheni Bär et Daday

Brachionus militains Ehrb.

Brachionus pala Ehrb. var. *wilkyi* Apst.

Brachionus rubens Ehrb. (Page 37, Fig. 12)

Noteus quadricornis Ehrb. (Page 37, Fig. 13)

FAMILY **ANURAEIDAE** (Page 37, Figs. 10, 15 and 17)

The lorica is box-shaped and is formed of two plates, one curved and the other flat. These rotifers are usually armed with numerous spines. They do not possess a foot. Probably there are more species of Anuraeidae than the single species recorded for Ceylon. Although no species of *Notholca* has been recorded from Ceylon, this genus has been observed by the present authors.

Anuraea valga Ehrb. var. *tropica* Daday (Page 37, Fig. 15)

Notholca sp. (Page 37, Fig. 17)

FAMILY **ASPLANCHNIDAE**

The body is soft and sac-shaped, a lorica being totally absent. Corona consists of two transverse, flattened cones with distinct summits. The alimentary canal is not well developed, there being no posterior or anal opening, the undigested waste being disgorged through the mouth. The foot is very often lacking or inconspicuous and there are no toes. Four species have been recorded from Ceylon.

Asplanchna brightwelli Gosse (Page 37, Fig. 14)

Asplanchna brightwelli Gosse var. *ceylonica* Daday

Asplanchna myrmeleo Ehrb.

Asplanchna syrinx Ehrb.

FAMILY PTERODINIDAE

Corona provided with two rings of cilia round its edge. A lorica is present. The foot is usually absent or inconspicuous, wrinkled, wholly retractile and ending in a ciliated cup or disc. Two species have been recorded from Ceylon.

Pterodina elliptica Ehrb. (Page 37, Fig. 9)

Pterodina patina Ehrb.

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PLATYHELMINTHES

(Flatworms)

PLATYHELMINTHES are bilaterally symmetrical, dorso-ventrally flattened worms which do not have an anus. In structure they are more complex than the Coelenterata and have three layers of cells and well developed internal organs. The group is divisible into three distinct classes, namely Turbellaria, Trematoda and the Cestoda.

With a few exceptions the Turbellaria are free living forms. The members of this group are easily recognised by their flattened leaf-like shape. They measure 10–40 mm. in length. Several forms are present in freshwater.

A group of large turbellarians are the triclads (Page 37, Figs. 20 and 21) which are found beneath stones and leaves in all freshwater habitats ranging from hill country torrential streams to stagnant pools in the low country. They are entirely carnivorous, feeding on insects and small crustaceans.

They are rare in tropical regions and there are no records of triclads being present in Ceylon.

Another group of turbellarians are the Rhabdocoela in which the gut takes the form of a simple sac. They resemble the triclads in shape but they are smaller and are usually covered with cilia. They are usually found in stagnant water and feed on cladocerans, copepods, lower plants such as algae and diatoms.

Two species "*Convoluta*" *anostica* Schmarda and *Mesostoma rostratum* Dug. are recorded for Ceylon. In addition the cosmopolitan species *Mesostoma erhenbergi* (Focke) is probably present in Ceylon together with *Stenostomum* spp. which are widely distributed in the tropics.

An interesting sub-division of Rhabdocoela is the Temnocephalida which contain small (less than 3 mm. in length), transparent unciliated forms with tentacles and adhesive organs. The temnocephalids live in the gill chamber of freshwater "shrimps". Rarely specimens may be found on the external surface of the "shrimps". Three species from two genera have been recorded from Ceylon: *Caridinicola platei* Fern. (Page 37, Fig. 19), *Monodiscus parvus* Plate and *M.macbridei* Fern. (Page 37, Fig. 18). They were all taken from the branchial chamber (under the carapace) of freshwater "shrimps," *Caridina* spp. Temnocephalids do not generally depend for their food on the host which harbours them but feed on small animals and plants that come their way. Fernando 1952 stated "*C. platei* is found throughout Ceylon; in the Kandy Lake and in the Central Province, it is found living with *M. parvus*; in the low-country and dry zone of Ceylon, *C. platei* and *M.macbridei* are found living together. It must be admitted that a few specimens of *M.parvus* are sometimes found in the dry zone collections, but I have not been able to find *M.macbridei* in the Kandy or Peradeniya collections."

The Trematoda (flukes) and Cestoda (tapeworms) are parasitic forms. Some of them have complicated life cycles involving two or more hosts.

The trematodes are typically leaf like and usually possess suckers; one at the anterior end surrounding the mouth and the other on the ventral surface. Trematodes which have only one host, are usually found as external parasites on gills of fishes and the urinary bladder of amphibia. The trematodes that parasitize more than one host are generally found as adults in the internal organs of the final host. In some cases all the hosts are freshwater animals, but in most cases the final host in which the trematode becomes adult is a vertebrate which may be a land form. Trematodes pass their larval stages in a mollusc. Free living larval stages (Miracidia and Cercaria) (Page 37, Fig. 16) occur in freshwater.[1]

The cestodes [2] are ribbon shaped without an alimentary canal. They have suckers or sucking grooves at the head end. They parasitize several hosts but the adult is always found in the alimentary canal of a vertebrate animal. When all the hosts of cestodes are freshwater animals, the adult worm lives in the alimentary canal of a fish. Others parasitize a number of freshwater invertebrates and finally reach maturity in the alimentary canal of a mammal, bird, reptile or amphibian.

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[1] Dissanaike and Fernando (1960) have reported that 90 per cent. of the freshwater crabs, *Parathelphusa ceylonensis*, collected from a paddy field in Nugegoda, near Colombo, Ceylon, were infected with metacercaria of *Pleurogenoides sitapurii* (Srivastava). A large number of snails from the same habitat were examined and were found to possess larvae which were suspected to be those of *P. sitapurii.*

[2] *Senga lucknowensis* Johri (Ptychobothridae) and a protocephalid cestode were collected by the authors from *Mastacembalus armatus* and *Wallago attu* respectively.

NEMATODA[1]

(Roundworms)

NEMATODA are unsegmented worms with cylindrically shaped bodies tapering towards both ends. Free living nematodes have adapted themselves to a wide variety of habitats such as dessert, rivers. lake beds, and the waters of hot springs. In addition, there are numerous parasitic forms which play an important role in causing disease in animals and plants. Nematodes found in freshwater can be divided into three groups : Free-living, Parasites of Insects[2] and Parasites of Vertebrates[3]."

A number of small free living nematodes are common in freshwater especially in the mud, at the bottom of lakes. These thread-like worms, measuring only a few millimetres in length, are seen to whip themselves about by means of rapid contortions of the whole body. Weerakoon and Samarasinghe (1958) estimated that there were as much as 118,000 angullid nematodes (*Dorylaimus* sp.) per square mile of soil in a paddy field at Meegoda. This species is probably *D. stagnalis* Duj. (Page 47, Fig. 14) which is a cosmopolitan species.

A closely related species *D. palustris* (Carter) occurs in India. *Anguina tritici* (Stein) (Page 47, Fig. 15) is common in the rice fields of S. E. Asia.

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[1] A closely allied group the Acanthocephala (spiny-headed worms) also occur as parasites in fishes. Two species were recorded by the authors in *Ophiocephalus striatus* and *Macrones vittatus*.

[2] Most of the parasitic forms have at least a brief free living stage during which they achieve the transfer to a new host. Weerakoon and Samarasinghe state ". . . . . it is worthy of note that two of the chironomid larvae (*Spaniotoma* sp.) collected on February 28, 1950, contained a large larval nematode each, within its body-cavity." These nematodes belong to the family Mermithidae.

[3] Kulasiri and Fernando (1956) and Yeh (1960) record seven species of camallanid nematoda from an examination of the guts of several species of freshwater fish. The seven species are *Zeylanema anabantis* Pearse, *Z. pearsi* Yeh, *Z. kulasirii* Yeh, *Z. fernandoi* Yeh, *Z. sweeti* Moorthy, *Procamallanus spiculogubernaculus* Agarwal and *P. planoratus* Kulkarni. These nematode parasites have an interesting life-history. From the hosts intestine newly hatched larvae reach the water along with the faeces. The larvae undergo further development when they are eaten by copepods. After a time they encyst in the body cavity of the copepod. When the infected copepod is eaten by a fish, the nematode developes further and attains adulthood.

Two species of spiruroid larvae were found in the mesenteries of *Wallago attu*, *Ompok bimaculatus* and *Glossogobius giuris* by the authors.

NEMATOMORPHA

(Horsehair worms or Gordian worms)

NEMATOMORPHA which often occur as inextricably coiled masses are referred to as gordian worms after the mythical gordian knot (Page 47. Fig. 9). The term horsehair worms originated with the myth that these worms were transformed horsehairs. The larvae are parasitic on arthropods, chiefly insects. The adult worms do not feed, but a few cases are recorded of the adult accidentally "parasitic" in man. Generally the adults are free-living and aquatic being found in ditches, ponds and various shallow freshwater habitats.

Superficially the Nematomorpha resemble nematodes but they differ from them in internal structure. They vary in size from 10–70 cms. in length and 0.3–3 mms. in breadth. The diameter of the body is constant throughout except at the very extremities where a slight narrowing is noticeable. The mouth is hardly visible and there is no functional alimentary canal both in the adult and juvenile stages. The gordiids take no food into the digestive tract at any stage of their life cycle and therefore must obtain their nutrition by absorption through the body surface. At the posterior end is a cloaca into which the reproductive canals (or genital ducts) open. The tail of the male is usually bifid or trifid. The body is covered by a hard cuticle which is much stiffer than that of the nematodes. The body surface is usually covered with minute warts (areoles) (Page 47, Figs. 11 and 12).

The adult worms mate in the water and each egg hatches out into a larva with a simple body having a proboscis and several hooks. The larvae encyst on vegetation near the water and when they are swallowed by an aquatic animal along with the vegetation, the larvae bore through the gut wall of the animal and reach its body cavity. The larvae can penetrate into almost any small aquatic animal but can develop further only in an appropriate host, usually an insect. Within the host the larva gradually grows into a juvenile worm losing the larval stylets and hooks of the proboscis but without undergoing any definite metamorphosis.

Insects harbouring adult gordian worms are known to seek water. The juvenile worms leave the host by piercing through the body wall of the insect, which injury usually kills the insect.

Three species of gordian worms belonging to 2 genera have been recorded from Ceylon.

Chordodes skorikowi Camerano

Chordodes verrucosus (Baird)

Paragordius tricuspidatus (Dufour)

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ANNELIDA

(Earthworms, Leeches)

ANNELIDS are elongate and cylindrical worms with soft segmented bodies covered externally by a cuticle which is a secretion of the skin. Some annelid groups, collectively termed the Chaetopoda, have chaetae or bristles which are embedded in the skin. These chaetae which are composed of chitin (a secretion of the skin) are arranged in definite patterns. The mouth of an annelid occupies a ventral position overhung by a small preoral lobe. The anus is terminal, i.e., it is at the posterior end of the body. The anterior and posterior ends of annelids, particularly the smaller chaetopods, appear to be alike.

The annelids found in fresh water belong to two groups, namely the Oligochaeta (earthworms) which is a sub-division of the Chaetopoda, and the Hirudinea (leeches).

KEY TO THE ANNELIDS

1. No suckers. Chaetae present. Body generally cylindrical....Oligochaeta, page 44
   Suckers present. No chaetae. Body generally flattened............Hirudinea, page 48

OLIGOCHAETA

These are chaetopod annelids with a comparatively small number of chaetae. The chaetae are arranged in four groups on each segment, two on the dorsal side and two on the ventral side. The structure and size of these chaetae are an important diagnostic feature of the various oligochaete families.

The aquatic oligochaetes or as they are more commonly called the "aquatic earthworms" inhabit the bottom ooze and debris where they could burrow deeply into the mud like terrestrial forms. Some of them are capable of constructing burrows which project above the surface of the mud as a tube made of sand and debris. The worm lives inside the tube with its anterior end at the bottom of the burrow feeding on the mud while its posterior end extends out of the tube into the water Most aquatic oligochaetes reproduce asexually by fission. When a worm is ready to multiply a number of new segments are formed at some point along the body. At this point it breaks up into two new individuals. Some of the new segments go to form the posterior end of one new worm while the rest of the segments form the front or anterior region of the other.

Aquatic oligochaetes are important as food for fishes. The bottom feeding fishes often feed on them and the undigested chaetae are commonly seen when the gut contents of these fishes are examined.

Aquatic earthworms may sometimes reach very great numbers in muddy soils rich in decaying organic matter. The Lumbricidae, of which one species has been recorded from Ceylon plays a role similar to that of the common earthworm in the soil, i.e., bringing up and mixing the soil.

The aquatic oligochaetes recorded from Ceylon fall into four families, namely, Aeolosomatidae, Naididae, Tubificidae and Lumbricidae

1. Only two chaetae per bundle (i.e. eight in all) on each segment............Lumbricidae, page 45
   More than eight chaetae in each segment.. 2
2. Zones of budding visible, reproduction by fission takes place at these zones............ 3
   No zones of budding. Reproduction sexual...............................Tubificidae, page 45
3. Preoral lobe (Prostomium) with cilia on the ventral side........Aeolosomatidae, page 45
   No cilia on ventral side of preoral lobe...Naididae, page 45

FAMILY **AEOLOSOMATIDAE**

These are small freshwater worms which are usually less than 10 mm. in length. The number of chaetae per segment varies from species to species. The paired testes of each animal tend to become fused together as happens with the paired ovaries. Although these worms possess well developed sex organs their chief means of reproduction is by fission.

Only one species has been recorded from Ceylon. It has three chaetae per group (i.e., 12 chaetae in all).

Aeolosoma ternarium Schmarda (Page 47, Fig. 7)

FAMILY **NAIDIDAE**

They are small aquatic worms, the largest forms growing up to 25 mm. in length. Although the sex organs are better developed than in the Aeolosomatidae, their usual mode of reproduction is by fission.

Ten species of Naididae have been recorded from Ceylon. They are very common in muddy soils like in paddy fields. *Dero* sp. construct tubes. At the posterior end of these worms are a number of ciliated " gills " in which red blood may be seen, giving the entire worm a pink colour. *Chaetogaster* is usually found associated with tube building insect larvae.

Allonais paraguayensis paraguayensis (Mich.)

Aulophorus michaelseni Steph.

Aulophorus tonkinesis (Vejd.)

Chaetogaster sp. (Page 47, Fig. 8)

Dero limosa Leidy (Page 47, Fig. 5)

Dero zeylanica Steph. (Page 47, Fig. 5)

Pristina breviseta (Bourne)

Pristina minutum (Steph.)

Pristina proboscidea Bedd.

FAMILY **TUBIFICIDAE** (Page 47, Fig. 10)

These aquatic worms are usually small but there are certain species growing up to 200 mm. in length. They are more slender than the other three families and do not reproduce by fission. They have red blood cells and they usually construct tubes in the mud out of which their tails project into the water (Page 47, Fig. 13). Two species of Tufibicidae have been recorded from Ceylon.

Bothrioneurum iris Bedd.

Limnodrilus socialis Steph.

FAMILY **LUMBRICIDAE**

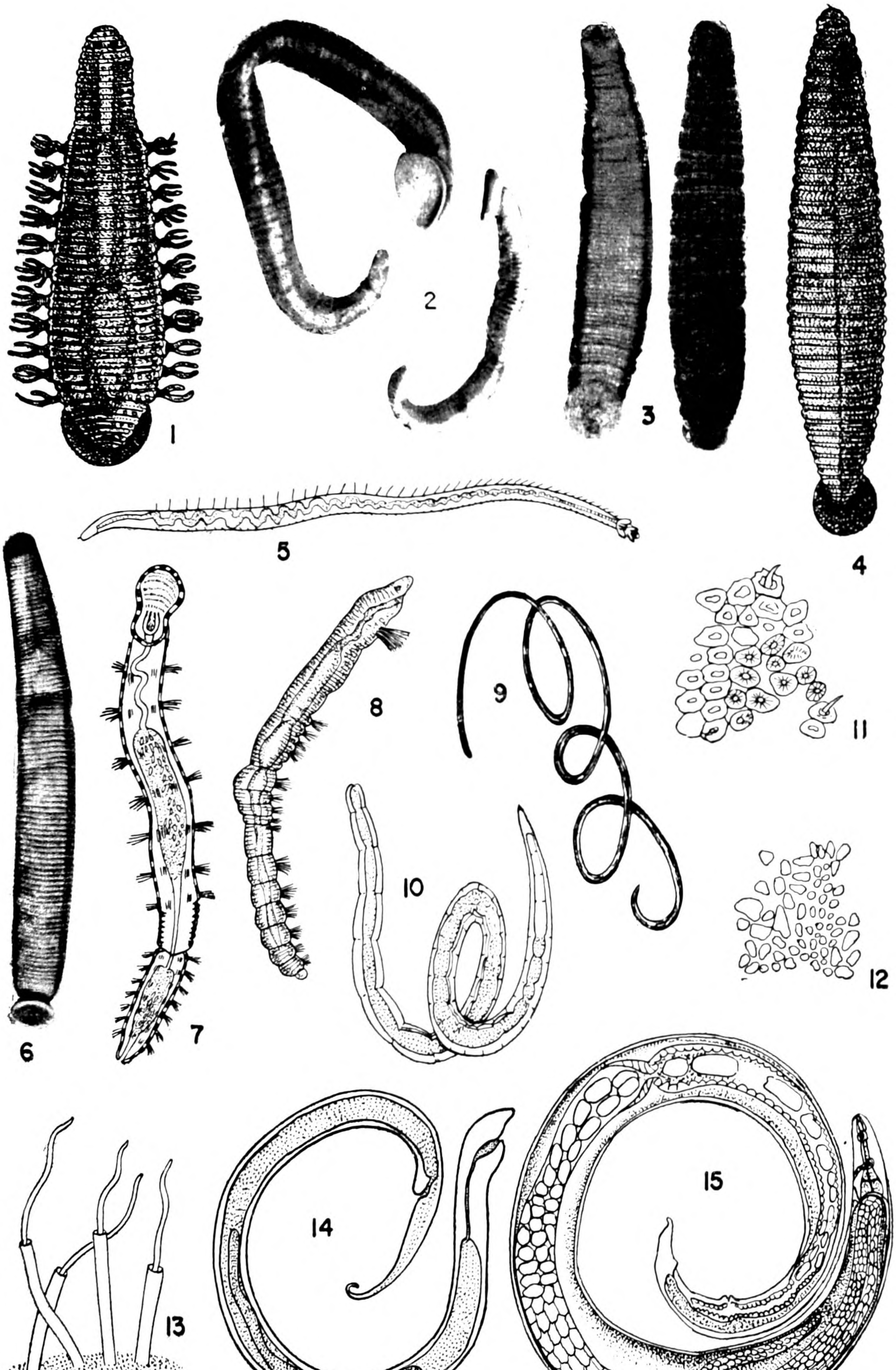
These are long worms that may measure up to 150 mm. in length. They are not truly aquatic forms, being usually found in marshy localities. They are deep red to reddish brown in colour due to the colour of their blood. Only two S-shaped chaetae are present in each of the four segmental groups (i.e., 8 chaetae per segment). They do not reproduce by fission.

One unidentified species has been recorded by Weerakoon and Samarasinghe (1958).

Glyphidrilus sp.

Explanation to figures on page 47

1. *Ozobranchus shipleyi* 20 mm. long.
2. *Dinobdella ferox,* from Dhanapala and Fernando 17 cms. long.
3. Ventral and dorsal views of *Hirudinaria manillensis,* from Dhanapala and Fernando 11 cms. long.
4. *Placobdella emydae* 13·5 mm. long.
5. *Dero* sp., from Mellanby 19 mm. long.
6. *Hirudo birmanica,* from Dhanapala and Fernando 7 cms. long.
7. *Aeolosoma* sp., from Mellanby 1–2 mm. long.
8. *Chaetogaster* sp., after Mellanby 7 mm. long.
9. A diagrammatic representation of a gordian worm.
10. *Tubifex* sp., after Mellanby 3 cms. long.
11. Surface view of *Chordodes* sp.
12. Surface view of *Gordius* sp., showing areoles.
13. *Tubifex* worms in mud tubes, after Mellanby.
14. *Dorylaimus stagnalis,* after Mellanby 5–8 mm. long.
15. *Anguina tritici,* from Goodey 3·5 mm. long.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HIRUDINEA

THESE are annelids with flattened and shortened bodies, which when extended take on a cylindrical form. They have a small and regular number of segments (usually 32), which are sub-divided into annuli. They usually have no chaetae and are distinguished from all other annelids in having two ventral suckers, one at each end of the animal. The sucker at the posterior end of the animal is very clearly visible but the anterior sucker with the mouth at its centre is not always well marked. The number of eyes vary with the species.

The Hirudinea are divisible into two sub-orders, namely Rhynchobdellae and Arhynchobdellae

1. Relatively small forms with a protrucible pharynx..............Rhynchobdellae, page 48

   Relatively large forms with teeth in their jaws. No protrucible pharynx..............Arhynchobdellae, page 49

SUB-ORDER **RHYNCHOBDELLAE** (Sucking Leeches)

THE rhynchobdellid leeches are 6–20 mm. in length, and are parasitic forms which suck the blood and body juices from their hosts. For this purpose the leech is provided with a protrucible proboscis. The proboscis which is a highly muscular adaptation of the pharynx, is thrust through the small oral opening at the centre of the anterior sucker into the flesh of the host. The rhynchobdellid leeches cause damage to the body surface of aquatic vertebrates including fishes. This may lead to secondary infection by fungi and bacteria. They may also cause considerable loss of blood if large numbers are present in a single host. Some species also act as intermediate hosts of blood parasites like trypanosomes and haemogregarines.

An interesting feature in these leeches is that the young are carried on the ventral surface of the parent. The rhynchobdellid leeches exhibit considerable diversity of forms as will be seen in the description below. Five species have been recorded from Ceylon.

Ozobranchus shipleyi Harding (Page 47, Fig. 1)

This leech is commonly found attached to the soft parts of the black terrapin (tortoise), *Melanochelys trijuga thermalis* (Lesson). Its body is translucent, the entire dorsal surface being dull yellow with dark green margins. The posterior sucker has dark green spots. A characteristic feature of this leech is that the posterior region has eleven pairs of lateral digitate branchiae or gills which are colourless and almost transparent. It has one pair of eyes. This leech is the intermediate host of a blood parasite (*Haemogregarina* sp.) of the black terrapin.

Placobdella ceylonica Harding

Placobdella emydae Harding (Page 47, Fig. 4)

Placobdella undulata Harding

These leeches are greatly flattened forms. The anterior sucker is fused with the ventral body wall, but the posterior sucker is free. Generally the leeches of this genus have only one pair of eyes but *P. ceylonica* has three pairs. They usually parasitize the soft terrapin (tortoise) *Lissemys punctata celonicus* (Gray) but it is not uncommon to find them on other freshwater vertebrates particularly fishes. *P. undulata* has been found on *Etroplus* (S. Koraliya). Placobdellid leeches are intermediate hosts of blood parasites of vertebrates.

Paraclepsis vulnifera Harding

The body of this leech is more rounded than the preceding forms. The mouth is sub-terminal leaving the anterior sucker imperforate. The dorsal surface of body is roughened due to the presence of numerous minute papillae. It has 3 pairs of eyes. This is a common parasite in the branchial cavities of freshwater crabs.

SUB-ORDER **ARHYNCHOBDELLAE** (Biting Leeches)

The Arhynchobdellae are relatively large forms ranging from 25 mm. to 300 mm. or more in length. They have teeth in their jaws and their bites can cause considerable loss of blood in the host. The arhynchobdellid leeches are common parasites of vertebrates, sometimes even in man. They do not have a protrusible proboscis.

Into this sub-order fall the so called "cattle leeches" namely *Limnatus* and *Dinobdella*. In Ceylon two species are on record.

Limnatus paluda (Tennant)

This leech is also called the "horse leech", and it grows to about 60 mm. in length. Both anterior and posterior suckers are large, the latter sometimes exceeding the maximum width of the body. It is uniformly brown in colour with longitudinal dark stripes.

Dinobdella ferox (Blanchard) (Page 47, Fig. 2)

This is a very large "cattle leech", the adults ranging from 200 to 300 mm. in length. They are uniformly dark green in colour, an uniformity which distinguishes this species. The posterior sucker is prominent and circular with its diameter exceeding the width of the body. The jaws are small and without teeth. There are numerous records of these leeches being present in the nasal passages of cattle and other animals. The "cattle leeches" have relatively small jaws with rudimentary teeth and are unable to penetrate the outer skin and hence suck blood from the highly vascular mucous membrane of the mouth, nasal passage, pharynx and larynx of their hosts (cattle, domestic animals and even man). The leeches get into these cavities when the animals visit stagnant pools. Several leeches may be present in the nasal passages of one host from where they are difficult to dislodge and they can cause the death of the host by suffocation.

The "Medicinal leeches" represented in Ceylon by *Hirudinaria manillensis* and *Hirudo birmanica* are two other species of arhynchobdellid leeches present in Ceylon.

Hirudinaria manillensis (Lesson) (Page 47, Fig. 3)

This species grows up to about 100 mm. in length and 25 mm. in breadth. The leech is brownish green on its dorsal surface and lighter green on its ventral side. In the median line of the dorsal surface is a series of elongated black spots on a broad light green stripe. On each side of this stripe are two narrow longitudinal yellowish stripes with black borders. The entire dorsal surface is flecked with black. There are two broad black stripes on the ventral surface. The anterior end of the leech is broad and the diameter of the posterior sucker is less than the width of the body. This leech is found in the low country in stagnant waters of paddy fields and slow running streams. The jaws are well developed and numerous teeth are present. They are often found attached to the skin of buffaloes. In addition to being called "medicinal" leeches, they are sometimes referred to as "paddy field" or "buffalo" leeches.

Hirudo birmanica (Blanchard) (Page 47, Fig. 6)

This leech is about 60mm. long and is slender in comparison to *Hirudinaria manillensis*. It is olive brown in colour with seven thin black stripes on its dorsal side. The leech is narrower at its anterior end. The posterior sucker is less than the width of the body. The jaws and teeth are well developed. This species is found in rivers and streams and sometimes in swamps and irrigation reservoirs. They are not as common as *Hirudinaria manillensis*.

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MOLLUSCA

(Snails and Mussels)

MOLLUSCS are relatively advanced invertebrates whose bodies are not segmented but a well developed "head" is usually present. Molluscs have complex internal organs with well developed digestive, respiratory and reproductive systems. Most molluscs possess a shell formed by secretions from the skin. The shell is composed of calcium compounds and is never discarded but constantly added to as growth proceeds. If the shell is removed from the fleshy portion, the animal dies. This is in direct contrast to the arthropods where with growth of the animal, the chitinous exoskeleton is being periodically discarded and replaced by a larger one.

Molluscs are hardy animals and survive periods of drought buried in the mud. They are scavengers and eat decaying organic matter and the aquatic species thereby help in purifying water. Molluscs form an important item in the diet of some fishes and other aquatic and non-aquatic animals. Some species are intermediate hosts of parasites particularly the digenetic flukes which are found in man, domestic animals and nearly all vertebrates. The control of flukes depends largely on the control of the mollusc involved. Two groups of molluscs are common in the freshwater; (1) the univalve molluscs or snails termed the Gastropoda, and (2) the bivalve molluscs or mussels termed the Lamellibranchia.

1. Shell of a single piece....................Gastropoda, page 51
   Shell of two valves which are hinged together....................Lamellibranchia, page 58

GASTROPODA

(Univalve Molluscs or Snails)

In this group the shell of each mollusc is of one piece and hence they are termed "univalve molluscs". The shells of the various species take on different forms and shapes (flattened, cone shaped, spirally coiled, &c.). Gastropods possess a distinct "head" with a pair of contractile tentacles. At the base of the tentacles are a pair of eyes. (Land gastropods have the eyes on the tip of the tentracles). The mouth which occupies a ventral position lies just below and between the two tentacles. The upper jaw is chitinous while in the lower part of the mouth is a radula or rasp which is a muscular ribbon covered with rows of minute teeth. Gastropods feed by rasping off plant material with the aid of the chitinous jaw and the radula. As the front portion of the radula wears off the ribbon grows forward bringing fresh teeth into use. The head is continuous with the flattened foot on the ventral side. The gastropods glide over any object lying in the water by muscular action of the foot. Sometimes they even move about on the surface of the water with the body hanging downwards. All that portion of the animal which lies within the shell excluding the head and foot is referred to as the visceral hump which contains the organs of digestion, circulation, respiration and reproduction.

For reproduction to take place in gastropods two individuals must come together although some molluscs possess both male and female sex organs. Most gastropods deposit eggs but the members of some families such as Thiaridae and Viviparidae are viviparous. These viviparous molluscs are provided with pouches, referred to as "marsupia", in which the young remain until they are sufficiently developed to be liberated.

The fresh water gastropods are divided into two groups: (1) Operculate, and (2) Pulmonate.

1. Horny plate on foot which serves as an operculum............Operculate Gastropods, page 52
   No horny plate on foot....................Pulmonate Gastropods, page 57

5——R 19576 (9/61)

OPERCULATE GASTROPODS

These gastropods have a horny plate attached to the foot. The plate is of a peculiar chitinous or calcareous structure and closes the opening of the shell when the animal retracts. During the drought the snail can hibernate within the closed shell. The operculate gastropods breathe dissolved oxygen present in the water through special gills and they are generally present in water which is well aerated. Most operculate gastropods have separate male and female individuals (unisexual).

Operculate gastropods in Ceylon are represented by about 80 recorded species belonging to five families.

1. Shell subglobular or subpatelliform, i.e., flattened from top to bottom. May have a very small spire........Neritidae, page 52

   Shell globose, oval or carrot shaped and usually with a prominent spire........2

2. Shell distinctly carrot shaped, spire prominent........Thiarinae[1], page 52

   Shell globose or ovately fusiform........3

3. Shell large and globose........Pilidae, page 56

   Shell ovate or ovately fusiform........Paludominae[1-2], page 53, Paludestrinidae[2], page 56, and Vivaparidae[2] page 56

FAMILY NERITIDAE

This family consists of flattened forms similar to the common limpets present on wave washed rocks in the sea shore and rounded forms like the marine periwinkles. The shells are small and have a low spire. Most species have coloured patterns of lines and bands. The operculum is semicircular in shape. The freshwater species may extend to brackishwater bodies with rocky bottoms.

Septaria livesayi (Dohrn)

Septaria reticulata (Reeve)

Septaria squamata (Dohrn), (Page 55, Fig. 1)

Theodoxis perotetiana (Reclus)

FAMILY THIARIDAE

These operculate gastropods are viviparous. *Faunus*, *Melanoides* and *Thiara* spp. have turreted shells with many whorls, *Paludomus* spp. have ovoid shells with a low spine and few whorls. *Faunus*, *Melanoides* and *Thiara* have adapted themselves to inhabit stagnant or slow running waters in which decaying vegetable matter and mud are present. *Thiara* and *Paludomus* spp. are abundant in up-country streams with rocky bottoms. *Paludomus* spp. are chiefly rocky mountain stream forms but certain species are present in low country streams and even in paddy fields. *Faunus ater* is present in fresh and brackish water. *Melanoides* is found both in the low and up-country.

SUB-FAMILY THIARINAE

Faunus ater (L.) (Page 55, Fig. 5)

Faunus ater perdecollata Nevill.

Melanoides broti (Dohrn)

Melanoides broti subviridis (Nevill)

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[1] Sub-families of the family Thiaridae.

[2] There is much variation in the shape of the shell of the species of operculate gastropods belonging to these three groups. Hence no attempt has been made to separate them by simple external characters.

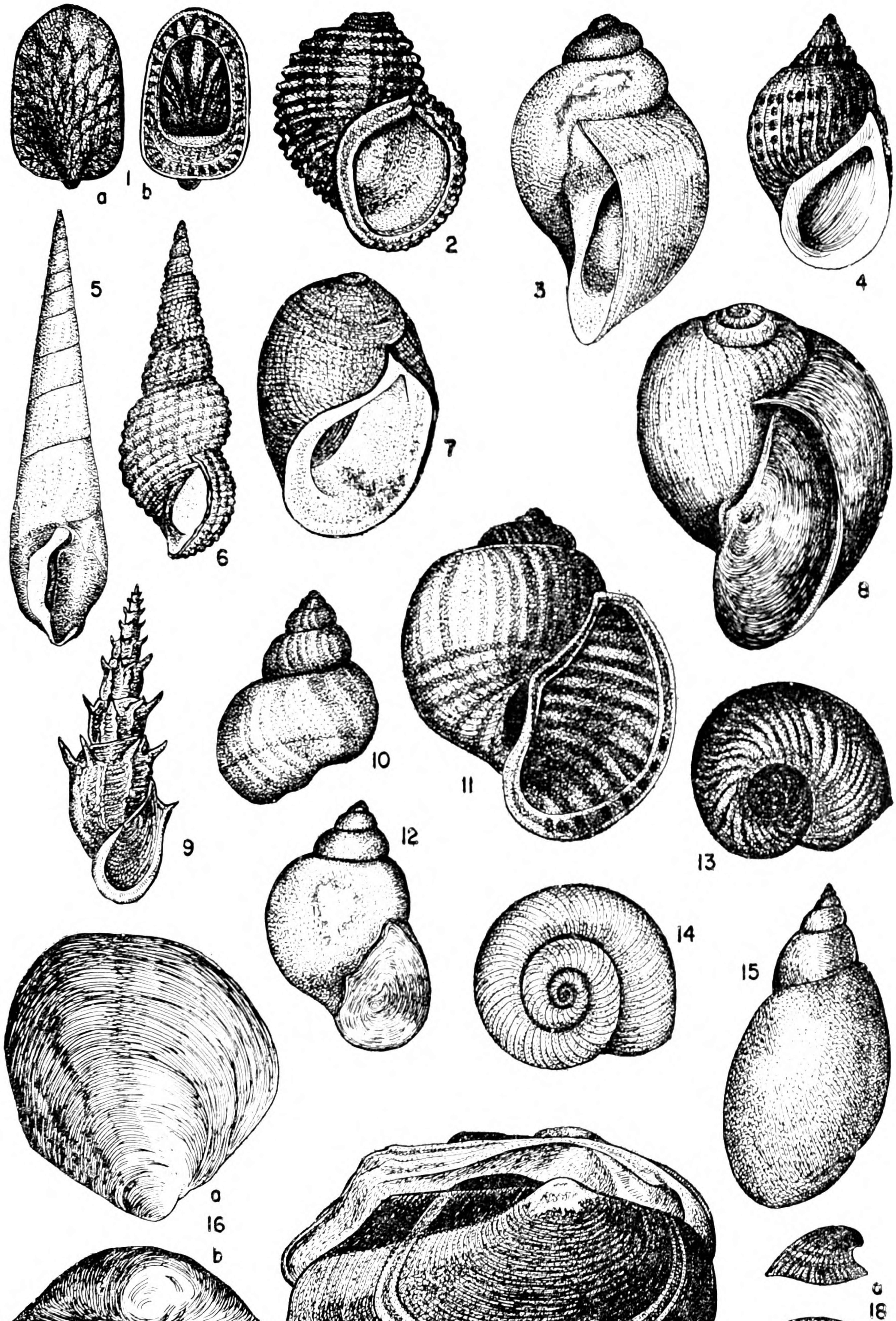
Melanoides crenulata (Deshayes)
Melanoides crenulata confusa (Dohrn)
Melanoides lineata (Gray)
Melanoides tuberculata (Müller), (Page 55, Fig. 6)
Melanoides tuberculata layardi (Dohrn)
Melanoides tuberculata subcreba (Nevill)
Thiara acanthica (Lea) (Page 55, Fig. 9)
Thiara datura (Dohrn)
Thiara rudis (Lea)
Thiara scabra (Müller)

SUB-FAMILY **PALUDOMINAE**

Paludomus abbreviatus Reeve
Paludomus bicinctus Reeve
Paludomus chilinoides Reeve (Page 55, Fig. 3)
Paludomus clavatus Reeve
Paludomus constrictus Reeve
Paludomus cumingianus Dohrn
Paludomus decussatus Reeve
Paludomus dilatatus Reeve
Paludomus distinguendus Dohrn
Paludomus dromedarius Dohrn
Paludomus erinaceus Reeve
Paludomus erroneus Nevill
Paludomus fulgurata Dohrn
Paludomus funiculatus Reeve
Paludomus gardneri Reeve
Paludomus globulosus Gray
Paludomus hanleyi Dohrn
Paludomus hanleyi major Nevill
Paludomus laevis Layard
Paludomus loricatus Reeve (Page 55, Fig. 2)
Paludomus melanostomus Hanl. & Theob.
Paludomus nasutus Dohrn
Paludomus neritoides Reeve (Page 55, Fig. 7)
Paludomus neritoides globosus Brot.
Paludomus nigricans Reeve
Paludomus nigricans subgranulosa Nevill
Paludomus nodulosus Dohrn
Paludomus palustris Layard
Paludomus pictus Reeve
Paludomus pyriformis Dohrn

Explanation to figures on page 55

1. Dorsal (*a*) and ventral (*b*) views of *Septaria squamata* from Hanley and Theobald. Diameter 20 mm.
2. *Paludomus loricatus* 30 mm. high.
3. *Paludomus chilinoides* 2 cms. high.
4. *Paludomus zeylanica*, from Han. and Theo.
5. *Faunus ater* 8 cms. high.
6. *Melanoides tuberculata* 20 mm. high.
7. *Paludomus neritoides* 2 cms. high.
8. *Pila globosa* 4·5 cms. high.
9. *Thiara acanthica*, from Han. & Theo.
10. *Bellamya ceylonica* 2 cms. high.
11. *Pila layardi*, from Han. & Theo. 5 cms. high.
12. *Bithynia inconspicua* 5 mm. high.
13. *Indoplanorbis exustus*. Diameter 15 mm.
14. *Gyraulus saigonensis*. Diameter 4 mm.
15. *Lymnaea pinguis* 15 mm. high.
16. A single valve (*a*) and hinge view (*b*) of *Polymesoda impressa* from Preston.
17. *Lamellidens marginalis* from Han. & Theo.
18. Side view (*a*) and dorsal view (*b*) of *Ancylus zeylanicus* from Han. & Theo.


1 a b
2
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16 a b
17
18 a b

Paludomus reevei Layard

Paludomus regalis Layard

Paludomus rupaeformis Brot.

Paludomus similis Layard

Paludomus skinneri Dohrn

Paludomus solidus Dohrn

Paludomus sphaerica Dohrn

Paludomus spiralis Reeve

Paludomus striatula Nevill

Paludomus subdentatus Nevill

Paludomus sulcatus Reeve

Paludomus sulcatus compactus Nevill

Paludomus sulcatus contractus Nevill

Paludomus sulcatus minor Nevill

Paludomus swainsoni Dohrn

Paludomus tennanti Reeve

Paludomus thwaitesi Layard

Paludomus torrenticolus Dohrn

Paludomus violaceus Layard

Paludomus zeylanica Lea (Page 55, Fig. 4)

FAMILY **PALUDESTRINIDAE**

The shell is pyramid like. The last whorl of the shell is large and inflated. Members of this family inhabit stagnant or slow running water, especially those with a plentiful supply of mud and decaying vegetable matter.

Bithynia inconspicua (Dohrn) (Page 55, Fig. 12)

Bithynia stenothyroides (Dohrn)

Mysorella costigera [1] (Küster)

FAMILY **VIVAPARIDAE**

The shell has a pointed apex and a rounded base and its profile is like that of a pyramid. The operculum has several concentric rings. These gastropods liberate young and not ova.

Bellamya ceylonica (Dohrn) (Page 55, Fig. 10)

Bellamya ceylonica ecarinata (Han. & Theob.)

FAMILY **PILIDAE**

Their shells are large or moderately large, being almost the size of the common garden snail, *Acatina*. The shell is light brown coloured. The operculum has several concentric rings round an

[1] New Record for Ceylon.

eccentric nucleus. The sexes are separate and eggs are laid in clusters containing several eggs. These gastropods live in stagnant or slow running water that is amply provided with decaying vegetable matter and mud.

Pila alucinans (Sowerby)
Pila carinata (Swainson)
Pila cinerea (Reeve)
Pila dolioides (Reeve)
Pila globosa [1] (Swainson) (Page 55, Fig. 8)
Pila layardi (Reeve) (Page 55, Fig. 11)
Pila moesta (Reeve)
Pila tischbeini (Dohrn)
Pila woodwardi (Dohrn)

PULMONATE GASTROPODS

These gastropods do not have an operculum, nor do they have special gills. Within the visceral hump is a special chamber where air is stored. This chamber, which is always kept moist, acts as a lung. They come periodically to the surface of the water to replenish the supply of air in the " lung " Because of this ability to store air in the " lung ", pulmonate gastropods can live in all types of water. All pulmonate gastropods are hermaphrodites and eggs are usually fertilized by another individual or in special cases by themselves. The eggs are laid in clear, transparent, gelatinous capsules attached to pond weeds, stones or floating objects.

Pulmonate gastropods in Ceylon are represented by 20 recorded species belonging to three families.

1. Shell similar to that of a marine limpet. (Page 55, Fig. 18) Ancylidae,, page 57
   Shell with several whorls, i.e., they are coiled..2
2. Shell spirally coiled and is taller than it is broad............Lymnaeidae, page 57
   Shell coiled in one plane and it is broader than it is tall........Planorbidae, page 58

FAMILY **ANCYLIDAE**

These molluscs have flattened limpet-like shells. They are generally found attached to rocks and stones or stems and leaves of plants.

Ancylus verruca Benson
Ancylus zeylanicus Benson (Page 55, Fig. 18)

FAMILY **LYMNAEIDAE**

The shell of gastropods belonging to this family have a thin shell. The whorls of the shell are rounded. The spire is moderately high. They have broad feet. They inhabit stagnant or slow running water habitats. Eggs are deposited in gelatinous strings on water plants, stones and similar objects.

Lymnaea ovalis [1] Gray
Lymnaea pinguis [2] (Dohrn) (Page 55, Fig. 15)

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[1] New Record for Ceylon.
[2] Hubendick, B. (1951) states that *Lymnaea luteola* Lamark the common Indian species occurs in Ceylon. The record of *L. pinguis* for Ceylon = *L. luteola*. (*Proc. zool. Soc. Lond.* 26, p. 134).

Lymnaea tigrina (Dohrn)
Lymnaea tigrina minor (Preston)

FAMILY **PLANORBIDAE**

The shells of the snails belonging to this family are coiled in one plane only and broader than they are high. This family includes the extremely common species *Indoplanorbis exustus* which is found in paddy fields, ponds and tanks throughout the low country. It also includes many species which are important intermediate hosts of flukes.

Gyraulus saigonensis (Crosse et Fischer) (Page 55, Fig. 14)
Indoplanorbis exustus (Desh.) (Page 55, Fig. 13)
Indoplanorbis exustus eburneus (Gray)
Indoplanorbis exustus zonatus Dunker
Planorbis associatus Westl.
Planorbis caenosus Benson
Planorbis calathus Benson
Planorbis demissus Westl.
Planorbis elegantulus Dohrn
Planorbis hypticyclos Benson
Planorbis liratus Westl.
Planorbis spirodelus Westl.
Planorbis stelzneri Dohrn
Planorbis versicolor Westl.

LAMELLIBRANCHIA

(Bivalve Molluscs, Mussels)

These molluscs are bilaterally compressed and symmetrical. They secrete a shell consisting of two symmetrical, opposing valves which could be closed ventrally by the contraction of two powerful muscles enclosing the soft parts of the animal. Lamellibranchs breathe by means of gills. Unlike in the gastropods the head is rudimentary. Eyes, tentacles, jaws and radula are all absent. They capture their food through a series of cilia or hairs which act as a sieve or filter, collecting small food particles present in the water and passing them onto the mouth. The foot which is not flattened but wedge shaped can dig into the sand or mud. Lamellibranchs are capable of very slow movements, by attaching their foot in the sand and dragging themselves towards it. They are bisexual, but fertilisation does not take place by the union of the two sexes. When mature, the male discharges spermatozoa into the water which enter a mature female animal and fertilizes her ova.

Ten species of lamellibranch molluscs have been recorded from Ceylon. They belong to two families.

FAMILY **UNIONIDAE**

These lamellibranchs are most often found on sandy or muddy bottoms in clear running water. *Lamellidens* is a large mussel about 2–3 inches long and 1–2 inches broad. The eggs develop into larvae called " glochidia " which are parasitic on the gills or fins of fish during the early stage of their life, later dropping off to become free living mussels. They are very common in streams and ponds where they burrow into the sand or mud.

Lamellidens marginalis (Lamarck) (Page 55, Fig. 17)

Lamellidens marginalis consobrina (Lea)

Lamellidens marginalis lamellata (Lea)

Lamellidens marginalis thwaitesi (Lea)

Parreysia corrugata (Müller)

FAMILY **CORBICULIDAE**

These are relatively uncommon species.

Corbicula solida Clessin

Corbicula subnitens Clessin

Polymesoda impressa (Desh.) (Page 55, Fig. 16)

Polymesoda tennentii (Hanley)

Polymesoda zeylanica (Lam.)

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ARTHROPODA

ARTHROPODA are numerically dominant over all other animals on land as well as in the water. These animals possess an outer covering of chitin which in some arthropods is made harder by the presence of organic and inorganic substances particularly calcium salts. This external hard covering forms a supporting skeleton (exoskeleton) to which the muscles are attached. The body of an arthropod is divided into several segments. Each segment usually bears a pair of jointed limbs. These limbs which may be absent in some segments in some crustaceans are modified to perform different functions in others. The limbs at the front end are modified to serve a sensory function as antennae or feelers. The limbs behind the feelers are modified for feeding as jaws or mouth parts. The rest of the limbs behind the mouth parts are used for walking and swimming. The limbs may bear structures which are respiratory in function.

The fresh water Arthropoda are divisible into three groups (classes), namely (1) Crustacea, (2) Insecta, and (3) Arachnida.

KEY TO ARTHROPODA

1. Possess paired limbs, some of which are biramous, i.e., forked into two branches....2
   Paired limbs not branched....3
2. Only three or four pairs of appendages, the second and third pair being biramous....Immature Crustacea (Naupilii), page 63, ...Figs. 19 and 20)
   Two pairs of feelers (antennae) in front of mouth and more than four pairs of legs behind the mouth....Adult Crustacea, page 60
3. Globular body, the greater part of which is unsegmented. Four pairs of legs (three pairs in immature stages)....Arachnida, page 98
   Segmented body with three pairs of legs (sometimes the legs may be absent)....Insecta, page 72

CRUSTACEA

The body is divisible into head, thorax and abdomen. The first two divisions, namely the head and thorax are often fused together to form a cephalothorax. The cephalothorax is often covered by a carapace which protects the anterior region of the body. Crustaceans have two pairs of antennae or feelers in front of their mouth. Behind the mouth parts, all free-living crustaceans, have at least 5 pairs of limbs. Sometimes the limbs perform more than one function, i.e., locomotion, feeding and respiration, the last function being through special processes on limbs or through the thin walled limbs themselves.

There are 5 sub-classes of Crustacea represented in Ceylon's fresh waters, namely (1) Branchiopoda, (2) Copepoda, (3) Ostracoda, (4) Branchiura, and (5) Malacostraca.

KEY TO THE CRUSTACEA

1. At least ten pairs of similar consecutive appendages.... ....Branchiopoda (Part only) Anostraca, Conchostraca, page 61
   Less than ten pairs of similar, consecutive limbs....2
2. Thorax with eight pairs of legs, of which the first three pairs may be provided with claws. Six pairs of abdominal appendages, the last pair modified to form a tail fan....Malacostraca, page 67
   Less than eight pairs of thoracic legs, none of which have claws....3

3. A bivalve " shell " encloses the entire animal....................Ostracoda, page 66

No " shell " or if a " shell " is present at least the head is outside the shell........4

4. Body compressed (flattened from side to side) and enclosed by a carapace in the form of two valves .... Branchiopoda (part only) Cladocera, page 61

Body depressed (flattened from top to bottom)..5

5. Two suckers and carapace present ....Branchiura, page 66

No suckers nor carapace. Antennae prominent................Copepoda, page 65

Sub-Class Branchiopoda

As the name implies they are " gill footed crustacea". The limbs of these animals are broad and leaf-like and wave to and fro creating a current of water which aerates the respiratory organs. The respiratory organs are gills on the limbs or they are the thin walled limbs themselves. The Branchiopoda are divisible into three groups namely the Anostraca, Cladocera, and Conchostraca.

1. At least 10 pairs of similar consecutive appendages...2

Less than 10 pairs of similar consecutive appendages................Cladocera, page 61

2. No carapace. Swim with their appendages up....................Anostraca, page 61

Carapace present..Conchostraca, page 64

ANOSTRACA

(Fairy Shrimps)

Anostraca are considered to show more primitive features than the other crustaceans. They swim upside down with their feet up. They do not possess a shell fold or carapace. The body which consists of many segments is elongated and worm-like. The head is clearly marked off from the rest of the body, but the thorax and abdomen are not distinguishable unless the section of the body behind the limbs is termed the abdomen. There are about ten pairs of trunk limbs which are very similar in size and shape. The female carries an egg pouch attached to the first segment behind those carrying the limbs. Only one species, *Stegocephalus spinifer* Gurney (Page 63, Fig. 1), has been recorded from Ceylon. Recently this species has been collected in the Jaffna peninsula.

CLADOCERA

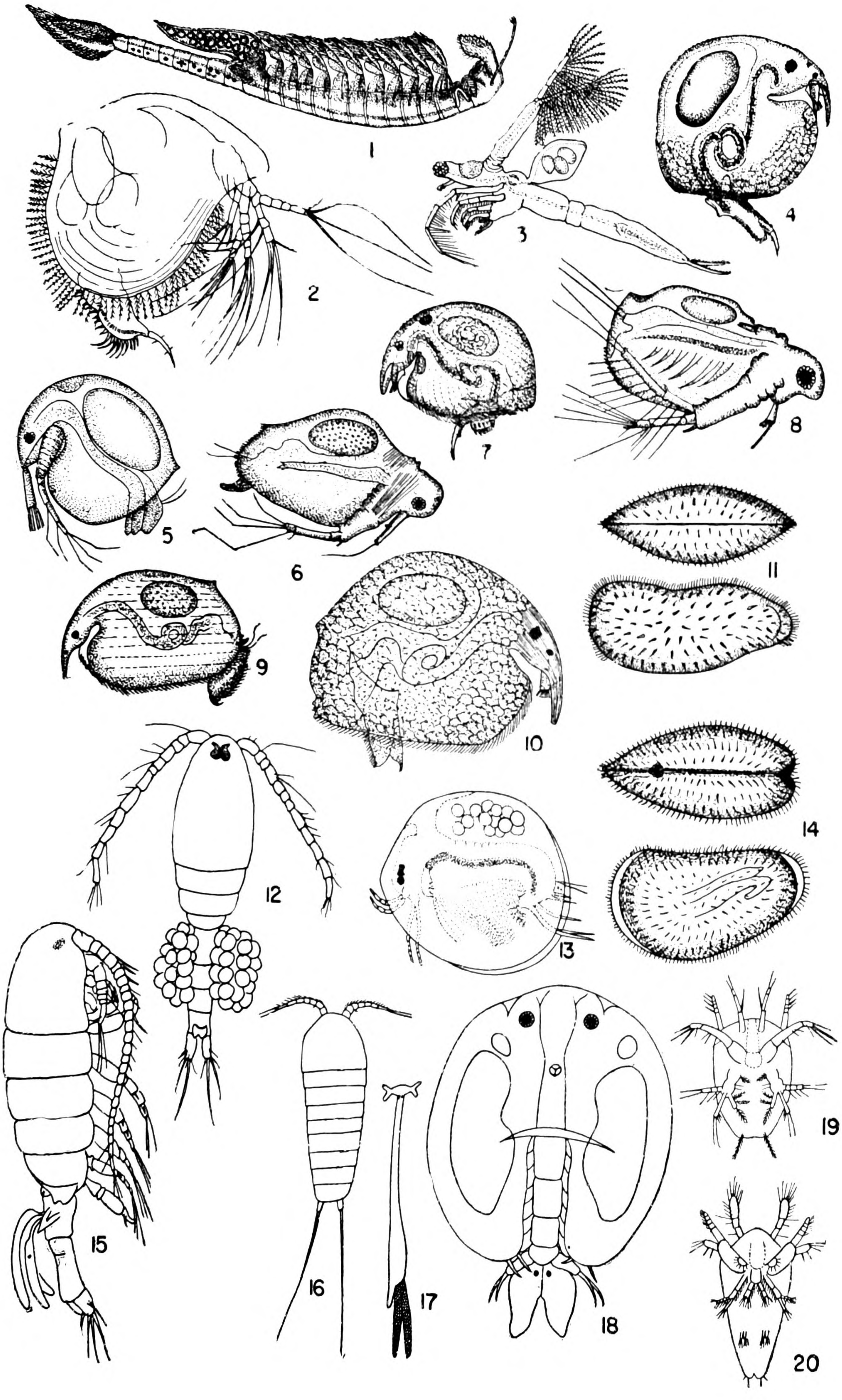
(Water Fleas)

Cladocera are microscopic animals and are usually found in large numbers in most types of waters. They usually move about in the water in a series of hops or jumps and hence they are termed " water fleas ". These branchiopods possess a transparent, compressed carapace which is open on its ventral side giving the impression that they are covered by a pair of symmetrical shells, but in reality it is a single piece without a hinge. Cladocerans have five or six pairs of leaf-like limbs, which are in constant motion and propel a current of water to pass between the limbs and the shell for aeration. The posterior portion of the body has no limbs but ends in two terminal claws. Cladocerans feed on microscopic plant life (Desmids and Diatoms), and are themselves important as food for young fishes. They are able to reproduce both sexually and parthenogenetically, i.e., the unfertilized eggs can develop into young. The rate of reproduction is so rapid that the progeny of a single female has been estimated to reach the astounding number of 13,000,000,000 in 60 days. The female carries its eggs in a brood pouch which is dorsal in position. The eggs produced before the drought are very resistant and survive considerable drying. These eggs develop with the onset of the rains.

Explanation to figures on page 63

1. *Stegocephalus spinifer* after Gurney.
2. *Illiocryptus halyi* after Brady 0·7 mm.
3. *Leptodora kindti* after various authors 1 cm.
4. *Chydorus sphaericus* after Ward and Whipple 0·3 mm.
5. *Guernella ceylonica.*
6. *Pseudosida szalayi* 2 mm.
7. *Alonella karua* 0·7 mm.
8. *Diaphanosoma singalense* 2·8 mm.
9. *Dunhevedia serrata* 0·9 mm.
10. *Pleuroxus laevis* 0·7 mm.
11. *Stenocypris ceylonica.*
12. *Cyclops prasinus* after Gurney up to 3 mm.
13. *Cyclestheria hislopi* from Weerakoon 3 mm.
14. *Cypricercus reticulatus.*
15. *Diaptomus viduus* after Gurney 2 mm.
16. *Canthocamptus (Elaphiodella) grandievi* after Gurney.
17. *Lernaea cyprinacea* del. P. Kirtisingha 20 mm.
18. *Argulus foliaceus* del. P. Kirtisingha 9 mm.
19. Nauplius larva after various authors.
20. Nauplius larva after various authors.

Figures 5 to 11 and 14 are after Daday.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The Cladocera recorded from the fresh waters of Ceylon are:

Alonella excisa Fisch.
Alonella globulosa (Daday)
Alonella karua (King) (Page 63, Fig. 7)
Alonella macronyx (Daday)
Alonella punctata (Daday)
Alonopsis orientalis Daday
Alonopsis singalensis (Daday)
Bosmina japonica Poppe et Richard
Ceriodaphnia cornuta Sars
Chydorus barroisi (Richard)
Chydorus leonardi King
Chydorus ovalis Kurz
Chydorus reticulatus Daday
Chydorus sphaericus (O. Fr. M.) (Page 63, Fig. 4)
Chydorus ventricosus Daday
Dadaya macrops (Daday)
Daphnia carinata Sars
Daphnia galeata Sars
Daphnia lumholtzi Sars
Diaphanosoma singalense Daday (Page 63, Fig. 8)
Dunhevedia crassa King.
Dunhevedia serrata Daday (Page 63, Fig. 9)
Euryalona orientalis (Daday)
Graptolebris testudinaria (Fisch.)
Guernella ceylonica Daday (Page 63, Fig. 5)
Illiocryptus halyi Brady (Page 63, Fig. 2)
Leptodora kindti (Focke) (Page 63, Fig. 3)
Leydigia acanthocercoides (Fisch.)
Macronynx spinosa King
Macrothrix triserialis Brady
Moinodaphnia macropa Straus
Moinodaphnia submucronata Brady
Pleuroxus laevis Sars
Pseudalona longirostris (Daday)
Pseudosida szalayi Daday (Page 63, Fig. 6)
Scapholeberis mucronata (Müller)
Simocephalus elizabethae (King.)
Simocephalus exspinosus de Geer

CONCHOSTRACA

Conchostraca look like small bivalve molluscs but the presence of jointed limbs (up to 27 pairs) identifies them as arthropod crustaceans. They make slow gliding movements by the rhythmic beating of their leaf- like limbs which are also used for respiration. The eggs are carried in a brood pouch within the valves of the shell. Conchostraca are generally found at the bottom of the water body and feed on detritus.

One species, *Cyclestheria hislopi* (Baird) (Page 63, Fig. 13) has been recorded from Ceylon. It is a pale yellow-coloured species which occurs in paddy fields and ditches. This species is widely distributed in S.E. Asia.

Sub-Class Copepoda

They are small crustaceans, the majority being under 5 mm. in length. The body is divisible into two regions namely the cephalothorax and the abdomen. They have two pairs of antennae and on each member of the 1st pair there is only one filament which is made up of 6 to 25 segments. There are two filaments on each member of the 2nd pair of antennae. In some species the antennae of the males are modified to form grasping organs. Most of the copepods have a single median eye. The eggs are retained by the female in an egg sac attached to its body. Some copepods have two egg sacs attached to them. Copepods are present in all types of habitats but are especially common in standing water.

Copepods may act as intermediate hosts for parasites. Some are intermediate hosts for parasitic worms (Nematoda & Cestoda) which reach their final host, usually a fish, when the fish eats the infected copepods.

Copepods are divisible into Calanoida, Cyclopoida and Harpactoida.

1. Antennae with 10 or fewer segments. Abdomen not clearly marked off from the thorax......Harpactoida, page 66
   Antennae with more than 10 segments. Abdomen clearly demarkated from the thorax...... 2
2. Antennae with less than 18 segments. Egg sac is paired......Cyclopoida, page 65
   Antennae with more than 22 segments. Egg sac is single......Calanoida, page 65

Calanoida

Diaptomus annae Apstein
Diaptomus doriai Richard
Diaptomus drieschi Poppe et Mrazek
Diaptomus lumholtzi Sars.
Diaptomus orientalis Brady
Diaptomus singalensis Daday
Diaptomus strigilepis Gurney
Diaptomus viduus Gurney (Page 63, Fig. 15)
Paradiaptomus greeni Gurney

Cyclopoida [1]

Cyclops [1] *distinctus* Richard
Cyclops fimbriatus Fisch.
Cyclops hyalinus Rehberg
Cyclops languides Sars
Cyclops leuckarti Cls.
Cyclops phaleratus Koch.
Cyclops prasinus Fisch. (Page 63, Fig. 12)
Cyclops serrulatus Fisch.
Cyclops varicans Sars
Cyclops varius var. *proximus* Lilly
Cyclops vernalis Fisch.

[1] The genus *Cyclops* has been divided into a number of new genera by recent authors.

Harpactoida

Canthocamptus (*Atteyella*) *cingalensis* Brady

Canthocamptus (Elaphiodella) *grandievi* Gurney et Richard (Page 63, Fig. 16)

Parasitic Copepoda

They pass all or part of their lives as parasites of fishes or other animals and are modified in various ways to lead a parasitic life. Due to the modifications it is difficult to make out the copepod characters of such parasites. In Ceylon observations have been made by the authors on two species of freshwater parasitic copepods namely, *Lernaea cyprinacea* L. var. and *Lamproglena chinensis*.

Lernaea cyprinacea L. var. (Page 63, Fig. 17)

From time to time there have been outbreaks of this parasite on fishes in the Fisheries Research Station ponds in Colombo. Some mirror carp brought to Colombo from the Ceylon Fishing Club's hatchery in Nuwara Eliya were also found to harbour the parasite. In *Lernaea* the limbs around the mouth are modified for sucking and attachment. The rest of the limbs are greatly reduced or are completely absent as they are of no use to the animal. The head of the animal is distinct from the rest of the body which is sac shaped and unsegmented.

Lamproglena chinensis Yu.

Females of this species have been recorded in Ceylon from the gill filaments of the snake-head (S. Loola), *Ophiocephalus striatus*. *Lamproglena* induces a distorted growth of the tip of the gill filaments of the host causing an enlargement of the connective tissue and a degeneration of the blood capillaries in the filaments.

Sub-Class Branchiura

The Crustaceans belonging to this class are, at least temporarily, parasitic on fish. The freshwater forms are referred to as carp-lice. The head is laterally expanded into a structure resembling a carapace. These animals have four pairs of thoracic limbs. The abdomen is unsegmented, limbless and bilobed. Only one species has been recorded from Ceylon.

Argulus foliaceus (L.) (Page 63, Fig. 18) has been reported from Ceylon only in the Fisheries Research Station experimental ponds in Colombo. These may have been introduced with the fish (Carp) imported for breeding. A pair of limbs is greatly modified to function as a pair of sucking discs in *Argulus*. The parasites are commonly found in the gill chamber of fish but they may attach themselves on other parts of the body as well. *Argulus* is strictly dependent on fish blood. They may be occasionally found swimming about in the water but sooner or later they must find a fish host.

Sub-Class Ostracoda

The Ostracoda are minute bean-shaped crustaceans, common in all types of fresh water. Each ostracod possesses a two-valved "shell" which is hinged dorsally. It is difficult to recognise the crustacean characters of ostracods because of this shell, which has to be partially removed to examine the internal structure. If an ostracod is disturbed the shell closes tightly enclosing the entire animal. When moving about a pair of antennae and a pair of limbs are the only parts of the body that project out of the bivalved shell. Some ostracods are free swimming, some move about on the surface of the water while others are creeping forms that live among plants or burrow in the mud at the bottom of the pond. Ostracoda are omnivorous, i.e., they can feed on decaying vegetable matter and on smaller animals particularly crustaceans and their larvae. Ceylon records are :

Cypricercus reticulatus Daday (Page 63, Fig. 14)

Cypridopsis assimilis Sars

Cypridopsis globulus Sars
Cypridopsis minna (King.)
Cyprinotus cingalensis Brady
Cyprinotus dentatomarginatus Baird
Cypris granulata Daday
Cypris subglobosa Sowerby
Iliocypris australiensis Sars
Notodromas entzi Daday
Stenocypris ceylonica Daday (Page 63, Fig. 11)
Stenocypris major Baird
Stenocypris malcolmsoni (Brady)

Sub-Class Malacostraca

Included in this class are a large number of species which show a great diversity in form. The cephalothorax is generally covered by a carapace and the eight thoracic and six abdominal segments all bear appendages. The abdominal appendages are always bifid, the first five pairs being slender and fringed with hairs for swimming. The pair of limbs in the last abdominal segment is broad and usually turned backward to form a tail fan, which is used in moving backwards. The thoracic limbs are used for walking and sometimes for grasping food. The mouth parts are modified for chewing. They have two pairs of antennae. The antennae have two filaments each (the members of other crustacean sub-classes have only one filament in each of the first antennae). These crustacea have compound eyes which in most members of the group are stalked. The fresh water malacostracans are divisable into 3 Orders, Amphipoda, Isopoda and Decapoda.

1. Carapace present. Eyes stalked....................Decapoda, page 70
   No carapace. Eyes not stalked....................2
2. Body depressed (i.e., flattened from top to bottom)....................Isopoda, page 70
   Body compressed (i.e., flattened from side to side,....................Amphipoda, page 67

ORDER AMPHIPODA

(Sand Hoppers and " Shrimps[1] ")

These malacostracan crustaceans do not have a carapace and their bodies are laterally compressed, i.e., flattened from side to side. They do not possess a tail fan and their eyes are not stalked. A typical member of the group is the sand hopper (this is not a freshwater form) which is exceedingly common on the sea beach particularly among debris which have been cast ashore. The freshwater amphipods usually live among water plants which is their food. The females carry their young in a brood pouch until the young are well developed. The females are usually carried about by the males. Amphipoda are not common in Ceylon freshwaters, their place being taken by *Caridina*. It is generally found that where *Caridina* are found Amphipoda are relatively few or absent. Amphipoda are quite common in saline waters such as in lagoons.

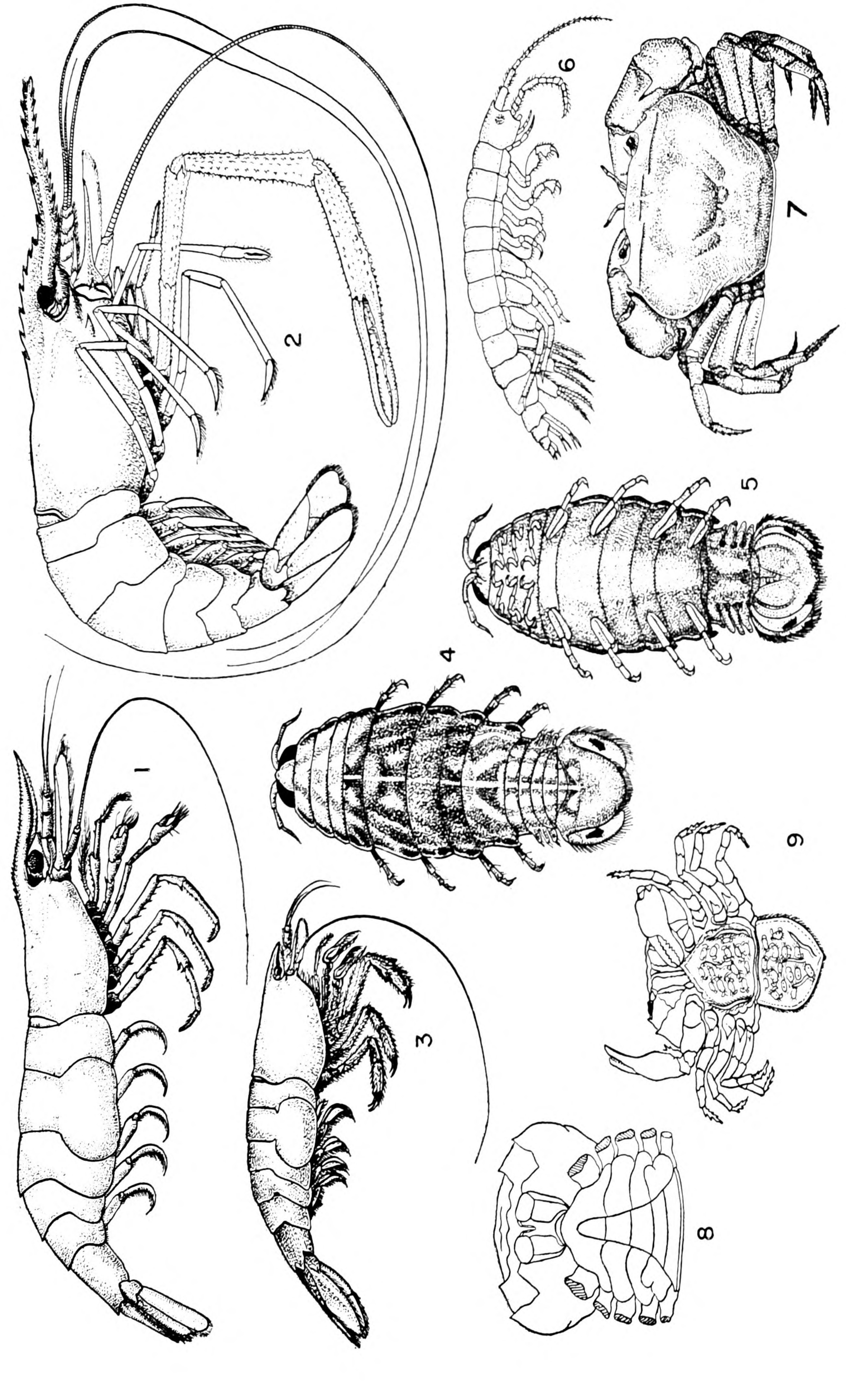
In 1958 a new species, *Paracallipe fernandoi* Wignarajah, obtained from tap water was described. Amphipods obtained from the Colombo (Beira) lake were indentified as *Grandidierella megnae* (Page 69, Fig. 6). A specimen of *Parorchistia* sp. was found in a tank at Angunuwila.

[1] The term "shrimp" has been used rather indiscriminately by different authors to include various crustaceans like Amphipoda, Anostraca and Caridea.

6——R 19576 (9/61)

Explanation to figures on page 69

1. *Caridina nilotica var. simoni* 22 mm. long.
2. *Macrobrachium rosenbergii* 30 cms. long.
3. *Atya typus* 7 cms. long.
4. *Alitropus typus* (dorsal view) 13 mm. long.
5. *Alitropus typus* (ventral view). 13 mm. long.
6. *Grandidierella megnae* (female) 8 mm. long.
7. *Paratelphusa ceylonensis* carapace 48 mm. wide.
8. Male crab to show the narrow abdomen.
9. Female crab with abdomen flexed back to show developing young.



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ORDER ISOPODA

(Water Loglice)

The members of this order have flattened (depressed) bodies. There is a distinct cephalothorax which represents the head and the first thoracic segment. The rest of the thorax consists of seven segments expanded laterally. The abdomen is relatively short and projects as a shield at the posterior end. The thoracic appendages are well developed but those of the abdomen are reduced, except the last pair which project backwards.

Specimens of *Alitropus typus* Milne Edw. (Page 69, Figs. 4 and 5) were collected from the gill chambers of the fishes *Rasbora daniconius* in Angunuwila (tank) and *Wallago attu* taken in the Kala-Oya. This species was also found free living in the Battulu Oya, Nedimala (Dehiwela) and the Fisheries Department ponds at Narahenpitiya. *Alitropus typus* is a facultative ectoparasite and lives in freshwater, close to the sea and in lagoons, from where it has probably migrated.

It has been reported that during the drought in Angunuwila, the fish are infested with *A. typus*, many specimens occurring within the gill chambers of a single fish, where they probably affect respiration.

ORDER DECAPODA

(Prawns, "Shrimps[1]" and Crabs)

These crustacea have a conspicuous carapace which covers all the thoracic segments. In the Decapoda the eyes are stalked and they have the usual mouth parts. The first three pairs of thoracic limbs are modified to aid in feeding and are called maxillipeds. The last five pairs of thoracic limbs are typical walking legs, a characteristic which has earned the order the name Decapoda (meaning 10 legs). Often one or more pairs of these walking legs are greatly enlarged and bear large claws. These chelate walking legs have lost their locomotary function and aid in feeding and defence. Such modified walking legs are seen in most crabs and certain species of prawns.

The Decapoda include the most highly organised crustaceans. Ceylon freshwater Decapoda are divided into two groups namely Caridea and the Potamonidae.

1. Body crab-like. Abdomen greatly reduced............................Potamonidae, page 71
   Body prawn-like. Abdomen not reduced..Caridea, page 70

GROUP CARIDEA

(Prawns and "Shrimps[1]")

This group includes the freshwater prawns and "shrimps" and are closely allied to the large marine prawns (Penaeidae). In the Caridea the body is long and somewhat laterally compressed. The abdomen is long and ends in a tail fan. The members of the third pair of walking legs are not equipped with claws. The lateral chitinous plate of the second abdominal segment overlaps the first and second lateral plates.

The Caridea are represented in Ceylon by two families, Atyidae and Palaemonidae.

1. Small forms, less than 5 cms. long. The clawed appendages have conspicuous terminal tufts of hair..Atyidae, page 70

   Large forms, more than 5 cms. long. The clawed appendages do not have terminal tufts of hair...Palaemonidae, page 71

FAMILY ATYIDAE

A group of freshwater forms in which the first pair of walking legs are provided with well developed claws or chelae, having conspicuous terminal tufts of hair. The mandibles have no palps. The last three pairs of thoracic limbs are not conspicuously enlarged. *Caridina* and *Atya* are two genera of Atyidae represented in Ceylon.

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[1] The term "shrimp" has been used rather indiscriminately by different authors to include various crustaceans like Amphipoda, Anostraca and Caridea.

The commonest species, *Caridina nilotica* var. *simoni* is found in paddy-fields, streams and the irrigation reservoirs throughout the low-country. It is an important constituent of the food of fishes and occurs in very large numbers. The female carries the eggs under her abdomen. *Caridina pristis* has been recorded from the Mahaweli ganga at Peradeniya and *Caridina singalensis* which is distinguished by the very short rostrum was recorded in Nuwara Eliya. All the species of *Caridina* are small, measuring about 1–2 cms. in length, and are generally called " shrimps ".

The *Caridina* recorded from Ceylon are:

Caridina fernandoi Arudpragasam and Costa
Caridina nilotica var. *bengalensis* de Man
Caridina nilotica var. *simoni* Bouvier (Page 69, Fig. 1)
Caridina pristis Roux
Caridina singalensis Ortmann

The genus *Atya* contains relatively large forms which reach a length of about 5 cms. They have relatively short limbs and can be called " prawns " rather than " shrimps ". In Ceylon there is only one species namely, *Atya typus* Milne Edw. (Page 69, Fig. 3) and specimens have been secured from the fast flowing Kuda-Oya near Tissamaharama.

FAMILY **PALAEMONIDAE**

Includes freshwater and marine forms. They are separable from the *Atyidae* in that the chelate legs have no terminal tufts of hairs. The second pair of pereiopods is very greatly enlarged and in mature specimens is often longer than the body.

Only one genus, *Macrobrachium* (*Palaemon*) is represented in Ceylon. *M. rosenbergi* is a very large form (30 cms.) occurring in brackish water. It is especially common in the Chilaw and Moratuwa areas where it is often seen in the markets. *M. malcolmsonii* is slightly smaller than *M. rosenbergii*. A few specimens have been collected from the Parakrama Samudra, Polonnaruwa. *M. idella* is known in Ceylon from only a few specimens taken near Dehiwela. *M. scabriculum* is a very common species found throughout the low-country. It bears a tuft of hairs at the base of the chelae on each member of the second pair of legs in the male *M. latemanus* occurs exclusively in hilly streams and is a stoutly built prawn much smaller in size than *M. rosenbergii*.

Macrobrachium idella (Hilgendorf)
Macrobrachium latimanus (Von Martens)
Macrobrachium malcolmsonii (Milne Edwards)
Macrobrachium rosenbergii (De Man) (Page 69, Fig. 2)
Macrobrachium rude (Heller)
Macrobrachium scabriculum (Heller)

GROUP POTAMONIDAE

(Freshwater Crabs)

The potamonid crabs (Page 69, Fig. 7) resemble marine and lagoon crabs. The body consists of a large cephalothorax dorsoventrally depressed and expanded laterally. The abdomen is greatly reduced and flexed under the cephalothorax. The female carries her eggs between the abdomen and the cephalothorax. The young are developed in this space (Page 69, Fig. 9) till they are old enough to feed by themselves. The young are generally released with the onset of the monsoon rain. The male has a narrower abdomen than the female (Page 69, Fig. 8). The abdominal limbs of both sexes are greatly reduced and are not used for swimming. The first pair of thoracic limbs are modified as chelipeds (bear claws). The other four pairs are used for walking and although somewhat compressed laterally they are not used for swimming.

The potamonid crabs are widely distributed in Ceylon occurring in freshwater from the coast to the mountains and are represented by the single genus *Paratelphusa*. In these crabs the carapace is broader than long and is generally smooth except for a long cervical groove. They live in burrows from which they emerge from time to time to feed. Their food is mainly decaying organic matter but they also attack animals such as small fishes, earthworms and arthropods. Freshwater crabs are eaten by many aquatic and terrestrial animals including fishes, amphibians, reptiles, birds and mammals. They also act as intermediate hosts for many parasitic animals such as nematodes and trematodes [1].

Three species namely *P. hippocastanum*, *bouvieri* and *innominata* are inhabitants of the low-country and are only rarely found in the hill-country. *P. ceylonensis* is the commonest freshwater crab in Ceylon and is present in the low and mid-country but not in the hill-country. *P. rugosa*, *soror* and *enodis* are inhabitants of the hill-country.

The following eight species have been recorded from Ceylon.

Paratelphusa bouvieri (Rathbun)

Paratelphusa ceylonensis Fernando (Page 69, Fig. 7)

Paratelphusa enodis (Kingsley)

Paratelphusa hippocastanum (Müller)

Paratelphusa innominata Fernando

Paratelphusa parvula Fernando

Paratelphusa rugosa (Kingsley)

Paratelphusa soror (Zehntner)

INSECTA

(The Insects)

The body of an insect is divisible into three parts : (1) A well marked head bearing a pair of feelers or antennae and three pairs of " jaws " which are modified according to the feeding habits of the insects and resemble shortened legs which are clustered around the mouth, (2) a central portion termed the thorax with three pairs of legs and two pairs of wings, and (3) a rear portion termed the abdomen which does not have any locomotory appendages. The most striking character of these animals is that the number of walking legs is constant, namely three pairs. It is therefore safe to assume that any animal with three pairs of jointed legs is an insect.

A characteristic feature among insects is that they pass through a free living larval phase. If the larva is similar to the adult except for the absence of well formed wings (short wings or wing pads may be present) and genitalia then it is called a nymph. This condition occurs in such groups as the Hemiptera, Odonata, Ephemeroptera and Plecoptera and it is quite easy to identify a nymph of a particular family or even genus. On the other hand if the larva undergoes considerable alteration of structure in reaching the adult condition then it is called a true larva. This condition is found in the Coleoptera, Diptera and Lepidoptera where larvae do not resemble their adults but they have a characteristic structure. The nymphs and larvae shed their outer covering (moult) and undergo a series of changes before attaining the adult condition.

The insects are a terrestrial group of animals, some members of which have invaded freshwater and a few even the sea. Since insects are only secondarily aquatic, the degree of adaptation to the aquatic habitat varies greatly among the families and sometimes even among genera within a family. Most aquatic species are capable of surviving outside water for a considerable period of time and some habitually spend their larval life in damp places outside water like their terrestrial relatives. Some of the largest insects in the world are found in freshwater and belong to the group of belostomatid bugs.

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[1] The human lungfluke *Paragonimus westermani* has been recorded in Ceylon recently in carnivorous animals like the leopard. The infective larval stages of this fluke occur in species of *Paratelphusa*.

The following ten orders of insects are found in the aquatic habitats: (1) Hemiptera—Bugs, (2) Coleoptera—Beetles, (3) Odonata—Dragonflies and Damselflies, (4) Ephemeroptera—Mayflies, (5) Plecoptera—Stoneflies, (6) Lepidoptera—Moths and Butterflies, (7) Trichoptera—Caddisflies, (8) Diptera—True flies, (9) Neuroptera—Alderflies, (10) Collembola [1] —Springtails.

Of the above orders only the aquatic Hemiptera, Coleoptera and Collembola [1] spend their full life-cycle in the water. Some of the hemipterans and coleopterans can fly and are therefore able to colonise new habitats.

KEY FOR THE IDENTIFICATION OF ADULT AQUATIC INSECTS

1. Hind end of insect with a forked organ with which it can spring in the air (Page 95, Fig. 16) .... Collembola, page 93
   Do not have such an organ 2
2. Head prolonged into a proboscis.[2] Forewings not hardened.... Hemiptera, page 74
   Head prolonged into a proboscis. Forewings hardened to form a protective covering (elythra) for the hind wings .... Coleoptera, page 83

THE LARVAE OF AQUATIC INSECTS

There are a large number of insect larvae and pupae which live in the water while the adults lead a terrestrial or aerial life. It is not possible to give adequate treatment in this work to such insect larvae. However figures, ecological notes and other data that will aid in their field identification are given.

KEY FOR THE IDENTIFICATION OF THE LARVAE OF AQUATIC INSECTS

1. Larvae with visibly developed external wing pads (rudimentary wings) 2
   Larvae without external wing pads 5
2. Mouth parts, which are modified for sucking, take the form of a jointed beak which is directed backwards beneath the head .... Hemiptera[2], page 74
   Mouth parts not in the form of a beak 3
3. Lower lip (labium) modified to form a " mask " to capture prey .... Odonata, page 93
   No such mask 4
4. Three posterior processes (Page 95, Fig. 9) .... Ephemeroptera, page 93
   Two posterior processes (Page 95, Fig. 5) .... Plecoptera, page 96
5. With jointed thoracic legs 6
   Without jointed thoracic legs .... Diptera, page 96
6. Prolegs directed backwards and present only on last abdominal segment. (Prolegs are absent in *Sialis* which has a single long median tail at the end of the abdomen) 7
   Prolegs often entirely wanting but if present they are found on more than one segment 8

[1] Most authors disagree as to whether Collembola are aquatic insects, since they live in damp places or close to the water's edge and occasionally take to the water.

[2] The hemipteran insects belonging to the family Corixidae do not have a conspicuous proboscis.

7. Each abdominal segment has a pair of lateral fleshy lobes and at the base of each lobe is a large tuft of tracheal gills..Neuroptera, page 96

   No abdominal fleshy lobes but there may be minute gill filaments ....

   ....Trichoptera, page 96

8. Five pairs of prolegs present..Lepidoptera, page 96

   Generally without prolegs but always less than five pairs....Coleoptera, page 83

HEMIPTERA

(Bugs)

These insects have mouth parts greatly modified for piercing and sucking. The head is prolonged into a proboscis which is usually backwardly directed except when feeding. It is grooved, stout and jointed and is the highly modified labium or second pair of maxillae (lower lip). Within the proboscis are two pairs of thin stylets, the two stylets forming the first pair are the modified mandibles while the other two are the first maxillae. The stylets of the second pair are placed close together forming two long narrow channels one of which leads to the alimentary canal. In feeding both pairs of stylets pierce the covering of the host and the juices of the latter are sucked up along this channel. The Hemiptera are adapted to feed on a liquid diet and some species (Corixidae) feed on thick suspensions of bottom ooze. Metamorphosis is gradual, the larvae resembling the adults except that the larvae do not have well formed wings.

The aquatic Hemiptera are divisible into two main groups:

(*a*) Those that live under water are collectively referred to as the Cryptocerata. They have very short concealed antennae. Their limbs are modified for swimming in the active forms like the Corixidae while they act as grasping organs in the Nepidae and Ranatridae, and they are modified for both swimming and for grasping in the Belostomatidae. Hemiptera are all dependant on an aquatic habitat and die if deprived of water for any considerable time. However some of them are capable of flying relatively long distances. The families Nepidae, Ranatridae, Belostomatidae, Naucoridae, Corixidae, Notonectidae, Pleiidae and Helotrepidae are included in the Cryptocerata.

(*b*) Those that live on the water surface and on vegetation very near the water are referred to as the Gymnocerata. They are generally light bodied and the limbs possess hydrofuge hairs. Their antennae are prominent and are longer than the head. They are incapable of swimming but "walk" on the surface of the water. They can withstand considerable desiccation and often aestivate under vegetation. They are however only active in water or moist situations. They have raptorial appendages and feed mainly on dead and dying insects on the water surface. The families Hydrometridae, Veliidae, Mesoveliidae, Gerridae and Hebridae are included in the Gymnocerata.

KEY TO THE ADULT HEMIPTERA

The larvae (nymphs) of Hemiptera resemble the adults in general body form and hence a separate key is not provided for the larvae. In any case it is not advisable to identify species from the larvae.

1. Live beneath the water surface. Antennae shorter than the head........................ 2

   Live on the surface of the water. Antennae prominent, longer than head............ 8

2. Head provided with a beak which is not pointed........................Corixidae, page 79

   Head provided with a sharp pointed beak.. 3

3. Respiratory tubes at posterior end of abdomen and no hairs on legs.................... 4

   No posterior respiratory tubes, hairs on the hind legs........... 5

4. Body flattened and leaf-like....................Nepidae, page 75
Body cylindrical and stick-like....................Ranatridae, page 75

5. Swim on their backs with the belly towards the water surface....................6
Swim normally with the back towards the water surface.................... 7

6. Antennae four segmented....................Notonectidae, page 79
Antennae three segmented....................Pleiidae, page 78
Antennae two segmented....................Helotrephidae, page 78

7. Middle and hind legs flattened for swimming. Tip of abdomen with two strap like retractile appendages .... Belostomatidae, page 78
Feet adapted for walking, not flattened. The hind feet have spines on them. No appendages at tip of abdomen....................Naucoridae, page 78

8. Head very long, body slender....................Hydrometridae, page 82
Head almost as broad as long.................... 9

9. Antennae with five segments....................Hebridae, page 83
Antennae with four segments.................... 10

10. Beak four jointed, two posterior pairs of legs long and slender....................Gerridae, page 82
Beak three-jointed. None of the legs extremely long and slender.................... 11

11. Legs inserted almost at middle of body on ventral surface....................Mesoveliidae, page 82
Legs, particularly hind legs inserted towards or at sides of body on ventral side.................... Veliidae, page 82

FAMILY **NEPIDAE**—The Water Scorpions

Superficially they resemble scorpions. The first pair of legs is raptorial, i.e., for capturing prey. These bugs can be recognised by the long "tail" which is a respiratory tube formed of two grooved filaments. They have flat, oval shaped bodies. The antennae or feelers are three segmented. Although they are provided with wings these insects rarely fly. When they float on the surface of the water they resemble small dead leaves. Their eggs are inserted into the stems of water plants. The Nepidae commonly live at the bottom of paddy fields and ditches where they prey upon small animals.

Laccotrephes flavovenosus Dohrn

Laccotrephes griseus (Guer.)

Laccotrephes grossus (Fabr.) (Page 77, Fig. 1)

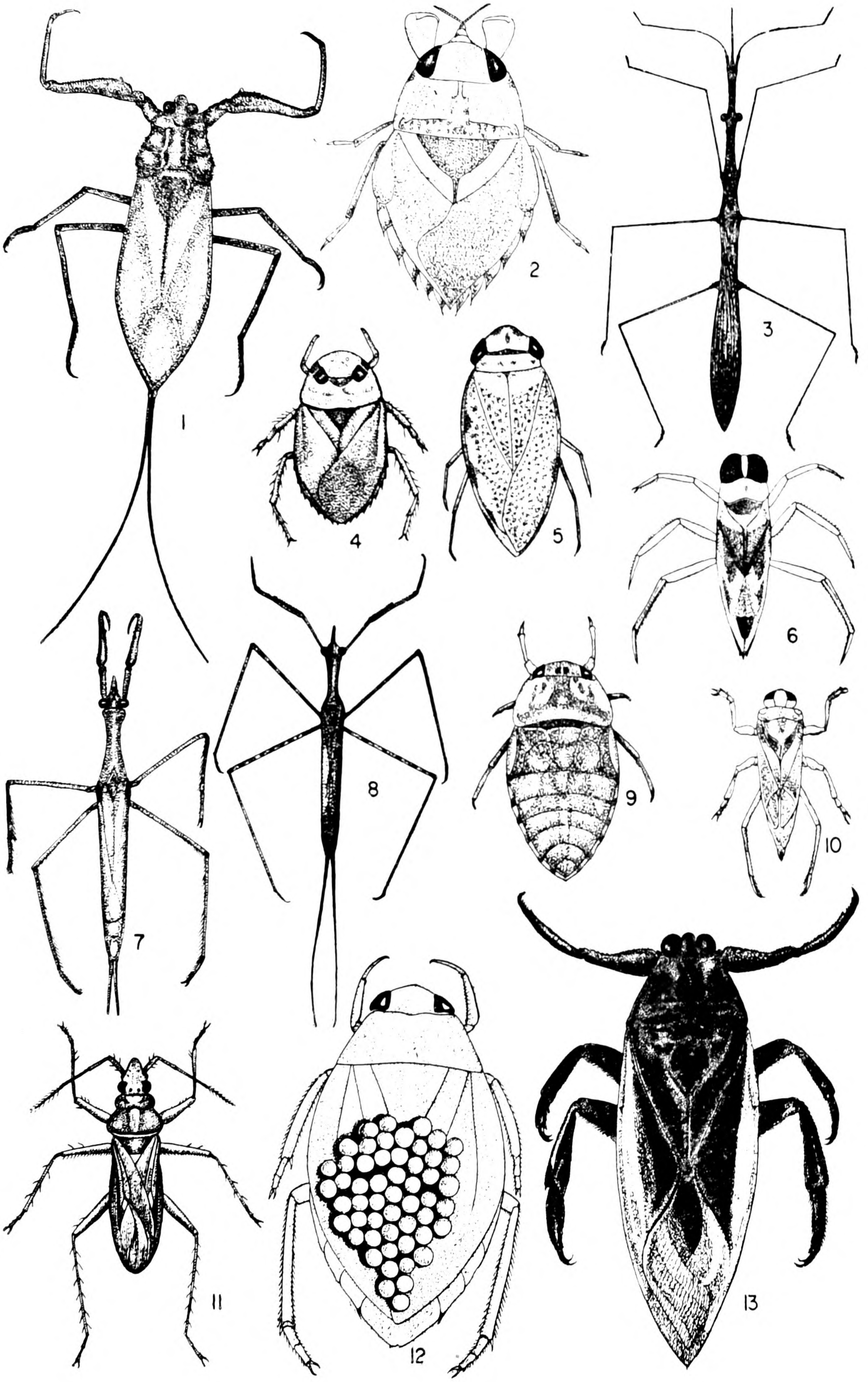
Laccotrephes maculatus (Fabr.)

FAMILY **RANATRIDAE**—The Water Stick Insects

Characters are similar to those of the family Nepidae except that their bodies are narrower. These insects spend most of their time suspended from the surface of the water by the respiratory tube. This tube maintains communication between the atmosphere and the tracheal (respiratory) system of the insect. The insect remains for long periods in this position giving the appearance of a cluster of small twigs or roots thereby deceiving its prey. When the prey approaches within striking distance the insect captures it by means of its raptorial forelegs. *Ranatra* is a very common insect in paddy fields, ponds, tanks and slow running streams.

Explanation to figures on page 77

1. *Laccotrephes grossus* 60 mm. from tip of snout to origin of " tail ".
2. *Naucoris scutellaris* 7 mm.
3. *Hydrometra greeni* 13 mm.
4. *Diaphorocoris punctatissimus* 8 mm.
5. *Micronecta punctata* 2·5 mm.
6. *Anisops barbata* 11 mm.
7. *Cercometus fumosus* 60 mm.
8. *Ranatra filiformis* 23 mm. from snout to origin of " tail ".
9. *Heleocoris bengalensis* 8 mm.
10. *Enithares abbreviata* 12 mm.
11. *Mesovelia orientalis* 4 mm. after Distant.
12. *Sphaerodema rusticum* (male) with eggs cemented on its back, from Weerakoon 36 mm.
13. *Lethocerus indicus* 85 mm.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Cercometus fumosus Dist. (Page 77, Fig. 7)

Cercometus strangulatus Mont.

Ranatra elongata Fabr.

Ranatra filiformis Fabr. (Page 77, Fig. 8)

Ranatra longipes Stal.

Ranatra varipes Stal.

FAMILY **BELOSTOMATIDAE**—Giant Water Bugs

The largest insects are included in this family. Their forelegs are relatively unmodified while the hind legs are flattened and adapted for swimming. They have no respiratory tail processes. The feelers are four segmented. They are predatory and the larger species may even prey upon fishes. *Lethocerus* is capable of flying considerable distances and is often seen at night round electric and other lights. In the genus *Sphaerodema*, the female lays her eggs in neat rows cemented to the back of the male (Page 77, Fig. 12) which then acts as a "nurse maid" carrying the eggs on his back until they hatch. The male is therefore not able to fly till the eggs hatch out. *Sphaerodema* occurs in paddy fields and also in fast flowing streams of the low country.

Lethocerus indicus (Lep. et Serv.) (Page 77, Fig. 13)

Sphaerodema[1] *rusticum* (Fabr.) (Page 77, Fig. 12)

FAMILY **NAUCORIDAE**—Creeping Water Bugs

These insects have oval shaped bodies and four segmented feelers. *Naucoris scutellaris* is commonly found in tanks throughout the low country. *Diaphorocoris punctatissimus* occurs on moist rock faces in the hill country and is a rather slow moving insect. *Heleocoris bengalensis* is a very powerful swimmer and occurs in fast flowing rivers. It has been collected from the Kelani ganga at Kitulgala, from Welimada and the Kuda-Oya near Tissamaharama. It is capable of inflicting a very painful sting and should be handled with care.

Diaphorocoris punctatissimus (Kirby) (Page 77, Fig. 4)

Heleocoris bengalensis Mont. (Page 77, Fig. 9)

Naucoris scutellaris Stal. (Page 77, Fig. 2)

FAMILY **HELOTREPHIDAE**—Backswimmers

The head and thorax of these insects are fused. Three species are present in Ceylon.

Helotrephes kirkaldyi Esaki et China

Limnotrephes campbelli Esaki et China (Page 80, Fig. 4)

Tiphotrephes indicus Dist. (Page 80, Fig. 3)

FAMILY **PLEIIDAE**—Small Backswimmers

They are very similar in structure to the Helotrephidae. Two species occur in Ceylon.

Plea frontalis Fieb. (Page 80, Fig. 2)

Plea liturata Kirk.

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[1] Lauch et Menke 1961 changed the name *Sphaerodema* to *Diplonychus*.

FAMILY **NOTONECTIDAE**—Backswimmers

These insects are strong swimmers but they do so on their backs, propelling themselves by means of their long hind legs. When they dive into the depths of water, they carry with them a bubble of air between a series of hairs on either side of the body. They periodically come up to the surface to renew their supply of air. They have large broad heads with prominent eyes and four segmented feelers (antennae). The proboscis is short and made up of three or four segments. The forewings are well developed and they are capable of flight. These insects should be handled with care as they are capable of inflicting painful stings. *Anisops* spp. have silvery wings while *Enithares* spp. are drab brown to dark brown in colour. *Anisops* has a hair lined pit in the mid line at the junction of the thorax and abdomen. They are found throughout the low country in small habitats.

Anisops ali Dist.

Anisops barbata Brooks (Page 77, Fig. 6)

Anisops batillifrons Lundb.

Anisops bouvieri Kirk.

Anisops breddini Kirk.

Anisops crinata Brooks

Anisops extendofrons Brooks

Anisops nasuta Fieb.[1]

Anisops nivea (Fabr.)

Enithares abbreviata (Kirby) (Page 77, Fig. 10)

Enithares templetoni (Kirby)

Enithares triangularis (Guer.)

Enithares triangularis var. *simplex* (Kirby)

Nychia malayana Lundb.[2]

Nychia marshalli (Scott)[2]

FAMILY **CORIXIDAE**—The Water Boatmen

They are a family of minute water insects. However, *Agraptocorixa hyalinipennis* is relatively large being about 10 mm. in length. They are similar to the Notonectidae but do not swim on their backs. Like the Notonectidae they carry a bubble of air for respiration. They have oval and flattened bodies. They do not have a conspicuous proboscis. These insects suck up particles of debris, swept up with their spatulate forelimbs. The head is wider than the first segment (pronotum) of the thorax. The forelegs are short and thick and each consists of a single flattened segment which bears in the male, a row of small strong teeth giving it a rough surface. When the rough surfaces of the two feet are drawn across the inconspicuous proboscis a shrill note is produced. The middle and the hind legs are long. The hind legs are flattened and fringed with hairs to aid in swimming. The eggs are usually laid singly attached to the stems of plants or are attached to threads of floating algae. They are generally found in still waters being particularly numerous in paddy fields and the edges of irrigation reservoirs and are capable of flight. *Micronecta punctata* is often found in rock pools in river beds. *M. quadristrigata* is the commonest species.

Agraptocorixa hyalinipennis (Fabr.)[3]

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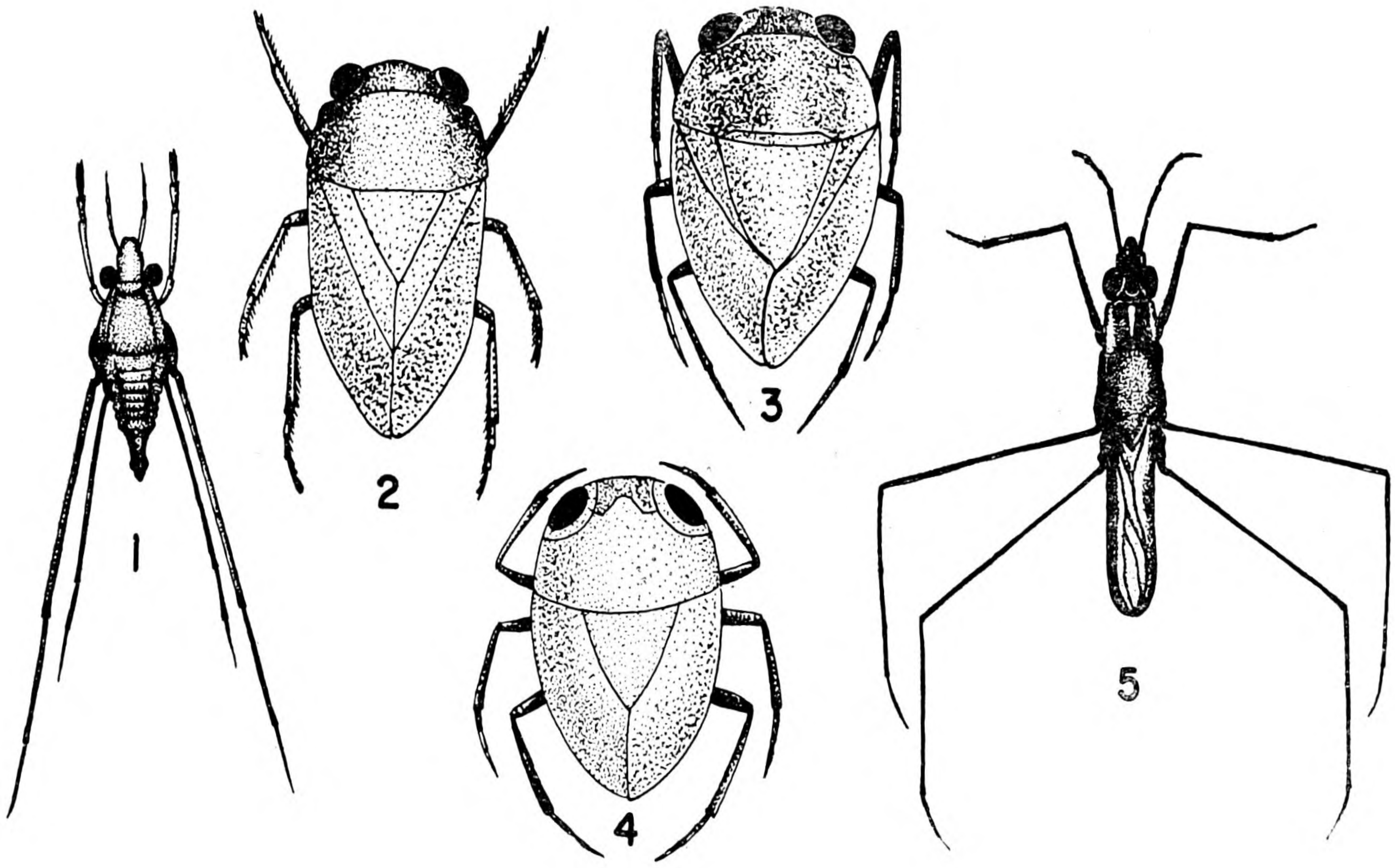
[1] Doubtful record for Ceylon. The original *A. nasuta* has been broken up into several species.

[2] Doubtful species, they are probably *Anisops breddini*.

[3] New record for Ceylon.

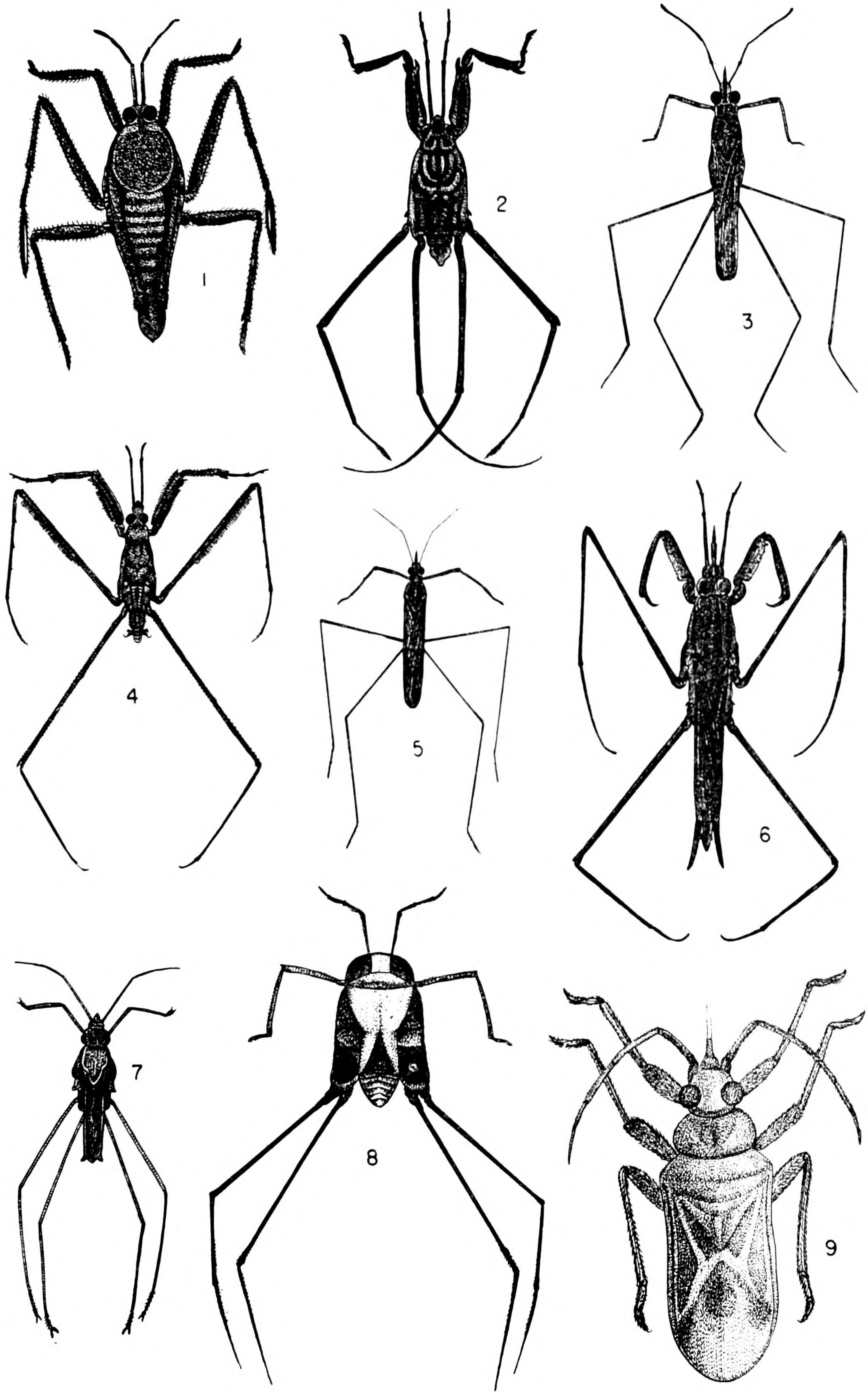


Explanation to figures above

1. *Rhagodotarsus kraeplini* 3·5 mm. from snout to end of abdomen.
2. *Plea frontalis* 2·5 mm.
3. *Tiphotrephes indicus* 1·5 mm.
4. *Limnotrephes campbelli* 1·5 mm.
5. *Gerris adelaidis* 15 mm.

Explanation to figures on page 81

1. *Rhagovelia ravana* 4 mm. from snout to end of abdomen.
2. *Metrocoris stali* 7 mm. from snout to end of abdomen.
3. *Limnogonus nitidus* 11 mm. from snout to end of abdomen.
4. *Ptilomera cingalensis* 14 mm. from snout to end of abdomen.
5. *Limnogonus parvulus* 6 mm. from snout to end of abdomen.
6. *Cylindrostethus productus* 24 mm. from snout to end of abdomen.
7. *Limnometra fluviorum* 13 mm. from snout to end of abdomen.
8. *Venidius henryi* 1·5 mm. from snout to end of abdomen.
9. *Timasius splendens* 3 mm.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Micronecta albifrons Motsch.
Micronecta fascioclavus Chen.
Micronecta flavens Wrobl.
Micronecta punctata Fieb. (Page 77, Fig. 5)
Micronecta quadristrigata Bredd.
Micronecta scutellaris (Stal)
Micronecta tarsalis Chen.
Sigara substriata (Uhl.)

FAMILY **HYDROMETRIDAE**—The Water Measurers

This family is represented in Ceylon by one species only. It lives on the surface of the water in sheltered situations. The length of the head is several times its width and the portion in front of the eyes is very elongate. The body is narrow and stick-like; the hind portion of the abdomen is covered with a velvety pile of hair. The antennae are four segmented. They lay their eggs singly on plants above the water level. They feed on smaller aquatic creatures or on floating waste material. *Hydrometra greeni* Kirk. (Page 77, Fig. 3) is often found near stagnant water walking on weeds and on the edges of the water. It is very common in buffalo wallows in paddy fields along with veliids.

FAMILY **MESOVELIIDAE**—Pond Skaters

Only one species, namely *Mesovelia orientalis* Kirk. (Page 77, Fig. 11) has been recorded from Ceylon. They live on the surface of the water and are similar to those of the families Veliidae and Gerridae. They frequent the leaves of plants and embed their eggs in the stems. The head is shorter than the thorax. The abdomen unlike in the Hydrometridae is not narrow. The insects of this family are similar to those of the families Veliidae and Gerridae.

FAMILY **VELIIDAE**—Water Skaters

In these insects the length of the head is about the same as the width across the eyes. The posterior legs are short. They possess the usual velvety pile of hair. These insects are generally found in streams, living in clusters or flocks on the surface of the water swimming against the current. *Microvelia longicornis* is a common inhabitant of small pools of water in the low country. It is capable of flight and is commonly seen in rain puddles.

Microvelia diluta Dist.
Microvelia longicornis Bueno
Rhagovelia nigricans Burm.
Rhagovelia ravana Kirk. (Page 81, Fig. 1)
Peritoppus breddini Kirk.

FAMILY **GERRIDAE**—The Water Striders

These insects live on the surface of the water. The head is short, its length being about the same as its width across the eyes. The posterior legs are very long, the femora (thigh or third division of leg) extending far beyond the abdominal apex. They possess a velvety pile of hairs beneath the abdomen. The eggs are deposited in a cluster surrounded by mucilage and attached to submerged plants.

Cylindrostethus bituberculatus Schmidt
Cylindrostethus nietneri Schmidt
Cylindrostethus productus Spin. (Page 81, Fig. 6)
Gerris adelaidis Dohrn (Page 80, Fig. 5)
Gerris pectoralis Mayr.

Limnogonus fossarum (Fabr.)
Limnogonus nitidus (Mayr.) (Page 81, Fig. 3)
Limnogonus parvulus (Stal) (Page 81, Fig. 5)
Limnometra anadyomene (Kirk.)
Limnometra fluviorum (Fabr.) (Page 81, Fig. 7)
Metrocoris illustrarius Dist.
Metrocoris stali (Dohrn) (Page 81, Fig. 2)
Onychotrechus sakuntala (Kirk.)
Ptilomera cingalensis (Stal) (Page 81, Fig. 4)
Rhagodotarsus kraeplini Breddin (Page 80, Fig. 1)
Rheumatogonus custodiendus (Dist.)
Rheumatogonus vittatus Esaki
Venidius henryi Esaki (Page 81, Fig. 8)

FAMILY **HEBRIDAE**

This is a family of minute insects with five segmented feelers. They usually live on floating pond weeds and even among damp weeds and moss on the shore.

Timasius atratus Dist.
Timasius splendens Dist. (Page 81, Fig. 9)

COLEOPTERA

(The Beetles)

Among the various insect orders the Coleoptera contains the largest number of species. They are found in all types of terrestrial habitats and a number of species are aquatic and show various grades of adaptation to an aquatic life. Some like the Dytiscidae are confined to the water although pupation takes place in moist places outside the water itself. The Hydrophilidae are aquatic in the adult stage but the larvae of some species are found in moist soil (like many terrestrial beetles). Most aquatic beetles are capable of withstanding considerable desiccation and during the drought live under various moist or even dry objects.

There is a large group of beetles which live near the water and invade it from time to time and they seem to be equally at home in or out of the water. Such forms have not been included in this publication.

A striking character of the Coleoptera is the specially modified pair of horny, hard, shiny first, pair of wings, termed elythra, which form a protective covering for the normally large and membraneous second pair of wings. In flying they use the second pair of wings. The beetles have strong biting mouthparts and their legs are flattened and fringed with hairs to help in swimming. The Coleoptera undergo extensive and complete metamorphosis, the larvae and adults being very different in appearance. The larvae of the different species are very variable in form and are difficult to recognise.

The list of aquatic beetles recorded for Ceylon can only be considered very tentative. Most of the records are very old and no recent revision of aquatic beetles of the area is available unlike the Hemiptera where many recent works deal with species from Ceylon.

The aquatic beetles recorded from Ceylon are placed in five families, namely, Dytiscidae, Noteridae, Haliplidae, Gyrinidae and Hydrophilidae. We have omitted from the present account some families, e.g., Helodidae, which are relatively rare.

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KEY TO ADULT COLEOPTERA

1. Maxillary palp generally longer than antennae. Each antenna is club shaped at its tip .... Hydrophilidae, page 89

   Maxillary palp shorter than antennae 2

2. Posterior end of abdomen not covered by wings. Each eye divisible into two parts Surface swimmers .... Gyrinidae, page 88

   Entire abdomen covered by the wings. Each eye not divided into two parts. Live submerged in the water 3

3. Large plates covering the bases of hind legs so that the point at which they are attached to the body cannot be seen (Page 91, Fig. 4) .... Haliplidae, page 88

   No plates covering the base of hind legs and the point of attachment to the body is visible 4

4. Feet not flattened but adapted for digging. Body somewhat crescentic in shape and slightly compressed .... Noteridae[1], page 88

   Feet generally flattened for swimming .... Dytiscidae[1] page 84

KEY TO THE COLEOPTERAN LARVAE

1. Last three segments of leg relatively long and well-developed, the last segment terminating in one or two movable claws 2

   Legs with not more than two long segments and a single claw shaped segment at the tip. More or less maggot—like (Dipteran larvae) (Page 91, Fig. 9) .... Hydrophilidae, page 89

2. Abdomen terminating in a long tapering tail process. Shape generally long and thin. Last segment of leg terminating in one claw (Page 91, Fig. 1) .... Haliplidae, page 88

   Abdomen without long process. Last segment of leg terminating in two claws. General shape robust 3

3. Four hooks at end of abdomen. Lateral abdominal gills present (Page 91, Fig. 6) .... Gyrinidae, page 88

   Abdominal hooks and lateral abdominal gills absent 4

4. Body cylindrical and tapering at the hind end. Legs short (Page 87, Fig. 7) .... Noteridae, page 88

   Body spindle shaped. Legs not short. Swimming and crawling larvae (Page 87, Figs. 1, 4 and 6) .... Dytiscidae, page 84

FAMILY **DYTISCIDAE**—Diving Beetles

These beetles occur both in standing and in running water and are well adapted for an aquatic life. They can be characterised as follows: The first pair of wings are as long as the abdomen. The hind legs are widely separated from the second pair of legs and possess very large coxae (segment nearest the body). The first two pairs of legs are short. In some species there are adhesive pads on the first pair of legs of the males which enable them to hold onto the female while copulating. The antennae are long and filiform. The adults breathe by coming to the surface and thrusting the extreme end of the abdomen out of the water and larvae do the same with the tail-like processes at the hind end of the abdomen. Their larvae have large heads and long tapering bodies. The larvae and adults are armed with powerful mandibles which are grooved for sucking the body juices of their victims.

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[1] It is difficult to give simple characters to separate the Dytiscidae and Noteridae. Some authors consider both families under Dytiscidae.

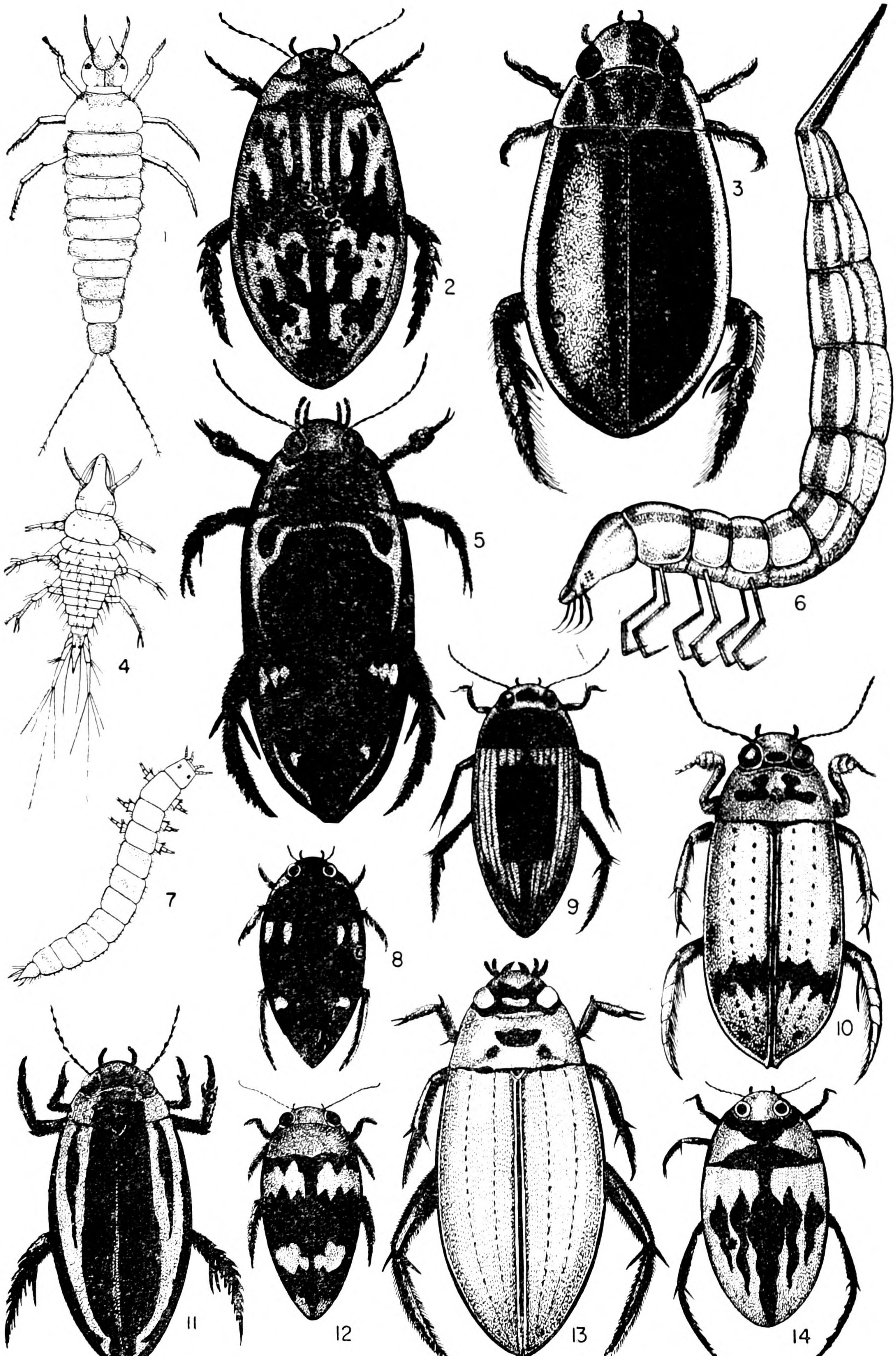
There are 43 species of diving beetles of which the commonest are *Cybister confusus*, *Hydraticus fabricii*, *Eretes sticticus*, *Laccophilus chinensis inefficiens* and *Bidessus*[1] *inconstans*.

Bidessus[1] *inconstans* Reg.
Bidessus (Bidessus) antennatus Reg.
Bidessus (Bidessus) flaviculus Motsch.
Bidessus (Bidessus) gentilis Sharp
Bidessus (Clypeodytes) bufo Sharp
Bidessus (Clypeodytes) griseoguttatus Reg.
Copelatus discoides Sharp
Copelatus horni Reg.
Copelatus indicus Sharp (Page 87, Fig. 9)
Copelatus pusillus Sharp
Cybister cardoni Sever.
Cybister confusus Sharp (Page 87, Fig. 3)
Cybister dejeani Aube
Cybister javanus Aube
Cybister sugillatus var. *prolixus* Sharp
Cybister ventralis Sharp
Eretes sticticus L. (Page 87, Fig. 10)
Hydraticus fabricii MacL.
Hydraticus fractifer Walk.
Hydraticus luczomicus Aube
Hydraticus pacificus Aube (Page 87, Fig. 5)
Hydraticus vittatus var. *angustulus* Reg.
Hydrovatus confertus Sharp
Hydrovatus ferrugatus Reg.
Hydrovatus fusculus Sharp
Hydrovatus obscurus Motsch.
Hydrovatus sinister Sharp
Hyphoporus interpulus Clark
Hyphydrus indicus Sharp (Page 87, Fig. 14).
Hyphydrus lyratus Schwartsz
Hyphydrus renardi Ser.
Lacconectus simoni Reg.
Laccophilus anitcatus Sharp
Laccophilus ceylonicus Zimm. (Page 87, Fig. 12)
Laccophilus chinensis inefficens Walk
Laccophilus ellipticus Reg.
Laccophilus flavescens Motsch.
Laccophilus flexnosus Aube
Laccophilus guttalis Reg.

[1] The Genus *Bidessus* in S. E. Asia has been given a new generic name—*Guignotus* after Prof. Guigr.ot.

Explanation to figures on page 87

1. Dytiscid larva from Macan 5 mm. long.
2. *Sandracottus festivus* 15 mm.
3. *Cybister confusus* 40 mm.
4. Young larvae of *Hydrovatus confertus* after Williams
5. *Hydraticus pacificus* 16 mm.
6. Larva of *Cybister* 60 mm.
7. Noterid larva from Macan 7 mm. long.
8. *Canthydrus luctuosus* 3 mm.
9. *Copelatus indicus* 4·5 mm.
10. *Eretes sticticus* 12 mm.
11. *Hydrocoptus subvittatus* 14 mm.
12. *Laccophilus ceylonicus* 5 mm.
13. *Rhantus punctatus* 13 mm.
14. *Hyphydrus indicus* 5 mm.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Rhantus interclusus Walk.

Rhantus punctatus Four. (Page 87, Fig. 13)

Rhantus taprobanicus Sharp

Sandracottus festivus (Ill.) (Page 87, Fig. 2)

FAMILY **NOTERIDAE**—The Digging Beetles

These are small beetles often included in the family Dytiscidae which they agree with in structure except that the legs are adapted for digging. They are crescentic in shape and are slightly compressed. In Ceylon they are very common in paddy fields and often are present in large numbers. Four species have been recorded from Ceylon.

Canthydrus laetabilis Walk.

Canthydrus luctuosus Aube. (Page 87, Fig. 8)

Hydrocoptus subvittatus Motsch. (Page 87, Fig. 11)

Neptosternus taprobanicus Sharp

FAMILY **HALIPLIDAE**—Crawling Beetles

These are closely allied to the Dytiscidae but are generally very small and oval in shape. The antennae are filiform and ten segmented. The hind coxae (segment nearest the body) have plate like structures which cover the origin of the hind legs and a portion of the ventral side of the insect (Page 91, Fig. 4). These larvae have each a long tail process.

A single specimen of *Haliplus pulchellus* was collected by the authors near an electric light at Maha Illupalama. This species is widely distributed in S. E. Asia. Only two species of this family has been recorded from Ceylon.

Haliplus angustifrons Reg.

Haliplus pulchellus Clark

FAMILY **GYRINIDAE**—The Whirligig Beetles

These beetles are surface swimmers and are gregarious in their habits. They are to be found constantly darting about in graceful curves around one another and hence the name "Whirligig Beetles". When the beetles are disturbed they dive underneath the surface of the water, carrying along with them a bubble of air. They fly readily from one pond to another. They are black and shiny with a depressed body. The wings do not cover the posterior section of the abdomen. Their antennae are very short and stout. Each eye is divisible into two portions, one for aerial vision and the other for vision in the water. The second and third pair of legs are greatly flattened, paddle-like and provided with hairs. They lay their eggs on the leaves of submerged water plants. The larvae are similar to those of the Dytiscidae except that they do not have a breathing tube but a pair of tracheal gills on each abdominal segment (Page 91, Fig. 6). Pupation takes place in a cocoon attached to water plants.

Both the adults and larvae are scavengers feeding mainly on dead and drowning animals. They aestivate in the mud during the drought. Seventeen species of Gyrinidae are on record for Ceylon.

Aulonogyrus obliquus (Walk.) (Page 91, Fig. 2)

Dineutes indicans Walk

Dineutes indicus Aube. (Page 91, Fig. 7)

Dineutes spinosus (Fab.)

Dineutes unidentatus Aube.

Gyrinus ceylonicus Reg.

Gyrinus convexiusculus Macl. (Page 91, Fig. 5)

Orectochilus ceylonicus Redt. (Page 91, Fig. 3)

Orectochilus dilatatus Redt.

Orectochilus disciter Walk.

Orectochilus fairmairei Reg.

Orectochilus fraternus Reg.

Orectochilus indicus Reg.

Orectochilus limbatus Reg.

Orectochilus productus Reg.

Orectochilus wehnckei Reg.

Porrhorrhynchus indicans Walk.

FAMILY **HYDROPHILIDAE**—Deep-water Beetles

A special feature of this family is that the first maxillae have each a pointed process (maxillary palp) which is exceptionally long and in most species is longer than the antennae. For this reason these beetles are called Palpicornia. However there are a few Hydrophilidae which do not have long maxillary processes. The eggs may be laid in the form of floating cocoons or they may be attached to grass or floating objects depending on the species. *Helochares* spp. and *Berosus* spp. attach the eggs on to their own bodies. The larvae show a great diversity in form and structure. They usually pupate in damp earth near the water.

The hydrophilid beetles form an important item in the diet of many fishes both in the larval and adult stages. The large *Hydrophilus* is carnivorous and may even kill small fishes. The Hydrophilidae are poor swimmers and generally walk on aquatic vegetation and other objects at the bottom of the habitat. When the water is disturbed many of the smaller species float on the surface. Some of the larger species like *Hydrophilus*, and *Sternolophus* are relatively good swimmers. *Berosus indicus* which is one of the commonest of the hydrophilids makes a high pitched sound when taken in a net.

The hydrophilid beetles are common in standing water habitats. They occur in large numbers in mud, and paddy fields are a favourite habitat. Because of their small size and habit of living at the bottom they are often missed from collections and hence our present knowledge of this group in Ceylon is very incomplete. However, sixty-one species have been recorded from Ceylon.

Amphiops gibbus Ill.

Amphiops mirabilis Sharp

Amphiops pedestris Sharp

Amphiops simplex Sharp

Anacaena advena Sharp

Anacaena minima Sharp

Armostus optatus Sharp

Berosus (*Berosus*) *aeneiceps* Motsch.

Berosus (*Berosus*) *pulchellus* MacL.

Berosus (*Berosus*) *viticollis* Boh.

Berosus (*Enoplurus*) *indicus* Motsch. (Page 91, Fig. 12)

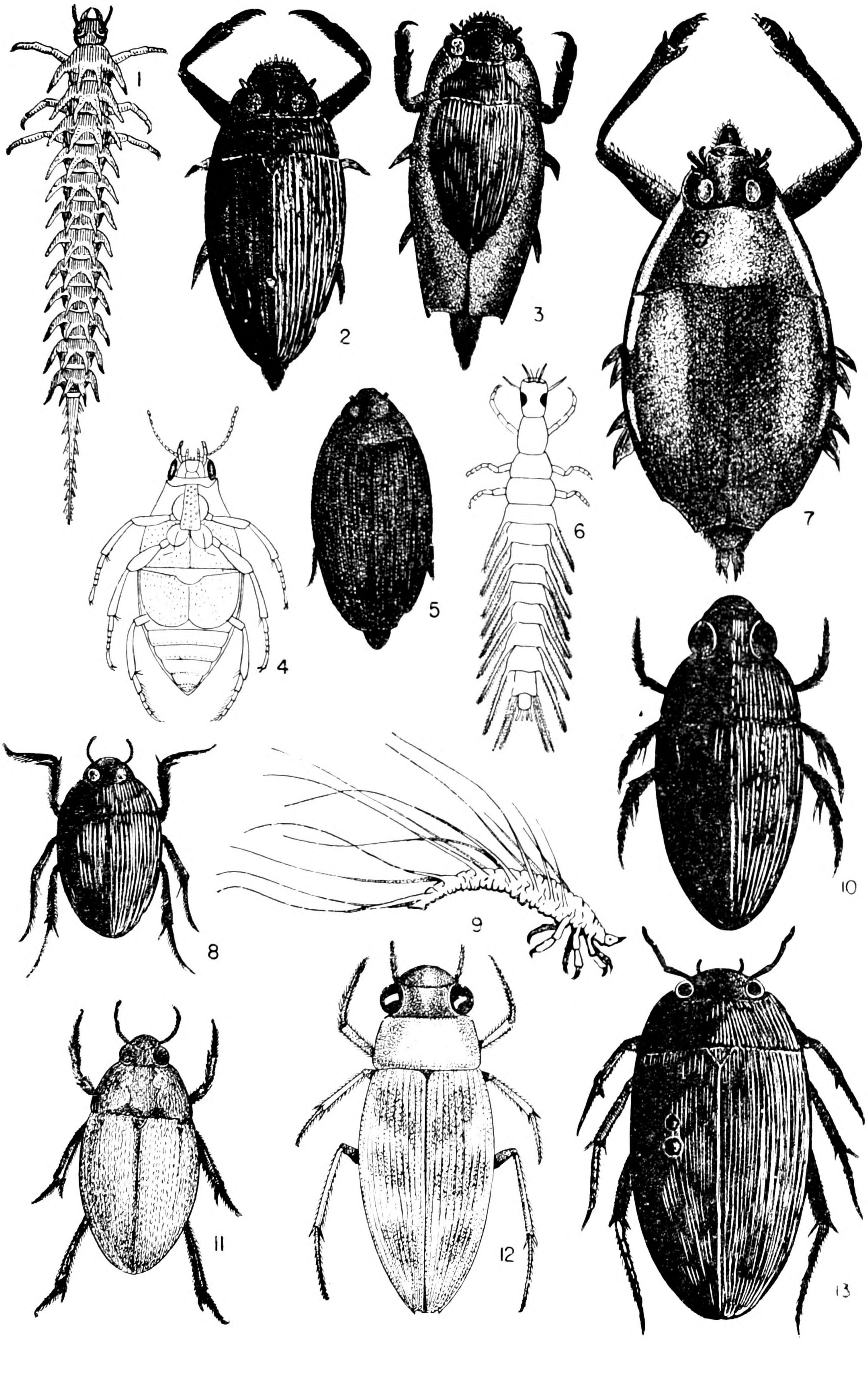
Cercyon aviarius Knisch (Page 91, Fig. 8)

Cercyon hydrophiloides Motsch.

Cercyon lineolatus Motsch.

Explanation to figures on page 91

1. Haliplid larva from Macan 7 mm. long.
2. *Aulonogyrus obliquus* 8 mm.
3. *Orectochilus ceylonicus* 13 mm.
4. *Haliplus* sp. ventral view to indicate the plates covering the base of the hind legs, from Macan 4 mm. long.
5. *Gyrinus convexiusculus* 5 mm. long.
6. Gyrinid larva, after Mellanby 16 mm. long.
7. *Dineutes indicus* 16 mm. long.
8. *Cercyon aviarius* 3 mm. long.
9. Larva of *Berosus*, from Weerakoon 25 mm. long.
10. *Sternolophus* (*Neosternolophus*) *brachyacanthus* 11 mm. long.
11. *Helochares* (*Hydrobaticus*) *anchonalis* 6 mm. long.
12. *Berosus* (*Enoplurus*) *indicus* 6 mm. long.
13. *Enochrus* (*Lumetus*) *iteratus* 8 mm. long.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Cercyon lunulatus Germm. and Har.
Cercyon nigriceps Marsham
Cercyon punctigerum Knisch
Cercyon rufotestaceus Motsch.
Cercyon uniformis Sharp
Cercyon vicinalis Walk.
Coelostoma horni (Reg.)
Coelostoma stultum (Walk.)
Cryptopleurum ferrugineum Motsch.
Cryptopleurum sulcatum Motsch.
Dactylosternum abdominale (Fabr.)
Dactylosternum dytiscoides (Fabr.)
Enochrus (*Lumetus*) *esuriens* (Walk.)
Enochrus (*Lumetus*) *fragilis* Sharp
Enochrus (*Lumetus*) *fuscatus* (Motsch.)
Enochrus (*Lumetus*) *iteratus* (Sharp) (Page 91, Fig. 13)
Enochrus (*Lumetus*) *nigropiceus* (Motsch.)
Epimetopus flavidulus Sharp
Globaria leachi Hope
Helochares densus Sharp
Helochares pallens MacL.
Helochares (*Chasmogenus*) *livornicus* Kuw.
Helochares (*Helochares*) *taprobanicus* Sharp
Helochares (*Hydrobaticus*) *anchonalis* Sharp (Page 91, Fig. 11)
Helochares (*Hydrobaticus*) *lentus* Sharp
Hydraena fontana Orch.
Hydrochus lacustris Niet.
Hydrophilus inconspicuus (Niet.)
Hydrous (*Hydrous*) *cashmirensis* Redt.
Hydrous (*Hydrous*) *olivaceus* Fabr.
Laccobius (*Laccobius*) *rectus* Sharp
Limnebius rufipennis Reg.
Neohydrophilus rufiventris Niet.
Neohydrophilus spinicollis (Esch.)
Neohydrophilus spinicollis elongatus Reg.
Omicrogiton insularis Orch.
Oocyclus latus Orch.
Oosternum horni Orch.
Pachysternum nigrovittatum Motsch.
Paracymus evanescens Sharp
Protosternum atomarium Sharp
Regimbartia attenuata Fabr.
Scoliopsis spinosa Orch.
Sphaeridum dimidiatum Gory
Sphaeridum quinquemaculatum Fabr.
Sternolophus rufipes Fabr.
Sternolophus (*Neosternolophus*) *brachyacanthus* Reg. (Page 91, Fig. 10)

COLLEMBOLA

(Springtails)

A group of wingless insects whose legs are very feeble. They move about by leaps made with the assistance of the furcula, a forked lever-like tail process, present at the end of the abdomen. Most Collembola live in damp places. A few are aquatic, living on the surface of the water. It is only rarely that they go below the surface of the water. A number of species live very close to the waters edge on damp vegetation and occasionally venture on to the water. Springtails are mainly detritus feeders but occasionally they feed on floating plants. *Isctomurus* sp. (Page 95, Fig. 16) which has been recorded from the Indian region.

ODONATA

(Dragonflies and Damselflies)

The dragonfly larvae (nymphs) are completely aquatic and predacious and have resemblances to the adult. Each larva is equipped with a well developed prehensile "mask" (the labium) having claws or hooks for seizing prey. It is hidden under the head when not in use. The larvae are very clumsy and slow in locomotion. They have wing pads and well developed legs. The larvae are green, brown or grey varying in different species to match their background.

Two main types of larvae are recogniseable. The first group termed the Anisoptera are broad forms (Page 95, Fig. 3) without posterior external gills. They have from 5–6 small projections at the hind end of the abdomen. The gills in this group line the hind part of the alimentary canal. Water is pumped in and out of the anus to aerate the gills. The other group termed the Zygoptera are narrower than the Anisoptera and have three flattened leaf-like caudal fins (Page 95, Fig. 8). The caudal fins contain a large number of tracheae and act as gills. The damselflies are included in the Zygoptera.

The larvae of the dragon and damselflies may also be divided into three groups on the basis of their habits, namely, climbers, sprawlers and burrowers. The climbers stalk their prey on the stems and roots of aquatic plants, the sprawlers lie in the bottom of the habitat and wait for their prey to come close to them and the burrowers do likewise after covering themselves with a thin layer of sand and silt.

Dragonfly larvae cause damage to fish fry in culture ponds. On the other hand they represent a source of food for the larger fish.

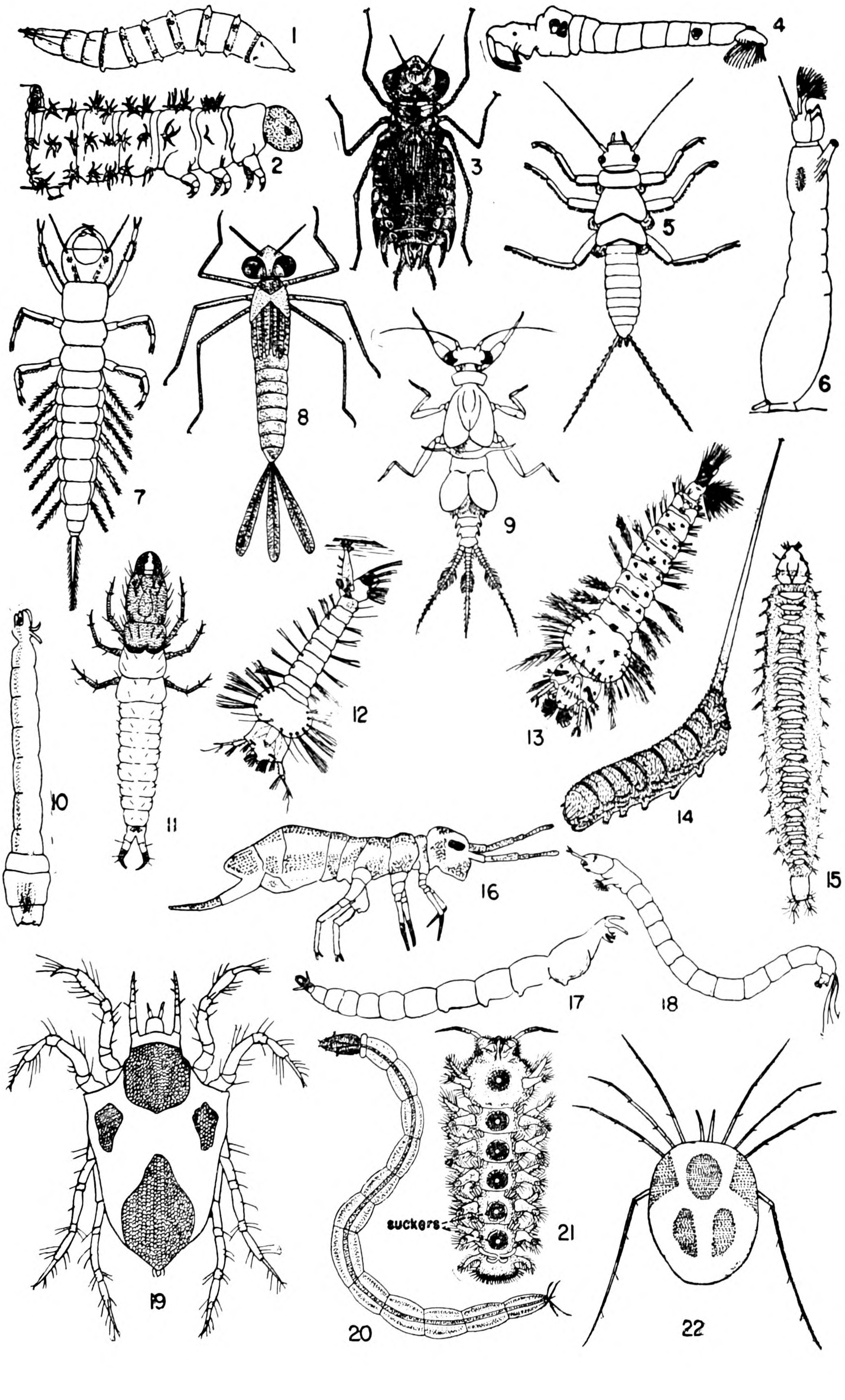
EPHEMEROPTERA

(Mayflies)

These superficially resemble dragonfly larvae but are much more delicate in structure (Page 95, Fig. 9). They are characterised by the presence of three "tails" at the posterior end. These "tails" are not gills but cerci of the abdomen. The flattened and shortened bodies are adaptations to torrential life commonly found in this group. The very young larvae do not have gills but the older ones possess gills in the abdominal region. The gills are differently shaped in the various genera. The mayfly larvae (nymphs) are generally herbivorous feeding on algae. The larvae possess wing pads and well developed legs and resemble the adults.

Explanation to figures on page 95

1. **Tabanid larva**, after Macan, 15 mm. long.
2. **Lepidoptera** (*Nymphula*), from Weerakoon 19 mm. long.
3. **Odonata**—Dragonfly larva (*Pantala flavescens*), 25 mm. long.
4. **Corethrid**—Phantom midge larva, from Weerakoon 4 mm. long.
5. **Plecoptera**—Stonefly larva, from Macan 25 mm. long.
6. **Simulid**—Blackfly larva from Macan 7 mm. long.
7. **Neuroptera**—Alderfly larva after various authors approximately 18 mm. long.
8. **Odonata**—Damselfly larva 24 mm. long.
9. **Ephemeroptera**—Mayfly (*Caenis*) larva, from Weerakoon 9 mm. long.
10. **Tipulid**—Cranefly larva from Weerakoon 9 mm. long.
11. **Trihcoptera**—Caddisfly larva without its case, from Macan 15 mm. long.
12. **Culicine**—Mosquito larva 9 mm. long.
13. **Anophiline**—Mosquito larva 8 mm. long.
14. **Syrphid**—Horsefly larva, from Macan 15 mm. long.
15. **Psychodid larva**, from Macan 4 mm. long.
16. **Collembola**—Springtail.
17. **Limnobiid larva**, from Macan 30 mm. long.
18. **Chironomid**—Lakefly larva, from Weerakoon 7 mm. long.
19. **Arachnida**—Water mite, from Macan 0·5 mm. long.
20. **Ceratopogonid**—Biting midge larva 6 mm. long.
21. **Blepharocerid**—Net winged midge larva, after various authors 10 mm. long.
22. **Arachnida**—Water mite, from Macan 1·5 mm. long.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PLECOPTERA

(Stoneflies)

Resemble the mayflies closely but can be easily distinguished from them by the presence of only two "tails" at the posterior end and no gills on the abdomenal segments (Page 95, Fig. 5). They have wing pads and well developed legs and resemble adults. Stoneflies are very common in fast flowing streams.

LEPIDOPTERA

(Moths and Butterflies)

Only one family of the Lepidoptera is aquatic, namely the Pyraustidae. They do not have wing pads. They have three pairs of short thoracic legs and five pairs of prolegs on the abdomen. The second and third thoracic segments and all the abdominal segments bear tufts of tracheal gills. A common form present in paddy fields is *Nymphula* (Page 95, Fig. 2). It lives just below the surface of the water, in cases made of leaves and silk.

NEUROPTERA

(Alderflies)

These larvae are in many respects similar to the larvae of aquatic beetles and quite unlike the adults (Page 95, Fig. 7). They differ from the aquatic beetle larvae in the possession of jointed lateral tracheal gills on each abdominal segment. The abdomen is prolonged into a tapering "tail". They do not have wing pads and their legs are relatively short. They are found in swift flowing streams beneath mud stones, vegetation, &c.

TRICHOPTERA

(Caddis flies)

These larvae live in cases constructed of debris, sand and other materials. Some live in tunnels made of silken threads. They have relatively short legs of which the first pair is the shortest and stoutest. They have no wing pads. The last abdominal segment bears a pair of hooked appendages which is characteristic (Page 95, Fig. 11).

DIPTERA

(True Flies)

Many families of Diptera have aquatic larvae. They can easily be recognised by the absence of walking legs (i.e., apodous). Some of their pupae are also very characteristic.

KEY TO THE COMMONER FAMILIES OF AQUATIC DIPTERAN LARVAE

Only the commoner families of dipteran larvae are included in this key. There are numerous other families of diptera whose larvae may be present in water. There are no records of these forms nor have the authors come across them in their field studies. However, diagrams of the larvae of the families Tabanidae Limnobidae and Psycodidae are included in Page 95, although there are no descriptions of them in the text.

1. Larvae with suckers on ventral surface .... Blepharoceridae, page 97
   No ventral suckers 2
2. Head indistinct and more or less retractle with thorax 3
   Head prominent and non-retractile 4
3. Several pairs of prolegs present. Long telescopic tail .... Syrphidae, page 98
   No prolegs .... Tipulidae, page 98
4. At least one pair of prolegs present 5
   Prolegs absent 6
5. Posterior end with an adhesive disc .... Simuliidae, page 98
   No adhesive disc at posterior end .... Chironomidae, page 97
6. Body not transparent. Mouth brushes present .... Culicidae, page 97
   Body transparent. No mouth brushes 7
7. Thoracic segments fused into a mass of greater diameter than the abdomen............
   .... Corethridae, page 97
   Each thoracic segment distinct .... Ceratopogonidae, page 98

FAMILY **BLEPHAROCERIDAE**—Net-winged midges (Page 95, Fig. 21)

Greatly flattened and elongated larvae. The body of each larva has seven distinct divisions and on the ventral surface of each of the first six divisions there is a sucker. By means of these suckers the larva attaches itself to the surface of rocks on the bed of streams in the hill-country. A pair of filamentous gill-tufts is present on each body division except on the first and the last.

FAMILY **CULICIDAE**—Mosquitoes (Page 95, Figs. 12 and 13)

The most widely distributed of the dipteran larvae. They can be easily distinguished because the thoracic segments are fused and the last abdominal segment bears anal flaps. Their antennae are always distinct. Two main types are worth noting.

1. Culicine. With respiratory siphons on the 8th segment (Page 95, Fig. 12)
2. Anophiline. With no respiratory siphons but a plate on the 8th segment for respiration (Page 95, Fig. 13).

FAMILY **CORETHRIDAE**—Phantom midges (Page 95, Fig. 4)

The phantom midge larva is transparent except for air sacs at the anterior and posterior ends. The head bears a long prehensile structure which is the modified antennae, used for seizing food. They frequent clear as well as muddy water and are even found in the mud at the bottom of lakes. Weerakoon and Samarasinghe found them in paddy fields and the authors have collected them in the Colombo (Beira) Lake as well as in the large tanks.

FAMILY **CHIRONOMIDAE**—Lakeflies (Page 95, Fig. 18)

The larvae of these insects are often red in colour and called "Blood-Worms". However there are larvae in this group which are yellow, blue, green or brown in colour. The head is quite distinct and the first thoracic segment bears a pair of false-legs. The second and third thoracic segments are fused. The posterior end bears lappets and hairs. These larvae are scavengers and live in all types of freshwater habitats. They are found in the mud, in decaying vegetation and moss. Many of them are free-living but some make mud cases in which they live.

FAMILY CERATOPOGONIDAE—Biting Midges (Page 95, Fig. 20)

These are also called Heleidae. They are transparent and may be red in colour or colourless. They resemble the chironomidae but have a more chitinised head. They usually do not have false legs (prolegs). Retractile gills are present on the last segment. Generally they are not common in clear water but are associated with algae or mud.

FAMILY SIMULIIDAE—Blackflies (Page 95, Fig. 6)

These larvae are broadened posteriorly where a disc with hooks and gills are found. The head is small and provided with a pair of fan-shaped mouth brushes. The thorax bears a pair of false legs. The larvae live mainly in swift flowing water.

FAMILY SYRPHIDAE—Horsefly (Page 95, Fig. 14)

The larvae are characterised by a long "tail" which is really a respiratory tube and given them the name "rat-tailed maggots". They possess seven pairs of false legs (prolegs) and a pair of "respiratory horns". They occur in polluted water.

FAMILY TIPULIDAE—Crane-flies (Page 95, Fig. 10)

These wrinkled larvae are cylindrical or slightly flattened. They have an indistinct head which is retractile. They have five hairy projections and tracheal gills at the posterior end.

ARACHNIDA

This group of arthropods includes such animals as scorpions, spiders, ticks and mites, most species of which are terrestrial. Two groups, the spiders (Aranaeda) and mites (Acarina) are represented in freshwater. Only Acarina have been recorded from Ceylon.

The mites that are present in water belong to the family Hydrachnidae. They are like the land mites in shape but are minute in size (average size is about 2 mm. only). The adults (Page 95, Figs. 19 and 22) possess a round or oval shaped, unsegmented body with four pairs of legs, which are six jointed and adapted for swimming by the provision of hairs. The last segment of each hind limb bears a pair of claws which can be retracted. In front, each mite has a pair of segmented palps, between which is the capitulum or "false head". The mouth parts of the water mites are modified for piercing and sucking. Water mites lay their eggs in water plants. The larvae resemble the adults except that they have only three pairs of legs.

Water mites and their larvae may be free living and carnivorous or parasitic in a large number of other animals. The adults have been found parasitizing the water scorpion *Ranatra elongata*, *Hydrometra greeni*, and *Eretes sticticus*. As many as sixteen larval mites were found in one specimen of an insect. Larval water mites are sometimes present on terrestrial insects which spend their larval phases in the water. A larval watermite has been collected from the under side of the thorax of the dragon fly *Diplocodes trivialis* Rambur. Because of their parasitic habits water mites and their larvae cause harm to a large variety of freshwater animals. Fourteen species of water mites have been recorded.

Arrenurus ceylonicus Daday

Arrenurus congener Daday

Arrenurus madaraszi Daday

Arrenurus orientalis Daday
Arrenurus rostratus Daday
Arrenurus singalensis Daday
Atax nodusus Daday
Atax singalensis Daday
Curvipes conglobatus C. K.
Curvipes horvathi Daday
Frontipoda ceylonica Daday
Frontipoda picta Daday
Hydrachna dilata Daday
Hydryphantes silvestrii Daday

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VERTEBRATA

PISCES

(Fishes)

IN Ceylon there are approximately sixty species of freshwater fishes. Several foreign species have been introduced but it is not certain whether some of these introduced varieties have established themselves in Ceylon.[1] Some species have never been caught in the field after their introduction. Because the fishes are an important group among the freshwater fauna, keys are provided to identify them down to species. The material for the keys and the descriptions of the species that follow have been drawn freely from other workers, chiefly from Deraniyagala's *Colored Atlas* (1952) and Munro's *Marine and Freshwater Fishes of Ceylon* (1955).

In order that the description of a fish be kept down to a minimum, fin ray and scale formulae have been provided for each species. The use of the formulae is best illustrated by taking a specific example.

Thus the formula for *Puntius vittatus* is D. II, 8. A. II, 5. P. I, 11. L. lat. 20–22. $\frac{3\frac{1}{2}}{3\frac{1}{2}}$.

This formula indicates that in *P. vittatus* the dorsal fin is made up of 2 spines and 8 rays, the anal fin of 2 spines and 5 rays and the pectoral fin of 1 spine and 11 rays. It also indicates that the fish has 20–22 scales along its lateral line, 3½ rows of scales above the lateral line and 3½ rows of scales below it.

KEY TO THE PISCES

1. Fish without scales or with very small inconspicuous scales .... Page 101
   Fish with prominent scales .... Page 108

FISHES WITHOUT PROMINENT SCALES

In this group are the catfishes, eels, spiny eels and loaches.

1. Body much elongated, eel-like 2
   Body short, not eel like 3
2. Fins not spinous .... Anguillidae, page 106
   Front portion of dorsal and anal fins spinous .... Mastacembelidae, page 106
3. Mouth on ventral side of head .... Cobitiidae, page 107
   Mouth terminal (i.e., at tip of snout).. Catfishes, page 102

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[1] *Ctenopharyngodon idellus* (Valenciennes) *Hypophthalmichthys molitrix* (Valenciennes) *Aristichthys nobilis* (Richardson) and *Puntius javanicus* are some species which have been introduced but it is uncertain whether they have established themselves in Ceylon. Introduced species that are now established in Ceylon are included in the text.

CATFISHES

All species of fish that are grouped under the name catfishes possess long feelers (whiskers) which are referred to as barbels. The number of barbels vary from 2–4 pairs. There are seven species of catfishes recorded from Ceylon and they belong to 4 separate families.

1. Tail (caudal) fin forked 2
   Tail (caudal) fin rounded 3
2. Laterally compressed body; 2 pairs of barbels .... Siluridae, page 102
   Sub-cylindrical body; 4 pairs of barbels .... Bagridae, page 103
3. Dorsal fin very long extending about 2/3 the body length .... Clariidae, page 102
   Dorsal fin very short even smaller than the paired fins .... Heteropneustidae, page 103

FAMILY **SILURIDAE**

Two species of Siluridae from two genera are found in Ceylon. They have elongate and laterally compressed bodies which are dull silvery white on the sides. The fins are yellow. They have two pairs of barbels on the head, one pair of which is on the upper jaw (maxillary) and the other on the lower jaw (mandibular). They have forked caudal fins.

1. Cleft of mouth extends beyond the eye posteriorly .... *Wallago attu*
   Cleft of mouth does not extend beyond the eye posteriorly .... *Ompok bimaculatus*

Wallago attu (Bloch and Schneider) [Freshwater Shark. (S. Maha Valaya, Valaya)]. D. 1, 4. A. 79–81. P. I., 13–14 (Page 105, Fig. 1).

A relatively large fish attaining a length of five feet and is greyish brown coloured on top (dorsal surface). A popular food fish in the North-Central Province where it is in great demand. The fish is common in the deeper waters of rivers and irrigation tanks of the low country.

Ompok bimaculatus (Bloch) [Butter Catfish (S. Kokussa, Pena Valapotta, Valapotta)]. D. I. 3–4 A. 61–66. P. I., 12–15 (Page 105, Fig. 4).

Does not grow as large as *Wallago attu*, but specimens measuring one and a half feet in length are not uncommon. They are pale bluish olive coloured dorsally and their gill covers (opercles) have yellow markings.

FAMILY **CLARIIDAE**

Fish belonging to this family have depressed heads and elongate but only slightly compressed bodies. They have four pairs of barbels. The caudal fin is rounded. They are adapted for breathing air when they leave the water for short periods. Two species have been recorded from Ceylon.

1. Uniformly coloured with dark brown to various shades of green or yellow. Pectoral spine serrated .... *Clarias teysmanni brachysoma*
   Conspicuously blotched or clouded with dark olive brown on a greenish yellow background. Pectoral spine almost smooth .... *Clarias nebulosus*

Clarias teysmanni brachysoma (Gunther) [Teysmann's Spotted Catfish. (S. Kaha Magura, Magura, Vel Magura)]. D. 70. A. 53–60. P. I, 8 (Page 105, Fig. 3).

This fish grows up to a length of about one foot and may weigh as much as eight pounds. It is a very common fish in muddy streams and ponds and is nocturnal in its habits.

Clarias nebulosus Deraniyagala.

This species may grow to about one and a half feet in length. It is restricted to rivers at higher elevations. The first record of the species in 1958 was from the Kalu Ganga at Ratnapura.

FAMILY **HETEROPNEUSTIDAE**

Only one species is recorded from Ceylon.

Heteropneustes fossilis (Bloch) [Stinging Catfish (S. Hunga, Kaha Hunga, Lai Hunga, Vel Hunga)]. D. 7–8. A. 68–78. P. I, 7 (Page 105, Fig. 2).

It is an elongate laterally compressed fish with 4 pairs of barbels, attaining a length of 10–14 inches. It has a strong spine on each pectoral fin and is capable of inflicting a rather nasty sting. The caudal fin is rounded. The adults are dark brown coloured with two lateral yellow bands. They are very common in the ponds and irrigation reservoirs in the low country and may enter brackish water. They occur in enormous numbers in some irrigation reservoirs and are considered a delicacy.

FAMILY **BAGRIDAE**

This is a family of fishes having sub-cylindrically shaped bodies. These catfishes have a prominent stout dorsal spine. They have four pairs of barbels. The caudal fin is forked. They are dark coloured on their dorsal surface and light coloured on the belly. Thre species have been recorded from Ceylon.

1. Three dark coloured lateral bands on each side of the body........*Macrones vittatus*,
   No lateral bands.. 2
2. Adipose fin[1] long. The length of its base is equal to or longer than that of dorsal fin...*Macrones keletius*
   Adipose fin short. The length of its base is much shorter than that of the dorsal.. *Macrones gulio*

Macrones gulio (Hamilton-Buchanan) [The Long-Whiskered Catfish (S. Mada Anguluwa, Mana Ankutta, Vel Anguluwa)]. D. II, 6–7 A. III–IV, 10–12. P I, 7–9 (Page 105, Fig. 5).

They may attain a length of ten inches and are usually present in brackish water but capable of moving up rivers into fresh water.

Macrones keletius (Valenciennes) [The Dwarf Catfish (S. Path Ankutta)]. D. II, 7–8. A. II, 8. P. I, 8 (Page 105, Fig. 10).

A medium sized fish only growing up to five inches in length and common in rivers and streams.

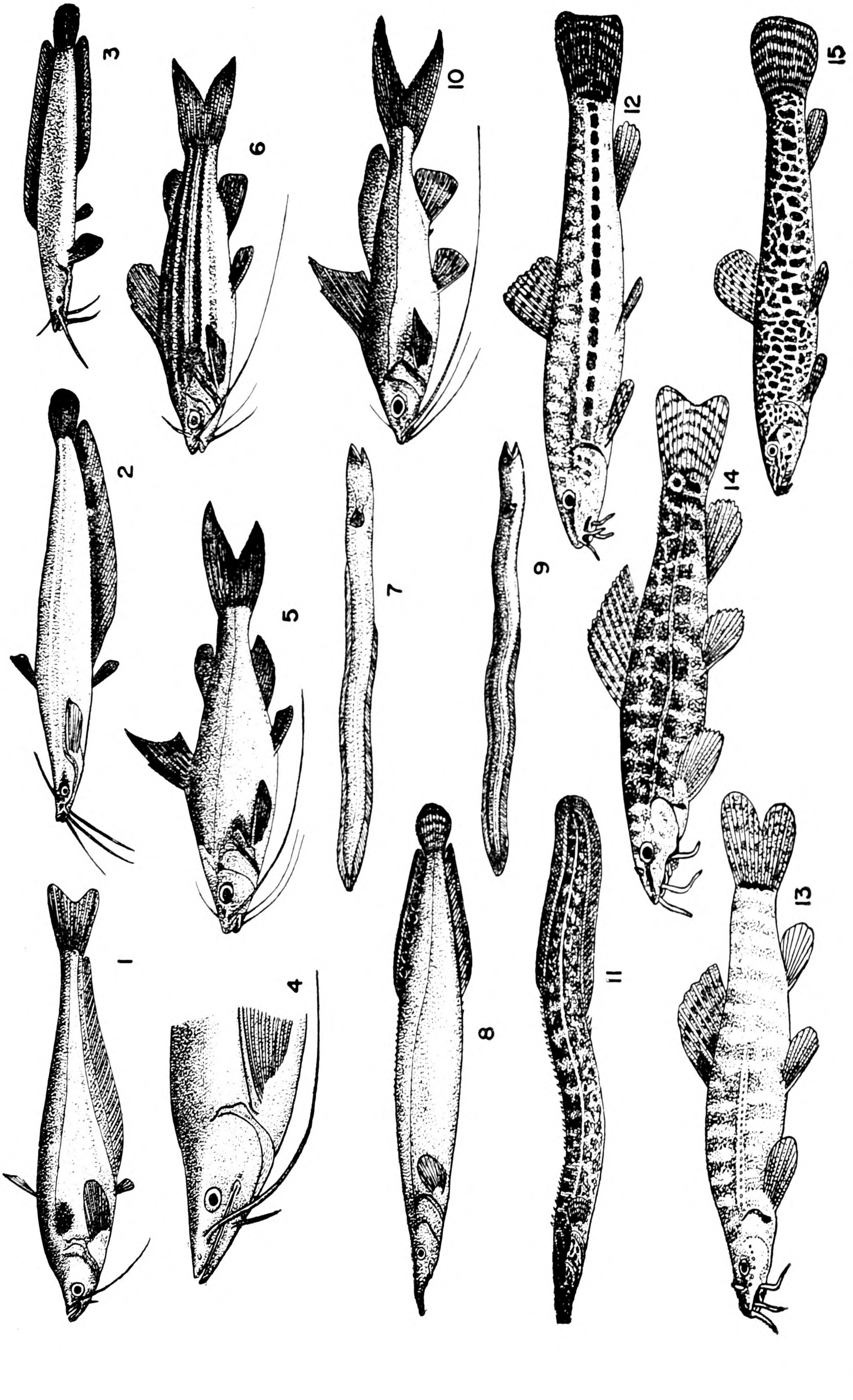
Macrones vittatus (Bloch) [Striped Dwarf Catfish (S. Hiri Ankutta, Iri Ankutta)]. D II, 7–8. A. II–III, 7–8. P. I., 8 (Page 105, Fig. 6).

This is a relatively small species attaining a maximum length of four inches. Present in ponds and streams of the low and mid-country.

[1] A fleshy fin without any fin rays or spines. It lies between the dorsal and caudal fins.

Explanation to figures on page 105

1. *Wallago attu* 150 cms. long.
2. *Heteropneustes fossilis* 30 cms. long.
3. *Clarias teysmanni brachysoma* 30 cms. long.
4. *Ompok bimaculatus* 40 cms. long.
5. *Macrones gulio* 25 cms. long.
6. *Macrones vittatus* 10 cms. long.
7. *Anguilla nebulosa nebulosa* 105 cms. long.
8. *Macrognathus aculeatus* 25 cms. long.
9. *Anguilla bicolor bicolor* 60 cms. long.
10. *Macrones keletius* 12·5 cms. long.
11. *Mastacembelus armatus* 65 cms. long.
12. *Lepidocephalus thermalis* 5 cms. long.
13. *Noemacheilus notostigma* from Deraniyagala 5.5 cms. long.
14. *Noemacheilus botia* 4·5 cms. long.
15. *Lepidocephalus jonklaasi* from Deraniyagala 3.5 cms. long.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FAMILY **ANGUILLIDAE** Eels

They are elongate fishes with cylindrical snake-like bodies. They have no pelvic fins. Scales are minute. The ventral surface is yellow in colour. The anus is in the anterior half of the body length. They migrate to the sea for breeding and the larval forms enter rivers and grow to maturity in fresh water. Two species are found in Ceylon.

1. Dorsal fin about the same length as anal and originates approximately above anus. Bluish tinge on dorsal surface. Sides brown in colour................*Anguilla bicolor bicolor*

   Dorsal fin noticeably longer than anal. Dorsal surface and sides brown in colour and mottled with a darker shade of brown.........................*Anguilla nebulosa nebulosa*

Anguilla bicolor bicolor McClelland. [The Level Finned Eel (S. Kakkutu Arndha, Kalu Arndha, Mada Arndha)]. (Page 105 Fig. 9)

These eels grow up to two feet in length. They are common in the freshwater streams, rivers and swamps near the coast but have not been recorded from the hill-country.

Anguilla nebulosa nebulosa. McClelland. [The Long Finned Eel (S. Kaha Arndha, Pol Mal Arndha, Polon Arndha, Vali Arndha. T. Pulli Vilangu)]. (Page 105 Fig. 7)

This species grows to larger size than *A. bicolor bicolor.* They are present in the hill-country pools and descend to the sea to spawn during the rainy season.

FAMILY **MASTACEMBELIDAE** Spiny Eels

This is a group of mud-loving, spiny, eel-like fishes with elongated and laterally compressed bodies. They have a characteristic pointed snout and a row of spines in front of the soft dorsal fin. In Ceylon they are represented by two genera with a single species in each genus.

1. Caudal fin distinct from dorsal and anal fins. Dorsal fin with several yellow edged blotches. Spinous portion of dorsal with 13–17 spines................*Macrognathus aculeatus*

   Caudal, dorsal and anal fins confluent. No yellow edged blotches on dorsal fin. Spinous portion of dorsal with 34–37 spines........................*Mastacembelus armatus*

Macrognathus aculeatus (Bloch). [Lesser Spiny Eel (S. Batakola Theliya)]. D. XIII–XVII, 50–54, A. II–III, 50–52, P. 22–25 (Page 105. Fig. 8).

The body is covered with a very large number of minute scales which are absent from the upper surface of the snout. Dorsally the fish is reddish brown to olive coloured with a light coloured stripe and a yellow coloured lateral band from the eye to the tail. Between these two bands is an indistinct row of light spots. The sides are greenish yellow and the belly is pink yellow or white. The fins are dusky brown. The fish grows up to 10 inches and inhabits, streams, ponds and tanks in the low country.

Mastacembelus armatus (Lacepede). [Spiny Eel (S. Theliya, Gan Theliya, Oya Theliya)]. D. XXXIV–XXXVII, 64–80. A. II–III, 64–78. P. 25 (Page 105, Fig. 11).

A much larger fish than the former species, growing up to 25 inches. Scales are very minute. Top of snout is scaleless. The dorsal and lateral surfaces are brownish coloured while the ventral surface is yellow. The entire body is mottled with blotches of dark brown. The fins are brown coloured. The fish inhabits flowing and still waters up to 4,000 feet above sea level.

FAMILY **COBITIIDAE** Loaches

This is a family of small fishes. They have three or four pairs of barbels. They are provided with protective colouration (camouflage) in the form of stripes and spots. They are bottom feeders. Four species from two genera are represented in Ceylon.

1. Four pairs of barbels around the mouth. Presence of a sub-orbital spine (on each cheek)..........2

   Three pairs of barbels. No spines on cheek..........3

2. A mosaic of large vertically elongated black spots on body.......... *Lepidocephalus jonklaasi*

   11–12 irregular brown blotches on lateral line.......... *Lepidocephalus thermalis*

3. Lateral line complete, scales distinct though minute.......... *Noemacheilus botia*

   Lateral line incomplete, scales rudimentary.......... *Noemacheilus notostigma*

Lepidocephalus thermalis (Valenciennes). [Lesser Loach (S. Ahirava, Ahiraya, Pulli Ahirava T. Aiarai)]. D. II, 6 A. II, 5. P. I., 6 (Page 105, Fig. 12).

The body colour of this loach is yellow with brown spots and reticulations on the head, back and sides. There are eleven to twelve irregular brown blotches along the lateral line. The tail fin has a black spot. They grow up to two inches in length and are found in pools below an elevation of 1,600 feet. They have been recorded from the hot springs near Trincomalee.

Lepidocephalus jonklaasi Deraniyagala (Page 105, Fig. 15.)

The dorsal fin is marked with five rows of spots. So far this species has only been recorded from shaded pools of hill streams in the thick forest at Akuressa. The pools are shallow, containing much leaf debris and are at an elevation of 500 feet above sea level.

Noemacheilus notostigma Bleeker. [Spotted Loach (S. Gomera Ahirava, Kandhu Ahirava)]. D. III, 6–8. A. III, 5. P. I., 7–9 (Page 105, Fig. 13).

They are olive green coloured on the dorsal surface and their sides are yellow. There are 13 to 14 broad vertical bands on the sides. There is a black vertical streak at the base of the caudal which has four indistinct bars. Fins are yellow. They grow to $2\frac{1}{4}$ inches and are present in hill country streams.

Noemacheilus botia (Hamilton-Buchanan). [Striped Loach (S. Pol Ahirava, Vairan Ahirava, Vairan Pol Ahirawa)]. D III–IV, 10–11. A. III, 5, P I, 10–12 (Page 105 Fig 14).

These loaches are brownish yellow. They have about 17 broad black vertical bars on their sides. A black, white edged ocellus (spot) is present on the tail. The tail fin is yellowish and has seven V-shaped black bars. They grow up to $1\frac{1}{2}$ inches. There are two subspecies—*Noemacheilus botia botia* Deraniyagala growing up to $1\frac{1}{2}$ inches, and *Noemacheilus botia aureus* Day. Both subspecies are present in small streams in the low country.

FISHES WITH PROMINENT SCALES

There are a large number of species of fish with prominent scales. They include the carps and carplets with very conspicuous scales, the surface swimming top minnows with a prominent spot on the head, the snake heads with heads resembling those of snakes and the spiny finned fishes.

1. Two distinct dorsal fins .... Gobiidae, page 124
   Dorsal fin single, a portion of which may be spinous 2
2. Dorsal fin placed far back near the tail; surface feeding fish .... Cyprinodontidae, page 117
   Dorsal fin generally midway between head and tail 3
3. Snake-like heads; more or less cylindrical elongated bodies .... Ophiocephalidae, page 118
   Typical fish like heads 4
4. Front portions of dorsal and anal fins spinous 5
   No spinous dorsal—(Carp-like fishes) .... Cyprinidae, page 108
5. Either pelvic fins with filamentous portion; or spines on gill cover (Air breathers) .... Anabantidae, page 119
   Pelvic fins without filamentous portion, no prominent spines on gill covers .... Cichlidae, page 123

FAMILY **CYPRINIDAE** Carps and Carp-like Fishes

The bodies of the fishes belonging to this family are compressed laterally and are provided with very conspicuous scales. The head is however devoid of scales. They do not have more than two pairs of barbels,[1] but one or both pairs may be absent in some species.

1. Belly compressed into a sharp edge .... Sub-family Abraminae, page 108
   Belly rounded 2
2. Lateral line, passes through ventral portion of tail, incomplete or absent .... Rasborinae, page 108
   Lateral line when complete passes through centre of tail .... Cyprininae, page 110

SUB-FAMILY **ABRAMINAE**

Chela laubuca[2] (Hamilton-Buchanan) [Winged Rasbora (S. Kara Adaya, Tatu Dandiya)].

D. II, 7–8. A. III, 17–19. P. I., 9–11, L. lat. 33-35. Tr. $\frac{6\frac{1}{2}\text{–}7\frac{1}{2}}{1\frac{1}{2}\text{–}3\frac{1}{2}}$ (Page 113, Fig. 7)

This species has a more or less hyaline or transparent body. It has a characteristic compressed body. The ventral surface or belly unlike all other carps and carplike fishes is not rounded but is compressed into a sharp edge (i.e., it is culturate). The body colour is a metallic blue and the fins are hyaline. It has a dark coloured spot behind the gill cover. It grows up to $2\frac{1}{4}$ inches and inhabits ponds, irrigation reservoirs and rivers in the dry parts of the low country.

SUB-FAMILY **RASBORINAE**

1. Barbels present 2
   Barbels absent 3

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[1] *Cyprinus carpio* is an exception with 4 pairs of barbels.

[2] Silas (1958) *J. Bombay Nat. Hist. Soc.* 55, 1, 54–100, indicated that the Ceylon forms of this species had different body proportions to the Indian ones. Deraniyagala 1960 gave the subspecific name *lankensis* to the Ceylon fish.

2. Anal fin with 5 rays..*Esomus danrica thermoicos*
Anal fin with 13–16 rays..*Danio aequipinnatus*

3. Lateral line absent...*Horadandiya atukorali*
Lateral line present.. 4

4. Lateral line complete........ ....*Rasbora daniconius*
Lateral line incomplete.................... 5

5. 11–12 scales in front of dorsal fin...*Rasbora vaterifloris*
28–30 scales in front of dorsal fin...............................*Amblypharyngodon melettinus*

Rasbora daniconius (Hamilton Buchanan). [Common Rasbora (S. Kehel Dandiya, Kiri Dandiya, Kudu Massa, Dandiya, Pethiya)]. D. II, 6–7, A. II, 5. P. I., 13–14, L. lat. 30–34. Tr. $\frac{4\frac{1}{2}-6\frac{1}{2}}{1\frac{1}{2}-2\frac{1}{2}}$ (Page 113, Fig. 2)

This species is olive coloured on its dorsal surface and white on the ventral. The fins are tinged yellow. Along its body there is a narrow dark stripe which is tinged on either side with yellow. The fish attains a length of four inches. One of the commonest fish in streams, ponds and irrigation reservoirs. Also found in large numbers in paddy fields.

Rasbora vaterifloris[1] Deraniyagala. [Vateria Flower Rasbora (S. Hal Mal Dandiya, Hal Mal Titteya)]. D. II, 8. A. II, 6. P. I., 11. L. lat. 25. Tr. 6 (Page 113, Fig. 3).

An indigenous fish which is much in demand by aquarists. It is a very delicate and translucent fish which will not stand much handling. The body colour varies from a very light shade of greenish grey dorsally to light yellowish blue on the sides and on the ventral surface. The dorsal and tail fins are orange while the other fins are hyaline. It is a small fish attaining a length of $1\frac{1}{2}$ inches. Found in the streams in the Ratnapura and Badureliya Districts.

Amblypharyngodon melettinus (Valenciennes) [Attentive Carplet (S. Soreya)]. D. II, 7. A. III, 5. P. I., 13–14, L. lat. 45–50 Tr. $\frac{8\frac{1}{2}-10\frac{1}{2}}{4\frac{1}{2}-5\frac{1}{2}}$ (Page 113, Fig. 4)

This is another species with a more or less translucent body which is somewhat compressed. The dorsal surface of the fish is brownish yellow, the vertex being bright green. The sides are silvery. It grows up to three inches in length and inhabits ponds and streams.

Horandandiya atukorali Deraniyagala. [Green Carplet (S. Hora Dandiya)]. D. II, 6. A. III, 5. P. 10, L. lat. 22. Tr. 6–7 (Page 113, Fig. 6).

This is not a common fish. It is pale yellowish green on the dorsal surface while its sides are silvery with pink reflections. It has a green longitudinal line on each side of the body. The ventral surface is silvery. The fins are hyaline. Its a small fish growing up to 1 inch or less and lives in streams and ponds of the Ratnapura and Badureliya Districts.

[1] Deraniyagala (1958) indicated that there are three varieties of *Rasbora vaterifloris* namely *ruber*, *rubrioculis* and *pallida*.

Esomus danrica thermoicos[1] (Valenciennes). (Flying Barb (S. Ravul Dandiya)]. D. II, 6. A. III, 5. P. I. 10–12, L. lat. 31–34, Tr. $\frac{5\frac{1}{2}}{1\frac{1}{2}}$ (Page 113, Fig. 10).

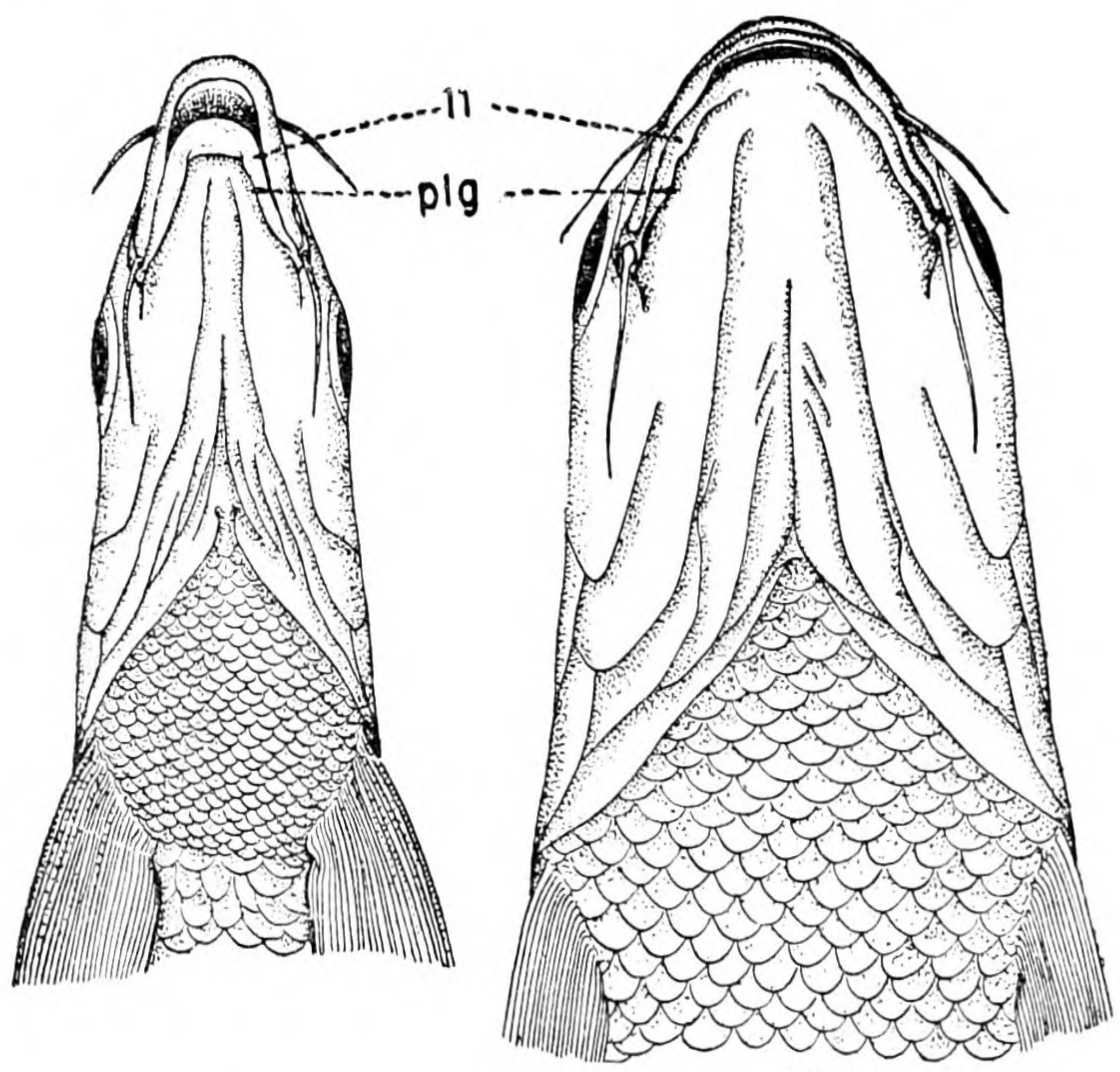
The dorsal surface is pale olive coloured while the sides and ventral surface are silvery. On each side of the fish there is a faint blue lateral stripe and above this another one of greenish yellow. The fins are hyaline and pale yellow. It has a pair of long feelers directed backwards. They grow up to $2\frac{1}{2}$ inches and are common in ponds, ditches and irrigation tanks.

Danio aequipinnatus (McClelland). [Giant Danio (S. Dankola Salaya, Rath Kailaya, Salaya, Suddara)]. D. II, 10–12. A. III, 13–16. P.I., II. L. lat. 37–40, Tr. $\frac{7\frac{1}{2}–8\frac{1}{2}}{1\frac{1}{2}–2\frac{1}{2}}$ (Page 113, Fig. 1).

The body is compressed and bright greenish blue coloured. There are two or three lateral bands which are not continuous along the entire length of the body. The fin colour varies from yellow to deep orange red. There is a dark blotch behind the gill cover. Grows up to 3 inches and is common in streams, ponds and irrigation reservoirs, Also found in paddy fields.

SUB-FAMILY **CYPRININAE**

1. Mouth terminal 2
   Mouth on ventral side of head for sucking .... Carp- like fishes with sucking mouths. page 116
2. Post labial groove* continuous (Fig. 1 below) .... *Tor khudree longispinis*, page 111
   Post labial groove* interrupted in front (Fig. 2 below) 3
3. Dorsal fin with 17–21 rays 4
   Dorsal fin with 7–9 rays .... *Puntius*, spp., page 111
4. Barbels on head .... *Cyprinus carpio*, page 111
   No barbels on head .... *Carassius carassius*, page 111



1 2

Fig. 1 Ventral view of head of *Tor khudree longispinis* and 2. of *Puntius sarana*.
ll—lower lip. plg—post labial groove

[1] Deraniyagala (1958) described a new sub-species *Esomus danrica brevibabartus*.

* Post labial groove is the groove behind the lower lip.

Cyprinus carpio (L.). [Common Carp (S. Rata Pethiya)]. D. III, 17–22. A. III, 5. P. I., 15. L. lat. 35–39, Tr.—$\frac{5\frac{1}{2}}{7\frac{1}{2}}$ (Page 113, Fig. 8.)

Around its mouth there are four pairs of barbels. The dorsal fin is longer in this fish than in the other members of this family. This species has been cultivated for over a thousand years in Asia and Europe. Several varieties of the species are now common. The fish are usually olive coloured but a golden or yellow type, often referred to as Golden Carp, is also common. Spawn from the same parent very often produces both olive or grey coloured and golden carp. Introduced into Ceylon waters recently and a few large specimens weighing as much as twelve pounds have been captured by commercial fishermen in Polonnaruwa. They are also common in the Norton Bridge reservoir. A variety of *Cyprinus carpio* the mirror carp, in which certain scales are reduced in size or in which certain scales are absent altogether had been introduced into the Nuwara Eliya lake and are now breeding there.

Carassius carassius (L.) Golden or Prussian Carp (S. Ran Pethiya). D. 15–25, A. 8–9, V. 9–10. P. 13–18. L. lat. 28–35, Tr.$\frac{6-7}{9}$

There are no barbels around the mouth in this species. The fish is olive brown on the dorsal surface, yellow grey on the sides and drab white on its ventral surface. It is very much like the ornamental gold fish. Introduced into the Nuwara Eliya lake in 1930.

Tor khudree longispinis (Gunther). [Mahsier (S. Hora Paleya, Lehella)]. D. IV, 9. A. III, 5. P. I., 15–17, L. lat. 23–24. Tr.—$\frac{3\frac{1}{2}}{2\frac{1}{2}}$ (Page 113, Fig. 11)

The dorsal surface of this species is pale olive coloured with blue and bronze reflections. The sides and belly are lighter coloured. It is a popular game fish and is common in the hill country streams and in the Castlereagh and Norton Bridge reservoirs. In Ceylon, fish weighing over twenty pounds are on record. It is sometimes caught in the larger irrigation reservoirs and the lower reaches of the Mahaweli ganga.

Puntius spp. There are thirteen species of *Puntius* recorded from Ceylon.

1. Lateral line incomplete 2
   Lateral line complete 5
2. Dorsal spine smooth .... *Puntius vittatus*
   Dorsal spine serrated 3
3. Barbels present .... *Puntius titteya*
   Barbels absent 4
4. Two dark bands across body .... *Puntius cumingi*
   A dark spot on shoulder and another on tail .... *Puntius ticto*
5. Dorsal spine serrated 6
   Dorsal spine smooth 8
6. Barbels absent, three dark bands across body .... *Puntius nigrofasciatus*
   Barbels present 7

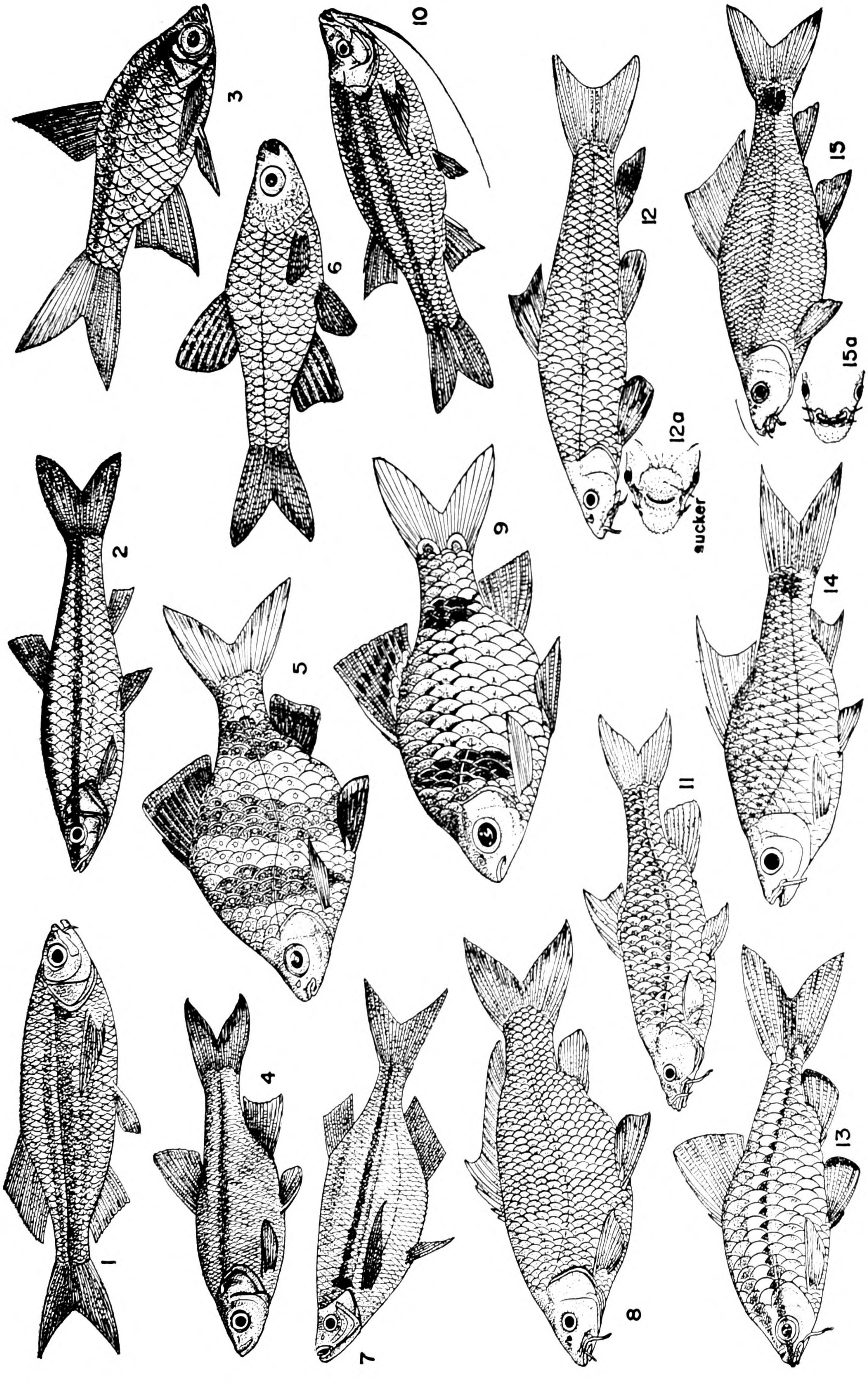
Explanation to figures on page 113

1. *Danio aequipinnatus* 7·5 cms. long.
2. *Rasbora daniconius* 12·5 cms. long.
3. *Rasbora vaterifloris* 3·*8* cms. long.
4. *Amblypharyngodon melettinus* 7·5 cms. long.
5. *Puntius nigrofasciatus* after Deraniyagala 5·5 cms.
6. *Horadandiya atukorali* 2·5 cms. long.
7. *Chela laubuca* 5·5 cms. long.
8. *Cyprinus carpio* 42 cms. long.
9. *Puntius cumingi* after Deraniyagala 5 cms. long.
10. *Esomus danrica thermoicos* 6·5 cms. long.
11. *Tor khudree longispinis* 35 cms. long.
12. *Garra ceylonensis* 17·5 cms. long.

12*a*. Ventral view of head of *Garra ceylonensis* showing the sucker (s..

13. *Puntius titteya* after Deraniyagala 5 cms. long.
14. *Puntius dorsalis* 24 cms. long.
15. *Labeo dussumieri* 36 cms. long.

15*a*. Ventral view of head of *Labeo dussumieri*.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4
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6
7
8
9
10
11
12
12a
sucker
13
14
15
15a

7. A dark lateral band from eye to tail fin .... *Puntius pleurotaenia*
No lateral band but a dark spot near tail .... *Puntius sarana*

8. Barbels absent .... *Puntius melanamphyx sinhala*
A pair of barbels present 9

9. Dorsal spine strong. $4\frac{1}{2}$ scales above lateral line and $2\frac{1}{2}$ below.... *Puntius dorsalis*
Dorsal spine slender 10

10. Black spot over base of anal fin .... *Puntius filamentosus*
No black spot or if present it is behind the base of anal 11

11. $5\frac{1}{2}$ scales above lateral line (and $3\frac{1}{2}$ scales below) .... *Puntius chola*
Less than $5\frac{1}{2}$ scales above lateral line 12

12. $4\frac{1}{2}$ scales above lateral line (and $2\frac{1}{2}$ scales below) .... *Puntius amphibius*
$3\frac{1}{2}$ scales above (and $2\frac{1}{2}$—$3\frac{1}{2}$ below) .... *Puntius bimaculatus*

Puntius sarana (Hamilton-Buchannan). [Olive Barb (S. Mas Pethiya, Pethiya, Vellan Kola Pethiya)]. D. IV, 8. A. III, 5. P. I., 12–16, L. lat. 26–29, Tr. $\frac{4\frac{1}{2}\text{–}5\frac{1}{2}}{3\frac{1}{2}}$

The largest among the species of *Puntius* in Ceylon attaining a length of 12 inches. It has a dark coloured spot in front of the tail. Has a prominent spine on the drosal fin. It is a very common fish in streams, rivers, ponds, lakes and irrigation reservoirs.

Puntius dorsalis (Jerdon). (Long Snouted Barb (S. Bingattaya, Honda Pethiya, Kattu Kuriya, Kattu Pethiya, Kandhaya, Kureya, T. Kendhai)]. D. IV, 8. A. III, 5.P. I., 11–13, L. lat. 23–25. Tr. $\frac{4\frac{1}{2}}{2\frac{1}{2}}$ (Page 113, Fig. 14)

It has no dark coloured spot in front of the tail but has a black blotch on the tail itself. It has a thick spine in the dorsal fin and hence the name Katu Pethiya. It grows up to $9\frac{1}{2}$ inches in length and is common in streams, rivers, ponds and irrigation reservoirs.

Puntius filamentosus (Valenciennes). [Filamented Barb (S. Dankolla Pethiya, Goma Kadeya Goma Kolla, Ipilli Kadeya)]. D. IV, 8. A. III, 5. P. 1., 15, L. lat. 22–23. Tr. $\frac{4\frac{1}{2}}{2\frac{1}{2}}$

This species grows to a moderate size attaining a length of $4\frac{1}{2}$ inches. It has a prominent dark coloured blotch in front of the tail above the posterior half of the anal fin. It inhabits rivers, large streams and irrigation reservoirs.

Puntius pleurotaenia Bleeker. [Side Striped Barb (S. Hitha Massa)]. D. IV, 8. A. III–IV, 4–5. P. I., 15, L. lat. 28–30 Tr. $\frac{4\frac{1}{2}\text{–}5\frac{1}{2}}{2\frac{1}{2}}$

This fish is found in streams at high elevations. The body colour is somewhat dark being greenish brown on the dorsal surface, and silvery on the rest of the body surface. There is a prominent dark band from the eye to the tail along the lateral line. This species grows up to six inches in length.

Puntius chola (Hamilton-Buchanan). [Green Barb (S. Kottu Ippilla, Kotu Pethiya)]. D. IV, 8. A.III, 5.P. I., 15.L. lat. 24-27. Tr.$\dfrac{5\frac{1}{2}}{3\frac{1}{2}}$

Puntius amphibius (Valenciennes). [Scarlet Banded Barb (S. Ippilli Kadaya, Mada Ippilla)]. D. IV, 8. A. III, 5.P. I., 15. L. lat. 23-24 Tr.$\dfrac{4\frac{1}{2}}{2\frac{1}{2}}$

These are both medium sized fish growing up to 3½ inches in length and inhabit streams and irrigation reservoirs of the low country. Compared to the other species of *Puntius* these two species are light coloured. Dorsally they are pale olive coloured. *P. amphibius* has a dark blotch at the end of the lateral line and the sexually mature fish possess a scarlet lateral band from eye to tail.

Puntius vittatus Day. [Striped Barb (S. Bandi Titteya)]. D. II, 8. A. II, 5. P.I., 11. L. lat 20-22. Tr.$\dfrac{3\frac{1}{2}}{3\frac{1}{2}}$

It has a more or less oblong body. On the dorsal surface it is pale olive in colour while the sides are silvery. It has three black spots, one on the dorsal fin, one near the base of the caudal fin and the other near the anus. It assumes a bright green or red colour during the breeding season. It is the commonest carplet in the low country and occurs in large numbers in paddy fields. It grows up to about one inch.

Puntius melanamphyx sinhala (Duncker). [Black Banded Barb (S. Goma Titteya, Iri titteya, Pulli titteya, Thirelliya, Titha Kadaya)]. D. III, 8. A. III, 5. P. I.14-16. L. lat. 20-22. Tr.$\dfrac{4\frac{1}{2}}{2\frac{1}{2}}$

It has a rather elongate body which is brownish coloured on the dorsal surface and has three dark vertical bands across the body. The dorsal and tail fins are reddish with black tips. Grows up to a little over an inch in length.

Puntius bimaculatus (Bleeker). [Two Spot Barb (S. Ippilli Kadaya)]. D. IV, 7-8. A.III, 5.P. I.,15. L. lat. 24-25. Tr.$\dfrac{3\frac{1}{2}}{2\frac{1}{2}\text{-}3\frac{1}{2}}$

It is a rather elongate carp with a black spot at the base of the dorsal fin, another on the lateral line near the tail and sometimes a third one on the anal fin. Spawning individuals have a crimson lateral band. It grows up to 2½ inches and is found at all elevations in slow running as well as in torrential streams.

Puntius nigrofasciatus (Gunther). [Three Banded Crimson Barb, Black Ruby. (Bulath Sapeya, Manamalaya)]. D.III, 8.A. III, 5.P.I., 12.L. lat. 20-22. Tr.$\dfrac{4\frac{1}{2}}{3\frac{1}{2}}$ (Page 113, Fig. 5).

A popular aquarium fish with a more or less oval shaped body. The head is orange-red in colour whilst the rest of the body is drab olive greem with golden spots on some of the scales. It has three black vertical bands. Dorsal and annal fins blackish. When stimulated

9——R 19576 (9/61)

the males assume a glowing dark shiny-red colour in the front portion of the body and the fins. Grows up to $2\frac{1}{4}$ inches in length and inhabits the shady parts of slow running streams.

Puntius titteya[1] Deraniyagala. [Cherry Barb, Crimson Carplet (S. Kondhaya, Dola Titteya, Lai Titteya, Vairan Titteya)]. D. III, 7. A. III, 5. P. I., 10. L. lat. 19–20, Tr. $\frac{3\frac{1}{2}}{3\frac{1}{2}}$—(Page 113, Fig. 13).

A small fish attaining a maximum length of a little under two inches. Its colour is variable, usually it is purplish brown on the dorsal surface while its sides are silvery and occasionally there is a slight redness on the head of males. There is a brown lateral stripe from the eye to the caudal fork and above this stripe is another of yellow. Found in the small streams and rivulets at the foot hills.

Puntius cumingi (Gunther). [Cuming's Two Banded Barb (S. Pothaya)]. D. II, 8. A. III, 5. P.I.11.L. lat. 19-21. Tr. $\frac{3\frac{1}{2}}{3\frac{1}{2}}$—(Page 113, Fig. 9).

The body is silvery with yellow reflections around the base of the pectoral fins. There is a rhomboid black patch on each side above the pectoral fin and another above the anal fin. The dorsal and ventral fins are orange and the former has two horizontal rows of 5-7 black spots. The other fins are yellow. It grows up to 2 inches in length and inhabits streams at high elevations.

Puntius ticto[2] (Hamilton-Buchanan). [Fire Fin Barb]. D. II, 8. A. III, 5.P. I., II. L. lat. 20-22. Tr. $\frac{4\frac{1}{2}}{2\frac{1}{2}-3\frac{1}{2}}$

This species of Puntius is an inhabitant of the ponds and irrigation reservoirs in the dry zone. It can attain a length of a little over $1\frac{1}{2}$ inches. It is pale olive coloured on the dorsal surface while its sides are silvery. There are two black spots between the gill cover and tail below the lateral line. There are two rows of indistinct spots on the dorsal fin. The male has an arched band of red on the dorsal fin which becomes more vivid during the breeding season.

Carp like fishes with sucking mouths

These fishes have their mouth adapted for sucking. Two genera of such fishes are present in Ceylon, namely *Garra* with a single species and *Labeo* with three species.

1. Sucker behind the mouth (Page 113, Fig. 12*a*)........*Garra ceylonensis*
   No sucker behind the mouth (Page 113, Fig. 15*a*)........2
2. 48–53 scales along lateral line........*Labeo dussumieri*
   40–42 scales along lateral line........3
3. Origin of dorsal fin in mid back........*Labeo fisheri*
   Origin of dorsal closer to tip of snout than to caudal fin........*Labeo porcellus lankae*

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[1] Deraniyagala (1958) has described a colour variety *Puntius titteya rubripinnis*.

[2] Deraniyagala (1956 and 1958) has indicated that the Ceylon species is a new sub-species *Puntius ticto melanomaculatus*.

Garra ceylonensis Bleeker. [Stone-sucker (S. Gal Panderuwa, Gal Pandiya, Pandiya, T. Kal Koravai)]. D. III, 8-9. A. II, 5. P. I., 9-12. L. lat. 33-35. Tr. $\frac{4\frac{1}{2}}{2\frac{1}{2}-3\frac{1}{2}}$ (Page 113, Fig. 12).

These fishes are olive green coloured on the dorsal surface and silvery yellow on the sides and belly. They have a dark coloured blotch just behind the gill cover and a pinkish longitudinal lateral streak along the body. They inhabit flowing streams, mainly in the hill country and grow up to about six inches in length. They are capable of climbing vertical rock faces against the current with the aid of their suckers.

Labeo dussumieri (Valenciennes). [Common Labeo (S. Hiri Kanaya, Gan Kanaya)]. D. III, 12–13. A. III, 5. P. I., 15. L. lat. 48–53. Tr. $\frac{8\frac{1}{2}-9\frac{1}{2}}{6\frac{1}{2}-7\frac{1}{2}}$ (Page 113. Fig. 15).

Body is oval shaped. The dorsal surface of the fish is golden brown coloured, pale on the sides while the belly at the anterior end is pinkish. The fins are golden brown coloured. A large black spot is present on the tail. Very common in the large irrigation reservoirs. Grows up to 14 inches and is an important food fish.

Labeo fisheri Jordon and Starks. [Green Labeo, Mountain Labeo (S. Gadaya, Kalu Gadaya, Vali Gadaya)]. D. III, 10–12. A. III, 5. P. I., 15. L. lat. 40–42. Tr. $\frac{7\frac{1}{2}}{5\frac{1}{2}}$

Pale olive coloured dorsally, while the sides are golden with red reflections. A greenish lateral stripe along upper half of body. Dark brown spot on tail. Inhabits hill country streams. Grows up to 15 inches.

Labeo procellus lankae Deraniyagala. [Orange Fin Labeo (S. Seva Kanaya Tambala Vanna, Tambalaya)]. D. III, 11–12. A. III, 5. P. I, 16. L. lat. 40–42 Tr. $\frac{7\frac{1}{2}-8\frac{1}{2}}{5\frac{1}{2}-6\frac{1}{2}}$

This species is olive coloured on its dorsal surface and white ventrally. The throat has a flush of pink. The fins are vermillion coloured, the caudal fin being edged with olive. There is a dark blotch on the tail. Common in the irrigation reservoirs of the dry zone. Grows up to 15 inches.

FAMILY **CYPRINODONTIDAE** Top Minnows

This is a group of small, essentially surface feeding fish. They usually have a silver or white coloured spot on the head. This spot is very prominent when the fish is swimming in the water. The dorsal fin is placed far back on the body. They are very common in shallow water and at the edges of deeper habitats. They feed on small drowning terrestrial animals and mosquito larvae. There are three species in Ceylon.

1. Anal fin with less than eighteen rays 2
   Anal fin with more than nineteen rays .... *Panchax melastigma*
2. 32 or 33 scales along lateral line .... *Panchax lineatus dayi*
   27 to 29 scales along lateral line .... *Panchax panchax blochii*

Panchax melastigma McClelland. [Estuarine Top-Minnow (S. Diya Pita Handeya, Handhe Titteya)]. D. 6–7. A. 20–24. L. lat. 27. Tr. 9–11.

The dorsal surface of the fish is a dull green and the abdomen is white. The outer edge of the anal fin is also white. There is a narrow dark line along the middle of each side terminating in the base of the caudal fin. Grows to 1$\frac{1}{2}$ inches and inhabits the estuaries round the coast.

Panchax lineatus dayi (Steindachner). [Striped Top-Minnow (S. Handhe Nalaya, Iri Nala Handheya, Iri Udda)]. D. 3–4. A. 13–16. L. lat. 32–33. Tr. 9.

The largest of the Ceylon Top-Minnows attain a length of 2$\frac{1}{4}$ inches. The dorsal side of the fish is olive coloured with bright green reflections. The sides are yellow with red spots and there are a few dark cross bars on the body. Fins are yellow with red or orange rays. The anal and tail fins are edged with red. The females have more cross bars than the male and their fins are hyaline. Common in the fresh waters of the coastal plains, principally in the wet zone. Found in paddy fields.

Panchax panchax blochii (Arnold) [Lesser Top-Minnow (S. Udda)]. D. 3–6. A. 14. L. lat. 27–29. Tr. 9 (Page 121, Fig. 5).

A fairly small species of top-minnows which only grow up to 1$\frac{1}{2}$ inches in length. Light olive coloured and has a black spot on the dorsal fin. Common in the fresh and brackish waters of coastal plains.

FAMILY **OPHIOCEPHALIDAE**—Snake Heads

The fish included in this group have elongate bodies which are more or less cylindrical in front but are compressed towards the tail. These hardy fishes have large mouths and are adapted for breathing atmospheric air in addition to the normal branchial breathing of fishes. This enables them to migrate on land from one freshwater body to another. They build nests in which they lay their eggs. They are carnivorous fishes. Five species from two genera have been recorded from Ceylon.

1. No ventral fins.......... *Channa orientalis*
   Ventral fins present.......... 2
2. More than 40 dorsal fin rays.......... 3
   Less than 35 dorsal fin rays.......... 4
3. A diffuse lateral band crossed by 5–6 incomplete cross bars on each side of the body.......... *Ophiocephalus marulius ara*
   About 15 dark W–shaped cross bars on each side of the body.... *Ophiocephalus striatus*
4. Lateral line scales (10–12) + (28–32).......... *Ophiocephalus gachua kelaarti*
   Lateral line scales (13–15) + (21–24).......... *Ophiocephalus punctatus*

Channa orientalis Bloch [Smooth Breasted Snake-head (S. Gas Kannaya, Kola Kannaya)]. D. 31–34. A. 20–22. P. 13–15. L. lat. (9–12) + (27–30). Tr. $\frac{5-6}{6-7}$ (Page 121, Fig. 1).

A comparatively small species which grows up to a length of 4 inches. The entire body has a ground colour of yellow brown. On the dorsal surface it is greenish coloured with bluish cross bars. The long dorsal fin is orange coloured with a greenish longitudinal band. The anal fin is also long and it is greenish coloured. It has a dark coloured longitudinal band. The other fins are yellow with several blue cross bands. This species is found in clear fresh water ponds near streams.

Ophiocephalus marulius ara Deraniyagala. [Giant Snake head. (S. Ara. Gang Ara, Kalumaha)]. D. 45–49, A. 23–31, P. 16–18, L. lat. (16–21) + (40–44) Tr. $\frac{6\text{–}7}{10\text{–}12}$

This is a very large fish growing up to a length of over two and half feet. It is pale olive to yellow in colour and has a diffuse violet lateral band crossed by 5 to 6 incomplete cross bars. Fins are dark olive to dusky violet and spotted with white. Present in streams, rivers and irrigation reservoirs up to an elevation of 1,500 feet and is a popular food fish amongst the people living in inland districts. There is a regular fishery for this species and for *O. striatus* in some of the tanks in the North-Central Province.

Ophiocephalus striatus Bloch. [Striped Snake-head, Murrel (S. Hal Pathmaha, Loolla)]. D. 42–46, A. 25–28, P. 15–17, L. lat. (15–18) + (39–42). Tr. $\frac{5\text{–}8}{10\text{–}14}$

This is also a large species and may attain a length of about 2¼ feet. It is more common than *O. marulius ara.* It is olive to dark brown dorsally and white to yellow with brownish mottling on the sides and ventrally. In addition there are about 15 W–shaped dark bars, transversely across its body. Fins are olive coloured. They are common in ponds, irrigation reservoirs, streams and paddy fields.

Ophiocephalus punctatus Bloch. [Green Snake–head (S. Mada Ara, Madaya, Mada Kanaya, Mada Kariya)]. D. 29–30, A. 20–22, P. 15–18, L. lat. (13–15) + (21–24), Tr. $\frac{5\text{–}6}{8}$ (Page 121, Fig. 4).

This is not a very large fiish, growing up to a length of 8 inches. The dorsal surface of this fish is olive coloured while its sides are yellow-green and the ventral surface is yellow-white. There are 6 to 7 dark transverse triangular patches dorsally and 10 ventral dark streaks. The fins are olive to yellow with several dark bands. Common in streams, ditches and paddy fields of the low-country.

Ophiocephalus gachua kelaarti Gunther. [Brown Snake-head (S. Parandal Kanaya, T. Para Korruvai)]. D. 30–33, A. 20–23, P. 14–15, L. lat. (10–12) + (28–32). Tr. $\frac{5\text{–}7}{7\text{–}8}$

Comparatively small fish which does not exceed 6 inches in length. The dorsal surface is brown coloured with W–shaped bars on it. The sides and ventral surface are lighter. The margin of the dorsal fin is orange and the anal fin is green-blue. This species is present in waters below an elevation of 3,600 feet. It has been recorded from the hot springs at Trincomalee.

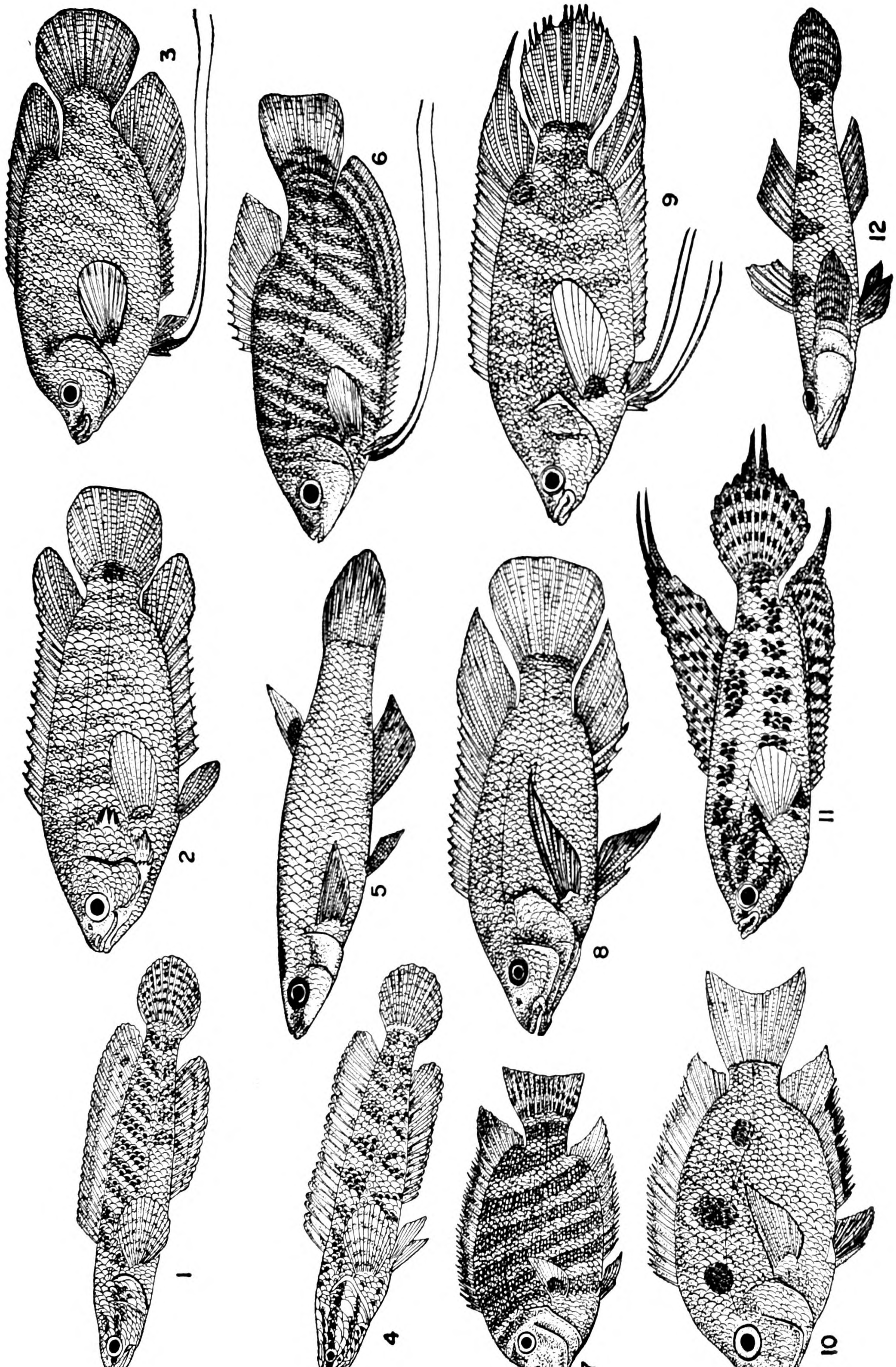
FAMILY **ANABANTIDAE** Climbing Perches and Bubble Nest Builders

These spiny finned fishes have a special respiratory organ formed by an expansion of a gill arch. They are therefore able to breathe atmospheric air. They have elongate, filamentous pelvic fins. *Anabas* has a pair of stout spines on the pelvic fins in addition to opercular spines but its pelvic fins are not filamentous.

1. At least one of the ventral fin rays filamentous 2
   None of the ventral rays filamentous .... *Anabas testudineus*
2. Ventral fin filament long, extending at least up to caudal fin 3
   Ventral fin filaments short 4

Explanation to figures on page 121

1. *Channa orientalis* 10 cms. long.
2. *Anabas testudineus* 16 cms. long.
3. *Osphronemus goramy* 60 cms. long.
4. *Ophiocephalus punctatus* 22 cms. long.
5. *Panchax panchax blochii* 3·8 cms. long.
6. *Trichogaster pectoralis* 15 cms. long.
7. *Etroplus suratensis* 30 cms. long.
8. *Tilapia mossambica* 40 cms. long.
9. *Belontia signata* 13 cms. long.
10. *Etroplus maculatus* 8 cms. long.
11. *Malpulutta kretseri* from Deraniyagala 3·8 cms. long.
12. *Glossogobius giuris* 35 cms. long.


1
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3. Seven spines on dorsal fin..*Trichogaster pectoralis*
Twelve to thirteen spines on dorsal fin.......................................*Osphronemus goramy*

4. Body oval shaped, caudal fin not filamentous........................*Helostoma temmincki*
Body elongate, caudal fin filamentous..5

5. Anal fin not filamentous..*Macropodus cupanus*
At least one of the anal rays filamentous..6

6. Outer ventral ray bifid and extends out as two elongated filaments................... ...
.... *Belontia signata*
Outer ventral ray single...*Malpulutta kretseri*

Anabas testudineus (Bloch) [Climbing Perch (S. Kavaiya, Pol Kavaiya, T. Kavaiyen)].

D. XV–XVII, 9–10, A. IX–XI, 9–11, L. lat. (15–19), + (10–15). Tr. $\frac{3\text{–}5}{9\text{–}11}$ (Page 121, Fig. 2).

This fish is light to dark green coloured on the dorsal surface and the sides are greenish yellow to orange. There are about ten indistinct olive cross bars on each side of the body. There is a black blotch on the tail and sometimes one behind the gill cover. The dorsal fin is green coloured. The eye is orange. It grows up to 6 inches in length. The fish can live out of water for short periods and even cross land from one water body to another, usually at night. It is very common in the low country inhabiting ditches, ponds and paddy fields, and it can live in polluted water.

Osphronemus goramy Lacepede. [Giant Gourami (S. Gourami, Seppali)]. D. XII–XIII, 11–13. A. IX–XI, 19–21. P. II, 13. L. lat. 30–33. Tr. $\frac{5\text{–}6}{13\text{–}14}$ (Page 121, Fig. 3).

The fish can be recognised at once because of its strongly compressed body which is oblong and much elevated. Even more striking are the two long filaments which are extensions of a portion of the ventral fin. The fish is brown to olive coloured on the dorsal side and silvery or yellowish below. In the young there are about 8 dark coloured cross bars on each side. The gourami is an excellent food fish. It was first introduced into Ceylon's fresh-waters about 50 years ago. They are able to live in rivers and ponds and they can even withstand brackish water. Eggs are laid in nests constructed out of decaying plant material or any similar soft material lying in the water. The fish take care of their young. They grow up to two feet in length and specimens weighing fifteen pounds are not uncommon.

Trichogaster pectoralis (Regan) Snake Skin Gourami. D. VII, 10–11, A. IX–XII, 33–38, L. lat. 55–63 (Page 121, Fig. 6).

This species looks like an *Osphronemus goramy*, but it is much smaller and more slender. It is brownish in colour with several dark brown vertical bands on the sides. It can grow up to about 10 inches and weigh about ¼ pound. Recently introduced into Ceylon and is now common in the marshes around Colombo.

Helostoma temmincki Cuvier. (Kissing Gourami). D. XVI–XVIII, 13–16, A. XIII–XV, 17–19.

P. II, 11, L. lat. 44–48. Tr. $\dfrac{8}{15\text{–}16}$

A flattened, broad fish whose jaws are provided with thick lips. The ventral fin filament is elongated but not to the extent in *Osphronemus* and *Trichogaster*. The fish is olive or grey coloured on the dorsal side and much lighter below with dark longitudinal stripes along rows of scales. They grow upto 12 inches in length. This species has been recently introduced into Ceylon and large numbers have been released into various water bodies but none have yet been captured from such waters.

Belontia signata (Gunther) (S. Pulutta, Kola Modaya). D. XVI–XVIII, 8–10, A. XIV–XVI, 10–12, P. 10–12, L. lat. 2–3) + (10–15) (2–3) + (13–16), Tr. $\dfrac{4}{10\text{–}11}$ (Page 121, Fig. 9).

A strongly compressed oblong fish. Each ventral fin has two filaments. The dorsal and anal fins are prolonged posteriorly. The fish is olive coloured dorsally and green on the sides and ventral surface, sometimes with blue reflections. A black blotch is present at the base of the dorsal fin posteriorly. A similar but smaller blotch is present at the base of the pectoral fin. The fin colour varies between shades of yellow and orange. The eyes are yellow. They grow up to 5 inches in length. They are present in ponds, tanks and streams of both the hill and low country.

Malpulutta kretseri[1] Deraniyagala. (S. Mal Pulutta). D. VIII–X, 6, A. XVI–XVII, 9–11, P. 12, V. I, 5. L. lat. 29–30, Tr. 9–10 (Page 121, Fig. 11).

This species could be easily recognised by the form of the fins. The ventral fin has a short filament. The caudal fin in the adult has two filamentous rays. The posterior portions of the dorsal and anal fins are produced into filament like projections. The fish are cinnamon brown coloured on the dorsal side and are lighter below. There are three dark coloured bands extending from the eye to the posterior end of the gill cover and there are two rows of similar coloured blotches along the sides. The fins are yellowish with black spots and blue margins. The filaments of the fins are also blue. These fish grow up to 1½ inches and inhabit small ponds adjacent to streams. They are not common.

Macropodus cupanus (Cuvier). (S. Tal Kossa, Tal Kadaya, Tal Padda). D. XIII–XV 5–7, A. XVII–XX, 10–13, P. 11, V. I, 5, L. lat. (9–13) + (17–20). Tr. $\dfrac{4\text{–}5}{7}$

It has a compressed body. The ventral fin has a moderately long filament. The fish is green coloured, the shade of colour being darker on the dorsal side. Sometimes a brown stripe extends from the eye to the posterior end of the gill cover and there are brown spots on the head. The fins are pale green except for the ventral fin filaments which are red. They grow up to 1¾ inches in length and inhabit ponds and ditches of the low country.

FAMILY **CICHLIDAE** Cichlids

This group of fishes have compressed, oblong bodies which are provided with moderate sized scales. There are numerous spines on the dorsal fin and a few on the anal. There are two genera with three species in Ceylon. Though these resemble the *Anabantids* superficially, the pelvic fins

[1] Deraniyagala (1958) indicated that there is another race of this species, namely *minor*.

are not elongate nor are opercular spines present.

1. Anal fin with three spines..*Tilapia mossambica*,
   Anal fin with 12 or more spines..2.
2. Yellowish in colour with 3 dusky blotches on each side of body...*Etroplus maculatus*,
   Green in colour with several conspicuous transverse bands on the side...*Etroplus suratensis*

Etroplus maculatus (Bloch). [Spotted Etroplus (S. Ran Koraliya, Kaha Koraliya, Ralliya)]. D. XVII–XX, 8–10, A. XII–XV, 8–9, L. lat. 35, Tr. $\frac{6}{19}$ (Page 121, Fig. 10).

This is a relatively small species, only growing up to a length of about 3 inches. It is yellowish in colour with a shade of pale green on the dorsal side. There are several rows of golden coloured spots, on its body and fins. These fish are found in the coastal fresh waters and also in the large irrigation reservoirs.

Etroplus suratensis (Bloch). [Banded Etroplus (S. Koraliya, Sethala, T. Sethel)]. D. XVIII–XIX, 14–15, A. XII–XIII, 11–12, L. lat. 35–40, Tr. $\frac{6}{17}$(Page 121, Fig. 7).

This is a large species which grows upto about a foot in length. Most of the scales on the dorsal half of the body have on each of them a central pearly spot. There are some irregular black spots on the abdomen. Originally this species was very common in the brackish waters. They have been introduced into most of the fresh water bodies in the low country where they now flourish. A desirable food fish and is found in large numbers in some of the tanks of the North-Central Province.

Tilapia mossambica (Peters) [Tilapia (S. Japan Koraliya)]. D. XV–XVI, 11–12, A III, 10. L. lat. 30. Tr. $\frac{4}{12}$ (Page 121, Fig. 8).

This fish is dark green to drab golden coloured and the scales have dark centres. The adult males are dark coloured and are sometimes almost black. *Tilapia* was introduced into Ceylon waters in 1951. It established itself with amazing rapidity and is now the predominant species in the fish harvest of the commercial fishermen of the coastal fresh and brackish water bodies and also the major tanks of the North-Central Province. *Tilapia* grows to a weight of 3 lb. It is also called a "mouth breeder" as the mother protects the young in her mouth for a time after they are hatched.

FAMILY **GOBIIDAE** Gobies

These are fish with elongated bodies. They have two dorsal fins which are generally separated from each other. The first or more anterior dorsal fin is spinous while the other is not. Only one species in fresh water.

Glossogobius giuris (Hamilton–Buchanan). [Bar-eyed Goby (S. Weligowa, Gal Katta, T. Ulavai)]. D. VI, I, 8–9, A. I, 7–8, P. 17–21, L. lat. 28–36, Tr. 8–14, (Page 121, Fig. 12).

The body of this species is elongate. Anteriorly the body is cylindrical while posteriorly, it is compressed. The head is pointed and depressed. On the dorsal side it is drab green coloured and on the ventral side it is a lighter shade of green. The head has a few dark spots laterally. The body has two rows of 4 to 6 dark blotches. The fins are yellow green with spots and dark margins. This is essentially an estuarine species common in the coastal waters and harbours. It has entered fresh waters and moved up rivers. Today it is a common fish even in the large irrigation tanks of the North-Central Province.

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AMPHIBIA

(Frogs, Toads and Cæcilians)

AMPHIBIA spend part of their life in water and part on land and therefore are not strictly aquatic animals. As a rule their eggs are laid in or near the water and the fish-like larvae (tadpoles) are aquatic. By a series of changes these larvae become adults. The adults of some species may continue to live in the water and only rarely go on land (e.g., certain frogs), while others become terrestrial and return to the water only to lay eggs (e.g., the toads).

Frogs and toads (Anura) are very common in shallow water and in moist places, many species being found in paddy fields. A few species are present in torrential streams.

Although frogs are used as food in some countries, in Ceylon they are not fancied for this purpose. They are of importance as scavengers and may eat small fish. They are reputed to keep drinking wells clean and as a whole cause little damage to other animals and crops. They form an important component in the diet of birds. The larvae are sometimes eaten by fishes.

The Caecilians (Apoda) are a primitive group of worm-like amphibians.

The amphibians present in Ceylon fall into two orders.

1. Limbs absent, eel-like body.......Apoda, page 131
   Two pairs of limb ....Anura, page 126

ORDER ANURA

(Frogs and Toads)

These are tailless Amphibia with the hind limbs greatly enlarged for jumping. They are represented by 31 species belonging to 4 families.

KEY TO ADULT ANURA

1. Upper jaw toothed.......2
   No teeth on either jaw.......3
2. Tips of digits enlarged.......Rhacophoridae, page 130
   Tips of digits not enlarged.......Ranidae, page 127
3. Skin with prominent tubercles and spiny warts.......Bufonidae, page 127
   Skin generally smooth and without spiny warts.......Microhylidae, page 130

KEY TO THE ANURAN TADPOLES (LARVAE)

1. Spiraculum on mid ventral line....................Microhylidae, page 130
   Spiraculum to the left of mid central line 2
2. Anal opening median....................Bufonidae, page 127
   Anal opening directed to the right side of the body.................... 3
3. Anal opening at the end of a tube....................Ranidae, page 127
   Anal opening not at the end of a tube but flush with the body....................
   ....Rhacophoridæ, page 130

FAMILY **BUFONIDAE** Toads

They are generally short limbed, and broad waisted. The skin is rough to the touch due to the presence of numerous tubercles and spiny warts. The jaws do not have teeth. There is a slight webbing at the base of the toes (rear limbs) but the fingers (front limbs) are free. They are terrestrial forms frequenting damp shady localities and entering the water to breed. They deposit their eggs in two long gelatinous strings.

The larvae which have horny mandibles are more or less black in colour. The anal opening is in the mid ventral line.

Five species of the genera *Bufo* have been recorded in Ceylon.

Bufo fergusonii Boulenger

Bufo kelaartii Günther (Page 129, Fig. 2)

Bufo melanostictus Schneider (Page 129, Figs. 1 and 5)

Bufo microtympanum Boulenger

Bufo stomaticus Lütken

FAMILY **RANIDAE** Frogs

They are generally long-legged and slim-waisted. The skin is smooth. The upper jaw is toothed. *Rana* spp. have webbed toes while the fingers are free. *Nannophrys* spp. have both fingers and toes free. The two species within the subgenera *R.* (*Hylarana*) have the tip of their digits enlarged into flat discs. Eggs are laid in the water in relatively large, rounded, grape like clusters.

The larvae have horny mandibles. The anal opening is at the end of a tube or spout and is on the right side of the mid ventral line.

Eleven species from two genera are represented in Ceylon. They vary considerably in size and are confined to aquatic habitats.

Rana corrugata Peters

Rana cyanophlyctis cyanophlyctis Schneider (Page 129, Fig. 6)

Rana hexadactyla Lesson (Page 129, Figs. 10 and 16)

Rana (*Hylarana*) *gracilis* Gravenhorst

Rana (*Hylarana*) *temporalis* Günther (Page 129, Fig. 9)

Rana limnocharis greenii Boulenger

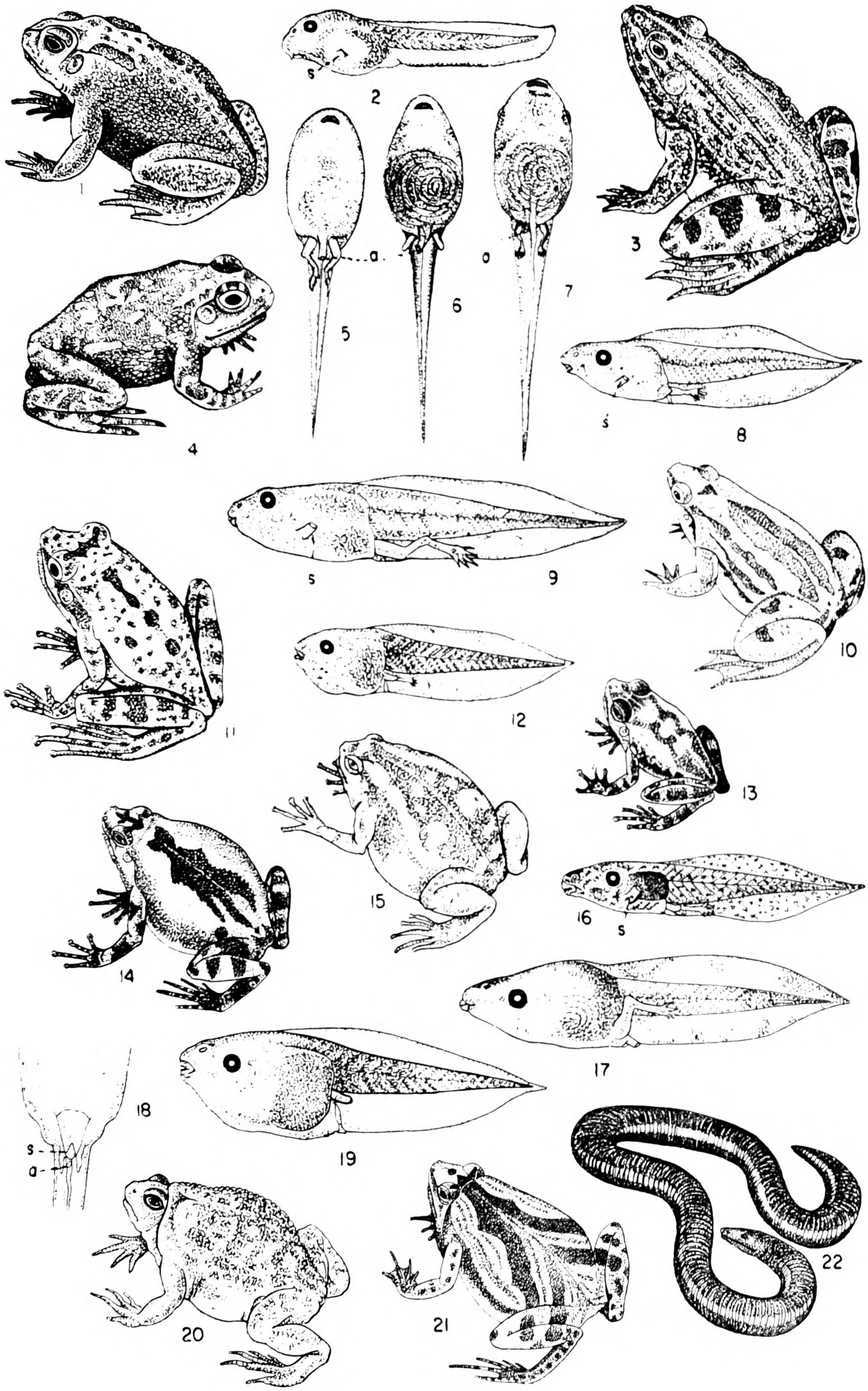
Rana limnocharis limnocharis Wiegmann

Explanation to figures on page 129

1. *Bufo melanostictus*, length from snout to vent up to 100 mm.
2. Larva of *B. kelaartii*, from Kirtisinghe, total length 11 mm.
3. *Rana tigrina crassa*, length from snout to vent up to 132 mm.
4. *Nannophrys ceylonensis marmorata*, length from snout to vent 44 mm.
5. Ventral view of larva of *Bufo melanostictus*, total length 20 mm.
6. Ventral view of larva of *Rana cyanophlyctis cyanophlyctis*, total length 30 mm.
7. Ventral view of larva of *Rhacophorus leucomystax maculatus*, total length 40 mm.
8. Larva of *Rana tigrina crassa*, total length 60 mm.
9. Larva of *Rana (Hylarana) temporalis*, total length 48 mm.
10. *Rana hexadactyla*, length from snout to vent 130 mm.
11. *Rhacophorus leucomystax maculatus*, length from snout to vent 64 mm.
12. Larva of *Kaloula pulchra taprobanica*, total length 21 mm.
13. *Philautus leucorhinus*, length from snout to vent 31 mm.
14. *Ramanella obscura*, length from snout to vent 31 mm.
15. *Kaloula pulchra taprobanica*, length from snout to vent 45 mm.
16. Larva of *Rana hexadactyla*, total length 40 mm.
17. Larva of *Uperodon systoma*, total length 30 mm.
18. Ventral view of spiracular and anal region of larva of *Microhyla rubra* from Kirtisinghe.
19. Larva of *Ramanella* sp., total length 30 mm.
20. *Uperodon systoma*, length from snout to vent 56 mm.
21. *Microhyla ornata*, length from snout to vent 23 mm.
22. *Ichthyophis glutinosus*, length up to 450 mm.

a—anus.

s—spiracle.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Rana tigrina crassa Jerdon (Page 129, Figs. 3 and 8)

Rana (*Tomopterna*) *breviceps* Schneider

Nannophrys ceylonensis ceylonensis Günther

Nannophrys ceylonensis marmorata Kirtisinghe (Page 129, Fig. 4)

Nannophrys guentheri Boulenger

FAMILY **RHACOPHORIDAE** Tree Frogs

These tree frogs have long limbs and slim waists. The tips of the digits are provided with adhesive discs. The toes are webbed but the fingers are free. Perhaps the webbing of the toes is an adaptation for supporting the animal in the air during its leaps from trees. The jaws are toothless. The eggs are usually laid outside the water in frothy masses. Certain species of *Rhacophorus* produce masses of green frothy spawn which are found sticking to the walls of wells, perpendicular rock faces in quarries or trunks of trees in such a position as to allow the larvae to readily drop into the water when they are old enough to move about and feed on their own.

The larvae have horny mandibles. The anal opening is not at the end of a tube or spout but is flush with the body and it lies to the right of the mid ventral line.

Eight species from two genera are represented in Ceylon.

Philautus leucorhinus (Lichtenstein and Martens) (Page 129, Fig. 13)

Philautus nasutus (Günther)

Philautus schmardanus (Kelaart)

Philautus variabilis (Günther)

Rhacophorus cruciger cruciger (Blyth)

Rhacophorus cruciger eques (Gunther)

Rhacophorus leucomystax maculatus (Gray) (Page 129, Figs. 7 and 11)

Rhacophorus microtympanum (Günther)

FAMILY **MICROHYLIDAE**

They are generally small with short limbs and smooth skin. The head is small with a pointed snout. This family comprises frogs which live amongst trees (arboreal), others on the ground (terrestrial) and some are burrowing forms. The arboreal forms usually have adhesive discs on their toes.

The majority of the species either pass the larval stage within the egg or hatch out as distinctive tadpoles without a sucking disc round the mouth. The larvae do not have any teeth and they do not have nostrils till just before transformation into the adult.

Eight species from four genera are represented in Ceylon.

Kaloula pulchra taprobanica Parker (Page 129, Figs. 12 and 15)

Microhyla ornata (Dumeril and bibron) (Page 129 Fig. 21)

Mycrohyla rubra (Jerdon) (Page 129, Fig. 18)

Microhyla zeylanica Parker and Hill

Ramanella obscura (Günther) Page 129, Fig. 14)

Ramanella palmata Parker (Page 129, Fig. 19)

Ramanella variegata (Stoliczka)

Uperodon systoma (Schneider) (Page 129, Figs. 17 and 20)

ORDER APODA

They are limbless, wormlike amphibia.

FAMILY **CAECILIDAE**

A family of burrowing terrestrial amphibians which are more or less blind, although the eyes are clearly marked. There is a protrucible tentacle between the eye and the nostril on each side. There are teeth on the lower jaw. The body is externally marked into rings by numerous annuler grooves in the leathery skin.

The female lays from 10 to 24 large eggs, each 6 to 9 mm. in diameter strung together by a prolongation of the outer capsule gathered to a cluster and deposited in a burrow near the water. This egg mass is protected by the female who coils herself round it. Each embryo has three pairs of long external gills. The eggs hatch into eel-like larvae.

In Ceylon there are two species from a single genus.

Ichthyophis glutinosus (L.) (Page 129, Fig. 22)
Ichthyophis monochrous (Bleeker)

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REPTILIA

(Reptiles)

THE aquatic reptiles are represented in Ceylon by three species of terrapins, two species of crocodiles, three species of snakes and a single species of monitor lizard. The terrapins are mainly herbivores but sometimes consume dead animal matter and young fish and small animals. The others are carnivorous and pests in fish cultivation. The monitor lizard is at home on land as well as in the water. All reptiles are air breathers and have to come to the water surface to take in air.

The reptiles are divisable into 3 orders :—

1. Jaws without teeth. Body enclosed within a bony corselet....Testudinata, page 132
   Jaws with teeth. Body not enclosed in a bony corselet.. 2

2. Cloacal opening longitudinal. Teeth set in alveoli (sockets)........Crocodylia, page 133
   Cloacal opening transverse. Teeth not set in alveoli (sockets)....Squamata, page 133

ORDER TESTUDINATA

(Turtles—Terrapins—Tortoises)

Two families of Testudinata are represented in the freshwaters of Ceylon.

1. Five claws on each fore limb. Corselet with bony scutes. No lips on beak ....Emydidæ, page 132
   Three claws on each fore limb. Corselet covered by smooth skin. The beak has lips..Trionychidæ, page 133

FAMILY **EMYDIDAE** Hard Terrapins

The oval body is enclosed in an exoskeleton and there are scutes on the exoskeleton. The head, tail and limbs which project through apertures in the exoskeleton are retractible. The limbs are flattened. There are five claws on each fore limb. The hard terrapins are dark brown or black in colour and the body surface appears to be corrugated.

Melanochelys trijuga parkeri Deraniyagala. [Parker's Terrapin (S. Parkerge Gal Ibba)].

This is the larger of the two sub-species of *Melanochelys* present in Ceylon growing up to 38 cms. in length. It is common in the dry zone up to an elevation of 3,000 feet. Feeds on plants and dead animal matter and is therefore a useful scavenger. During the daylight hours it spends its time in water and comes ashore at night.

Melanochelys trijuga thermalis (Lesson). [Common, Hard or Black Terrapin (S. Gal Ibba, Goo Ibba, Thumba Ibba, Valan Gebba, T. Kal Amai, Pe Amai, Karuppu Amai)], (Page 135, Fig. 7).

Smaller (grows up to 29 cms. in length) and more common than the previous sub-species with the same habits but more abundant particularly in polluted water. Common in the wet zone up to an elevation of 4,200 feet.

FAMILY **TRIONYCHIDAE** Soft Terrapin

The exoskeleton is covered by a soft skin and not by scutes. Limbs modified to serve as paddles. Only one species is present in Ceylon.

Lissemys punctata ceylonensis (Gray). [Soft Terrapin (S. Kiri Ibba, T. Pal Amai)]. (Page 135 Fig. 6).

They are usually present in stagnant water such as small tanks and pools. It does not come on land so frequently as the hard terrapins. They sometimes burrow into the mud at the bottom of ponds and tanks. They feed on earthworms, water snails crustacea, frogs and fishes. The flesh of this species is edible and is supposed to have medicinal properties.

ORDER CROCODYLIA

FAMILY **CROCODYLIDAE** Crocodiles

Reptiles in which the body surface is covered with rows of sculptured bony scutes (osteoderms). They are the largest reptiles found in freshwater and may be dangerous to man. Young crocodiles feed on insects and other small animals but as they grow older they feed mainly on fish.

1. Snout blunt. Most osteoderms (" scutes ") sub-quadrangular and not separated by skin...*Crocodylus palustris kimbula*

   Snout pointed. Osteoderms ovoid and separated by skin........*Crocodylus porosus*

Crocodylus palustris kimbula Schneider Deraniyagala. [Ceylon Swamp Crocodile, Ceylon Mugger (S. Ela Kimbula, Ali Kimbula, T. Kulathi Muthelei)] Page 135, Fig. 2).

This species is present in the coastal lagoons and fresh waters such as swamps, tanks and rivers.

Crocodylus porosus Schneider. [Marsh, Estuarine or Sea Crocodile (S. Pita Gatteya, Gatte Kimbula, Gorekeya, T. Semmukham Muthelei)] Page 135, Fig. 1).

Found at the mouths of muddy rivers and canals near the sea and are capable of moving from one river mouth to another by way of the sea. Occasionally they have been found to travel upstream and there are records of specimens found in the Kalu-ganga at Ratnapura.

ORDER SQUAMATA Snakes and Lizards

The order is split up into two sub-orders.

1. Limbs absent...Serpentoidea, page 133

   Limbs present...Lacertoidea, page 136

SUB-ORDER SERPENTOIDEA Snakes

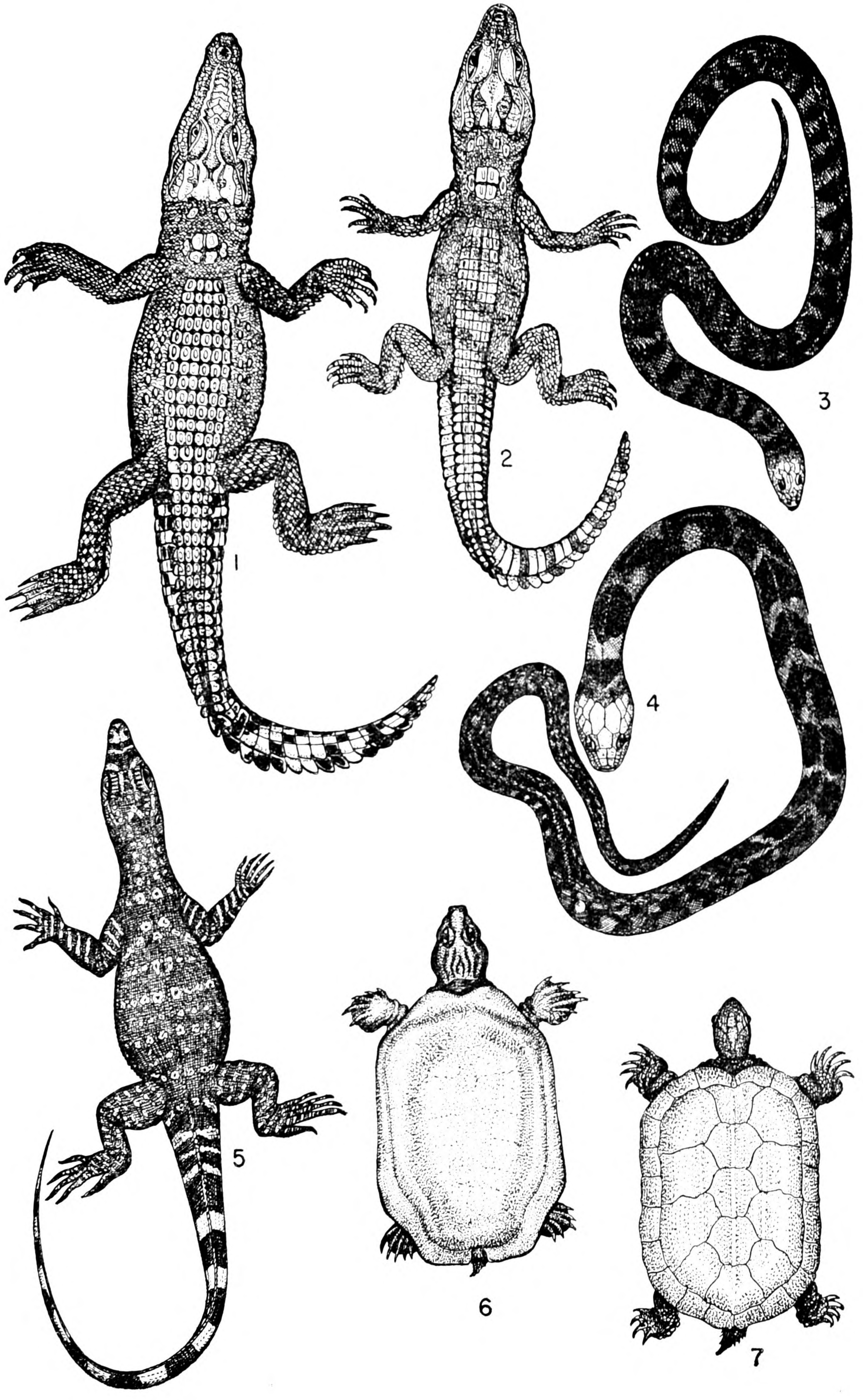
Elongate reptiles without limbs.

FAMILY **COLUBRIDAE**

A family of reptiles in which the body is elongate, narrow and cylindrical. The head is covered with a large shield.

Explanation to figures on page 135

1. *Crocodylus porosus* up to 610 cms. long.
2. *Crocodylus palustris kimbula* up to 40 cms. long.
3. *Cerberus rhyncops* 70 cms. long.
4. *Natrix piscator asperrimus* 75 cms. long.
5. *Varanus monitor kabaragoya* up to 200 cms. long.
6. *Lissemys punctata ceylonensis* shell up to 37 cms. long.
7. *Melanochelys trijuga thermalis* shell up to 29 cms. long.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Three freshwater snakes belonging to this family are present in Ceylon.

1. Dorsal surface prominently chequered with black blotches and greyish coloured areas.......... *Natrix piscator asperrimus*
   Not chequered.......... 2
2. Dorsal surface crossed by ill defined but conspicuous cross bars.... *Cerberus rhyncops*
   Dorsal surface uniformly coloured without cross bars.......... *Geradia prevostiana*

Natrix piscator asperrimus (Boulenger). [Chequered Keel Back S. Diya Polonga, Diya Naya, T. Tanni Pambu] (Page 135, Fig. 4).

Common in all types of freshwater habitats especially where the surrounding vegetation is damp. A non-poisonous snake. It is most active in the morning and at dusk when it can be seen in shallow waters. The body colour varies from dark olive green to dark olive brown. A series of black blotches and greyish areas form a chequered pattern giving the snake its name. Two black streaks on head extending backwards from eye is characteristic of this snake. Its food is small fish and amphibians.

Cerberus rhyncops Schneider. [Dog-faced Water Snake (S. Diyabariya)] (Page 135, Fig. 3).

This species is common in both fresh and brackish water. Rather an aggressive snake but its bite is quite harmless. This snake is dark slate coloured with ill defined darker bars.

Geradia prevostiana (Eydoux et Gervais). (Gerard's Water Snake).

This is a small non-poisonous snake frequenting tidal rivers and estuaries. Not a very common species.

SUB-ORDER LACERTOIDEA Lizards

FAMILY **VARANIDAE**—Monitor Lizards

Reptiles whose bodies are covered with overlapping bony scales. They have four strong limbs.

Varanus monitor kabaragoya Deraniyagala (Page 135, Fig. 5).

This species readily takes to the water. They are excellent scavengers, feeding on both dead and live freshwater crabs, insects, centipedes, snakes and rats.

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AVES

(Birds)

ALL freshwater habitats support bird life of various species in varying numbers. Birds cannot be strictly classified as aquatic animals although they visit aquatic habitats to feed on fish, insects and crustaceans. Certain birds like herons, rails, jacanas and coots live in areas close to the water. Other birds like the cormorants, teal, and ducks breed and feed in aquatic habitats.

When birds are present in large numbers their faeces help in fertilising the water. This increases the quantity of microscopic plant food for the smaller animals which in turn are preyed upon by the larger aquatic fauna. Some birds indirectly influence the aquatic fauna further through various parasites which they harbour. The early developmental stages of these parasites are present in other aquatic fauna which are intermediate hosts.

A list of the more frequent visitors to the aquatic habitats is given below. For a further account on birds the reader is directed to G. M. Henry's *A Guide to the Birds of Ceylon,* from which work the present list was compiled. The illustrations of the birds on page 143 are also after Henry.

ORDER PASSERIFORMES

(Sparrow-like Birds)

An order containing a very large number of species of birds, of which only a few live near water among reed-beds. Their toes are not webbed. The young which are born blind do not possess any down when they hatch out and they have to be looked after by the parents in a nest for some time.

Representatives of two families live near water habitats.

FAMILY **SYLVIDAE** Warblers

This is a family of small birds. Their beaks are small and slender. They are seldom seen on the ground. The food consists entirely of insects. Members of this family which frequent freshwaters are—

Acrocephalus dumetorum Blyth. [Blyth's Reed Warbler (S. Hambu-Kurulla, T. Tinu Kuruvi)].

Acrocephalus stentoreus meridionalis (Legge). [Ceylon Great Reed Warbler], (Page 143, Fig. 1).

Cisticola juncidis omalura Blyth. [Ceylon Fantail Warbler (S. Thanacola Kurulla, T. Tinu Kuruvi, Vayalan)].

Prinia inornata insularis Legge. [Ceylon White Browed Prinia (S. Hambu Kurulla, T. Tinu Kuruvi)].

Prinia socialis brevicauda Legge. [Ceylon Ashy Prinia, Ashy Wren-Warbler (S. Hambu Kurulla, T. Tinu Kuruvi)].

FAMILY **MOTACILLIDAE** Wagtails

Only one species frequents freshwater.

Motacilla cinerea melanope Pallas. [Grey Wagtail]

ORDER CORACIIFORMES

FAMILY **ALCEDINIDAE**—The Kingfishers

The toes of the birds belonging to this order and family are fused together except at the extremeties. The young hatch out blind and are devoid of down. They are carnivorous birds. The kingfishers are large headed birds with long, straight powerful beaks. They nest in burrows which they dig into the banks of rivers and ponds. Many of them feed almost exclusively on fish. Six species frequent freshwater.

Alcedo atthis taprobana Kleinschmidt. [Ceylon Common Kingfisher (S. Mal Pilihuduwa, T. Meen Kutti)].

Alcedo meninting phillipsi Stuart Baker. [Ceylon Blue-Faced Kingfisher (S. Mal Pilihuduwa, T. Meen Kutti)].

Ceyx erithacus (L.). [Three-toed Kingfisher (S. Rang Pilihuduwa, T. Sinna Meen Kutti)].

Ceryle rudis leucomelanura Reichenbach. [Indian Pied Kingfisher (S. Kallapu Pilihuduwa, Gomera Pilihuduwa, T. Meen Kutti)].

Halcyon smyrnensis fusca [(Boddaert). [Ceylon White-Breasted Kingfisher (S. Pilihuduwa, T. Meen Kutti)].

Pelargopsis capensis gurial (Pearson). [Stork-Billed Kingfisher (S. Wattura Anduwa, Maha Pilihuduwa, T. Meen Kutti, Kukuluppan)], (Page 143, Fig. 14).

ORDER STRIGIFORMES

FAMILY **STRIGIDAE**—Owls

Owls are not ordinarily seen during daylight hours because of their nocturnal habits. There are several species of owls in Ceylon but only one frequents the freshwater habitats. It is a common bird in all parts of Ceylon up to an elevation of 6,000 feet in forests along river banks, tanks and lakes. It feeds mainly on fish but may consume freshwater crabs, insects, lizards, snakes and small mammals.

Ketupa zeylonensis zeylonensis (Gmelin). [Ceylon Fish Owl (S. Bakamuna, T. Periya Andai, Unatan Kuruvi)]. (Page 143, Fig. 8).

ORDER FALCONIFORMES

FAMILY **PANDIONIDAE**—The Osprey

They are highly specialised for an exclusive diet of fish. One species frequents the water habitats. It captures fish by diving into the water from a reasonable height in the air, capturing its prey by means of its claws. In doing so it submerges itself more or less completely. Common near coastal lagoons and estuaries between September and April. Also present near tanks and may even venture to elevations of 6,000 feet.

Pandion haliaetus haliaetus (L.). [Osprey (T. Viral Addippan)].

FAMILY **ACCIPITIRIDAE**—Eagles and Allied Birds

Some species of the family frequent the forests bordering the larger tanks and rivers of the dry zone. Six species frequent freshwater habitats.

Circus aeruginosus aeruginosus (L.). [Marsh Harrier (S. Ukussa, Kurulla-goya, T. Punai Parandu)].

Circus macrourus (Gmelin). [Pallid Harrier (S. and T. same as former species)].

Circus melanoleucos (Pennant). [Pied Harrier (S. and T. same as former species)].

Circus pygargus (L.). [Montagu's Harrier (S. and T. same as former species)].

Elanus caerulus vociferus (Latham). [Black Winged Kite (S. Kurullu goya T. Parandu)].

Haliaeetus leucogaster (Gmelin). [White-Bellied Sea Eagle (S. Muhudu Rajaliya, T. Kakal Ali)].

Haliastur indus indus (Boddaert). [Brahminy Kite (S. Ukussa, T. Sem parundu)]. (Page 143, Fig. 12).

Ichthyophaga ichthyaetus plumbeiceps Stuart Baker. [Ceylon Grey-headed Fishing Eagle, Tank Eagle (S. Wewa Rajaliya, Loolu Mara, T. Vidai Ali)].

FAMILY FALCONIDAE—The Falcons

In this family the birds of prey reach their highest degree of specialization The beak is short, stout and strongly hooked, with a well marked "tooth" on the upper portion of the beak and a corresponding notch on the lower. The wings are developed to give the bird both speed and staying power in flight. Only one species frequents freshwater habitats.

Falco peregrinus calidus Latham. [Eastern Peregine (S. Kurulla-goya, T. Valluru)].

ORDER CHARADRIIFORMES

(Waders and Allied Birds)

The birds belonging to this order are waders or swimmers. Some of them are able to wade as well as swim. In the wading forms the legs are generally long and the toes are only moderately webbed. The wings are well developed for powerful flight. Their food consists of insects, crustaceans, molluscs and fish. The young possess down and are able to run almost immediately after hatching from the egg.

FAMILY JACANIDAE—Jacanas and Allies

These birds have long, slender, unwebbed toes with long, nearly straight claws. Only one representative in Ceylon. It is present in the low country wherever there are large weedy ponds particularly those covered with lotus. In such a habitat these birds are a common sight spending their time walking or resting on the floating vegetation, supported by the enormously long toes and claws.

Hydrophasianus chirurgus (Scopoli). [The Pheasant-tailed Jacana (S. Pan Kukkula, Ballal Seru, Vil Girrawa, Gnavva. T. Miwa, Manal Pura)]. (Page 143, Fig. 15).

FAMILY CHARADRIIDAE—Lapwings and Allies

They are all ground birds, never perching on trees and are carnivorous.. They can walk and run soon after hatching, their wings are long, tails short. They can fly well. Two species frequent freshwater.

Himantopus himantopus ceylonensis Whistler. [Ceylon Black-winged Stilt. (S. Kalapu Kirala, T. Pavali Kali)].

Lobivanellus indicus indicus (Boddaert). [Red-Wattled Lapwing or Did-he-do-it (S. Kiraluva, Kirala, T. Al-Katti)]. (Page 143, Fig. 6).

FAMILY **SCOLOPACIDAE** Sandpipers, Snipe etc.

They are wading and shore birds, legs are long and slender. Six species frequent freshwater habitats.

Actitis hypoleucos (L.). [Common Sandpiper (S. Sili Watuwa, T. Kottan)].

Capella gallinago gallinago (L.). [The Fantail Snipe, Common Snipe, (S. Keswatuwa, T. Ullan- Kuruvi)].

Capella stenura (Bonapatte). [Pintail Snipe (S. and T. same as for Fantail Snipe)].

Tringa glareola L. [Wood Sandpiper (S. Sili Watuwa, T. Kottan)]. (Page 143, Fig. 5).

Tringa nebularia (Gunnerus). [Green Shank (S. Maha Watuwa, T. Periya Kottan)].

Tringa stagnatilis (Bechstein). [Marsh Sandpiper (S. Sili Watuwa, T. Kottan)].

FAMILY **ROSTRATULIDAE** Snipe

In general form they resemble the birds of the family Scolopacidae.

Rostratula benghalensis benghalensis (L.) [Painted Snipe (S. Raja Watuwa, Ulu Keswatuwa, T. Ullan-Kuruvi)].

FAMILY **LARIDAE**—Terns

These birds have long wings adapted for sustained and powerful flight. They frequent the water and have their front toes webbed. Three species have been recorded in the freshwater habitats.

Chlidonias hybrida indica Stephens. [Indian Whiskered Tern (S. Lihiniya, T. Kadal Kuruvi)]. (Page, 143, Fig. 3).

Gelochelidon nilotica nilotica (Gmelin). [Gull-Billed Tern (S. and T. names, same as the former)].

Hydroprogne caspia (Caspian Tern).

Sterna albifrons sinensis Gmelin. [Little Tern (S. and T. names, same as the former)].

ORDER **RALLIFORMES**

FAMILY **RALLIDAE**—Rails, Waterhens, Coots

The miniature, domestic hen like birds of this order are small or medium sized water birds which can swim well. They have long legs and toes which are not webbed. They feed on both animal and vegetable matter. The young can walk and swim almost as soon as they are hatched. There are eight species which frequent the coastal marshy areas.

Amaurornis fuscus fuscus (L.) [Ruddy Crake (S. Punchi Korawaka, T. Kanan Koli)].

Amaurornis phoenicurus phoenicurus (Pennant). [White-Breasted Waterhen [S. Korawaka, T. Kanan Koli)].

Fulica atra atra L. (Common Coot).

Gallicrex cinerea (Gmelin). [Kora, Watercock (S. Vil Kukkula, T. Tannir Koli)]. (Page 143, Fig. 2).

Gallinula chloropus indicus Blyth. [Indian Waterhen (S. Vil Kukkula, T. Tannir Koli, Kanan Koli)].

Hypotaenidia striata gularis (Horsefield). [Blue-Breasted Banded Rail (S. Kirimeti Korawaka, T. Kanan Koli)].

Porphyrio poliocephalus poliocephalus (Latham). [Purple Coot (S. Kitala, Kitta, T. Kanan Koli)].

Rallina eurizonoides nigrolineata (Gray). [Banded Crake (S. Kirimeti Korawaka, T. Kanan Koli)].

ORDER **PELICANIFORMES**

(Pelicans, Cormorants)

The birds of this order have all toes united by webs. They are capable of strong flight and most of them are good swimmers but they are all poor walkers. They depend entirely on the aquatic habitat for their food which consists of fish and other aquatic animals. On hatching the young are blind and devoid of down. The young are fed on partly digested food of the parents supplied by regurgitation.

FAMILY **PELICANIDAE** Pelicans

These are large, ungainly swimming birds which have long, flattened beaks with a strong hook, at the tip of the upper portion of the beak. The legs are short and strong. The wings are long and powerful. The floor of the mouth is composed of a great pouch of extensible skin, used by the bird as a scoop for engulfing fish. Only one species is represented in Ceylon.

Pelicanus roseus Gmelin. [Spotted-Billed or Grey Pelican (S. Pas Boruwa, Pas Bara, T. Kulai Kida)].

FAMILY **PHALACROCORACIDAE** Cormorants

These birds are adapted for swimming and diving. Their wings are powerfully built. Four species frequent the freshwater habitats.

Ahinga melanogaster Pennant. [Indian Darter or Snake-bird (S. Hanseya, T. Pambu Kuruvi, Nedung Kilaththi, Nedung Kaluththan)]. (Page 143, Fig. 9).

Phalacrocorax carbo sinensis (Shaw). [Southern Cormorant or Indian Cormorant (S. Diya Kawa, T. Nir Kakam)].

Phalacrocorax fuscicollis Stephens. [Indian Shag. (S. Diya Kawa, T. Nir Kakam)].

Phalacrocorax niger (Vieillot). [Little Cormorant (S. Diya Kawa, T. Nir Kakam)]. (Page 143. Fig. 10).

ORDER **CICONIIFORMES**

(Ibises, Storks, Herons)

These birds have long beaks, necks and feet. They are adapted to lead a wading life. They are capable of powerful flight as their wings are well developed. Swamps and marshes are their usual habitats.

FAMILY **THRESKIORNITHIDAE** Ibises and Spoonbills

These birds fly with the neck extended. They are closely related to the storks. Two species frequent freshwater habitats.

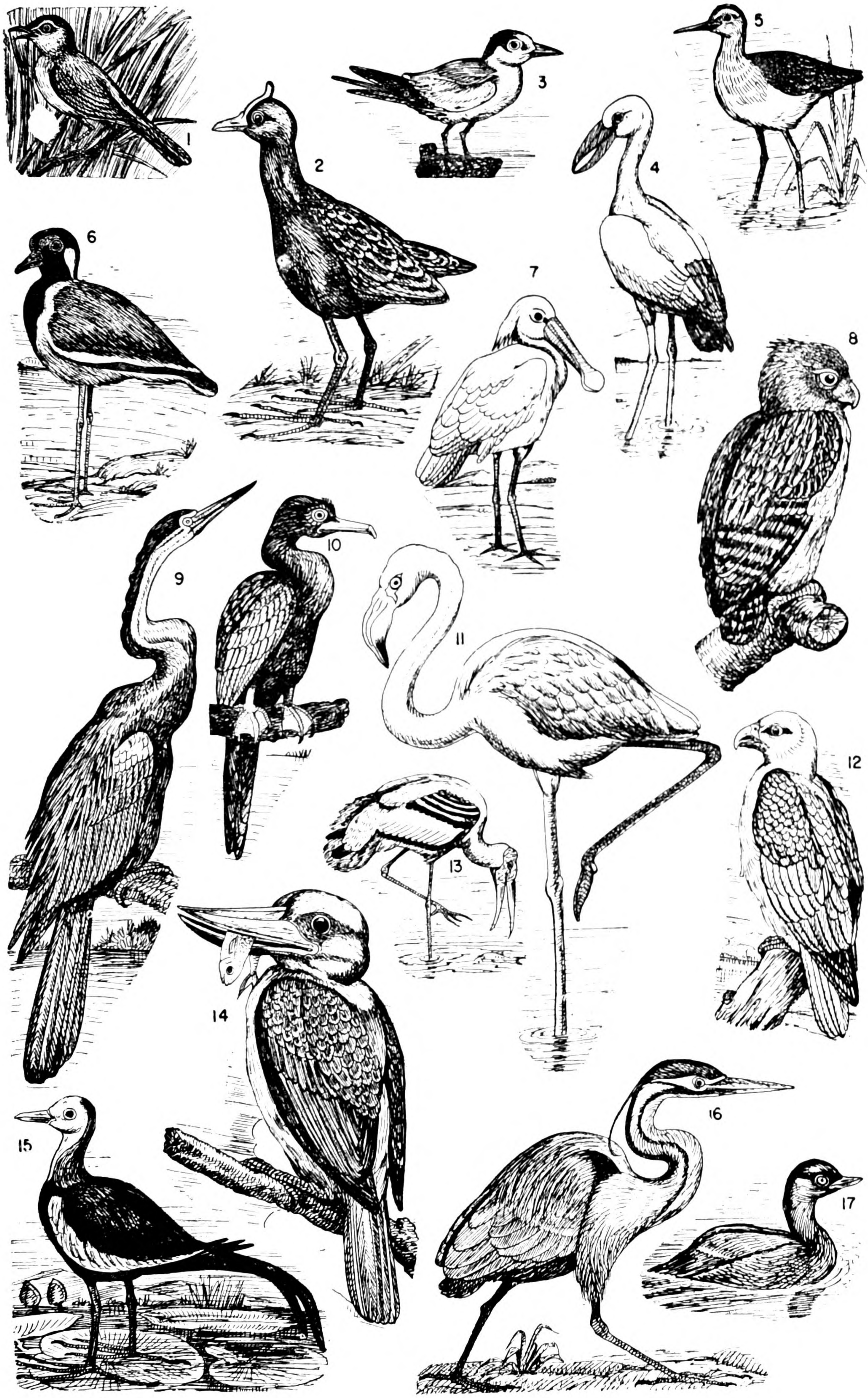
Platalea leucorodia L. [Spoonbill (S. Handi Alawa, T. Chappai Chondan)]. Page 143, Fig. 7).

Threskiornis melanocephala (Latham). [White Ibis (S. Tattu Kokka, Dahakatti Kokka, T. Thalkaththi Chondan)].

Explanation to figures on page 143

1. *Acrocephalus stentoreus meridionalis*
2. *Gallicrex cinerea* (male)
3. *Chlidonias hybrida indica*
4. *Anastomus ositans*
5. *Tringa glareola*
6. *Lobivanellus indicus indicus*
7. *Platalea leucorodia*
8. *Ketupa zeylonensis zeylonensis*
9. *Ahinga melanogaster*
10. *Phalacrocorax niger*
11. *Phoenicopterus ruber roseus*
12. *Haliastur indus indus*
13. *Ibis leucocephalus*
14. *Pelargopsis capensis gurial*
15. *Hydrophasianus chirurgus*
16. *Ardea purpurea manilensis*
17. *Podiceps ruficollis capensis*

All figures are after Henry.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FAMILY **CICONIIDAE**—Storks

Mostly large birds with long, heavy looking straight beaks. Except the Lesser Adjutant they all fly with their necks extended. Five species frequent Ceylon freshwater habitats.

Anastomus oscitans (Boddaert). [Open-Bill (S. Bellan Kokka, Beli Kawa, T. Naththai Kuththi Narai)]. (Page 143, Fig. 4).

Dissoura episcopus episcopus (Boddaert). [Indian White Necked Stork (S. Padili Kokka, T. Vannati Narai)].

Ibis leucocephalus (Pennant). [Painted Stork (S. Dae Tuduwa, T. Sangu Valai Narai)]. (Page 143, Fig. 13).

Leptoptilos javanicus (Horsfield). [Lesser Adjutant (S. Mana, T. Mana, Meva, Kokku)].

Xenorhynchus asiaticus asiaticus (Latham). [Black-necked Stork (S. Ali Kokka, T. Periya Narai)].

FAMILY **ARDEIDAE** Herons, Egrets and Bitterns

The long necks of the birds in this family are distinctly kinked in the middle due to the structure and arrangement of the vertebrae ; this enables the neck to be retracted into a very compact S, and extended quickly with great force for the capture of fish. In flight the neck is always retracted. Toes are long and thin. Twelve species frequent freshwater habitats.

Ardea cinera rectirostris Gould. (Eastern Grey Heron (S. Kalapu Kokka, T. Narayan, Naraı Kokku).

Ardea purpurea manilensis Meyen. [Eastern Purple Heron (S. Karawala Kokka, Barendi Kokka, T. Chen Varai)]. (Page. 143, Fig. 16).

Ardeola grayii (Sykes). [Pond Heron, Paddy Bird (S. Kane Kokka, T. Kuruttu Kokku, Nuli Madayan)].

Bubulcus ibis coromandus (Boddaert). [Cattle Egret (S. Harak Kokka, T. Unni Kokku)].

Butorides striatus javanicus (Horsfield). [Little Green Heron (S. Podi Kokka, T. Thosi Kokku)].

Dupetor flavicollis flavicollis (Latham). [Black Bittern (S. Kalu Kokka, T. Karuppu Narai)].

Egretta alba modesta (Gray). [Eastern Large Egret, Great White Heron (S. Lokku Sudu Kokka, Badadel Kokka, T. Periya Vellai Kokku)].

Egretta garzetta garzetta (L.) [Little Egret (S. Sudu Kokka, T. Vellai Kokka)].

Egretta intermedia intermedia (Wagler). [Median Egret (S. Sudu Kokka, T. Vellai Kokku)].

Gorsachius melanolophus melanolophus (Raffles) (Bittern).

Ixobrychus cinnamomeus (Gmelin). [Chestnut Bittern (S. Meti Kokka, T. Kuruttu Kokku)].

Ixobrychus sinensis sinensis (Gmelin). [Yellow Bittern (S. Meti Kokka, T. Mannal Narai)].

Nycticorax nycticorax nycticorax (L.) [Night Heron (S. Re Kana Kokka, T. Vakka)].

FAMILY **PHOENICOPTERIDAE** Flamingo

The beak is bent downwards at an angle. They fly with their necks extended and the long legs stretched out behind. They never perch. The young are able to run soon after the hatching. Only one species visit the Ceylon freshwater habitats.

Phoenicopterus ruber roseus Pallas. [Flamingo (S. Siyak Karaya, T. Pu Narai, Urian)]. (Page 143, Fig. 11).

ORDER **ANSERIFORMES**

FAMILY **ANATIDAE** Geese and Ducks

These are water birds with broadened and flattened bills. Legs are short with the three front toes fully webbed. The body is generally boat shaped. Six species visit the freshwater habitats.

Anas crecca crecca L. [Teal (S. Seruwa, T. Tara)].

Anas poecilorhyncha poecilorhyncha Forster. [Spotted-billed Duck (S. Seruwa, T. Tara)].

Casarca ferruginea (Pallas). [Ruddy Sheldrake, Brahminy Duck (S. Loku Seruwa, T. Tara)].

Dendrocygna bicolor bicolor (Vieillot). [Large Whistling Teal (S. and T. same as former species)].

Dendrocygna javanica (Horsfield). [Whistling Teal, Whistling Tree Duck (S. Seruwa, Thumba Seruwa, T. Chilli Tara)].

Nettapus coromandelianus coromandelianus (Gmelin). [Cotton Teal, " Quacky-Duck " (S. Mal Seruwa, T. Raja Tara)].

Sarkidiornis melanota (Pennant). [Comb Duck, Nukhta (S. Kabalittiya, T. Mukkan Tara)].

ORDER **PODICIPITIFORMES**

FAMILY **PODICIPITIDAE**—Grebes

This order contain birds which are well adapted for swimming and diving. Their bills are short, pointed and tapering. The toes are not webbed as in other birds. It appears as if each toe is individually webbed and is shaped like a leaf. The feet are placed very far back beneath the body. Only one species in Ceylon.

Podiceps ruficollis capensis Salvadori. [Little Grebe, Dabchick (S. Diya Seruwa, Gembi-Sera, T. Mukkuluva, Kuluppai)]. (P. 143, Fig. 17).

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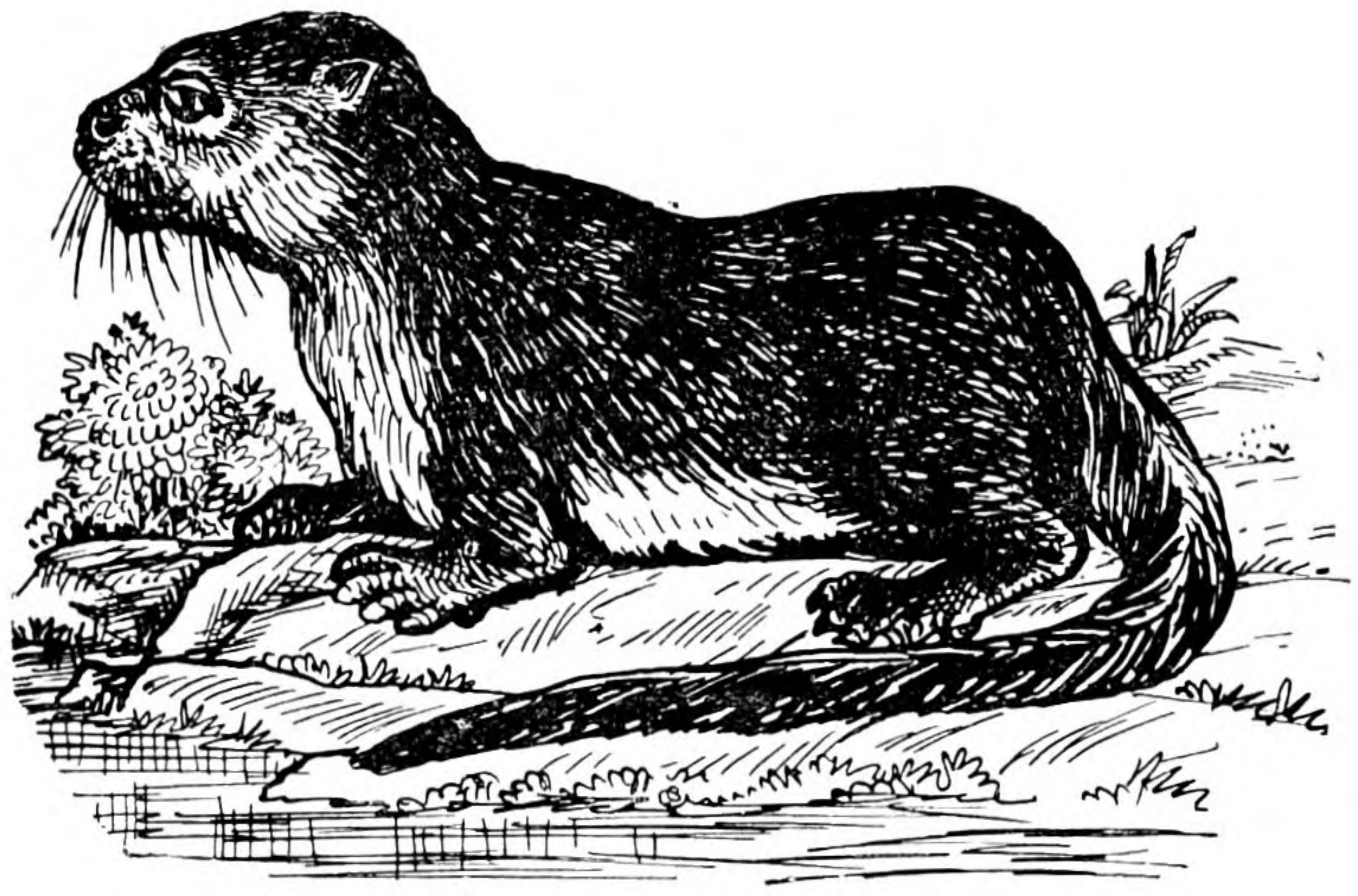
MAMMALIA

(Mammals)



Lutra lutra ceylonica body 61 cms. long—tail 40 cms. long.

There is only one species of mammal inhabiting freshwater in Ceylon, namely the otter.

Lutra lutra ceylonica Pohle. [The Ceylon Otter (S. Diya Balla, Mudiya Balla, T. Nair Nai)].

The body of this carnivore is rather long (61 cms.), while the limbs are short and the toes are webbed for swimming. The tail is thick at the base and flattened. The otter is found in and near rivers, streams, lakes, lagoons and paddy fields all over the Island. Its home is usually a burrow constructed beneath the roots of a large tree or beneath a rock at the water's edge. It has more than one entrance, one of which is invariably under water. It is an excellent swimmer, capable of diving and travelling long distances under water.

It is a shy animal, seldom seen, nocturnal in its habits and feeding on a wide variety of aquatic animals like insects, crabs, fishes, frogs, waterfowl and small rodents. The largest specimen on record had a body length of 61 cms. and a tail length of 40 cms.

REFERENCES

PHILLIPS, W. W. A. 1935. *Manual of the Mammals of Ceylon.* Ceylon. J. Sci. spec. publn., 373 pp.

INDEX

The index includes both scientific and common names. The numbers in the index are references to pages.

Specific and generic names are in italics. Names of higher natural groupings such as classes, orders and families are in capitals. The common English, Sinhalese and Tamil names are in ordinary type. The Sinhalese and Tamil names are in phonetic English and are followed by (S) and (T) respectively. References to illustrations are in bold type.

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PAGE

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