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Guide to the Freshwater Fauna of Ceylon (Sri Lanka)

Supplement 4

by

C. H. Fernando

INTRODUCTION

Supplement 3 " Guide to the freshwater fauna of Ceylon " by A. S. Mendis and C. H. Fernando, Fish. Res. Stn. Ceylon 12, 160 pp. (1962) was published by the prersent author in 1969. The three supplements so far published have (*a*) Added new taxonomic units at all levels (*b*) Corrected errors and up-dated the nomenclature of species (*c*) Added references where these had been recently published or overlooked and (*d*) Given keys to identification of various groups with illustrations where possible.

In the present supplement all the above features are covered, in addition where records in the past have been few in a group new records are given of localities both as regards species previously recorded from Sri Lanka and especially for new records. This gives the new records more standing and may enable others to collect these species. Over 50 species are recorded for the first time in Sri Lanka (Appendix I). A general survey of the freshwater fauna is attempted This is intended to give an indication of the groups as regards their numerical status in species and the extent to which different groups have been investigated. Using this data on the invertebrate fauna, the prospects for introduction of invertebrates is discussed. This field of scientific research is fast growing and is of particular significance to Sri Lanka where man-made lakes provide a situation where invertebrate introductions may prove beneficial. Fish introductions have already been discussed by Fernando (1965), Fernando and Indrasena (1969) and Fernando (1971, 1973).

Since 1968 the present author has collected and studied over 300 samples of invertebrates from lakes, ponds, rice fields, rivers and streams. Also the Swedish Lund University expedition (1962) to Sri Lanka has published a considerable amount of work on their collections which include some freshwater fauna. There have also been some general revisions which have added new species or new records to the Sri Lanka freshwater fauna.

At attempt has been made to illustrate as many species as possible with simple, clear illustrations. Wherever possible these reflect the level of sophistication in the taxonomy of the respective groups. Most of these illustrations have been made especially for this paper from specimens available to the author.

A special effort has been made to provide lists and illustrations of planktonic animals. This together with the paper of Chengalath and Fernando (1973) and Chengalath, Fernando and Koste (1973) should enable identification of practically all zooplankton species with accuracy.

A number of new species records for Sri Lanka are given under each section in the present supplement. A list of these species is given in Appendix I for easy reference.

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A table has been prrepared giving a number of species in the different groups of invertebrates in Sri Lanka. The data used for this table are mainly from the Guide to the freshwater fauna of Ceylon (Mendis and Fernando 1972) and the supplements 1-2 (Fernando 1963, 1964, 1969) and the present supplefent. Data on numbers of species in freshwater invertebrate groups in Malaya and Britain have been obtained from the authors unpublished and published data (Malaya) and the Freshwater Bioligical Association (Britain) publications.

Present Knowledge of the Freshwater Fauna

Table I summarises the status of the present knowledge of the freshwater fauna of Sri Lanka. A simple, arbitrary classification has been adopted and the various groups divided into three categories according to whether they are poorly known, fairly well known or well known. As can be appreciated, the dividing lines between these categories are not strictly definable.

Knowledge of the Sri Lanka freshwater fauna has been considerably enhanced in the last twenty years or so in two ways. 1. The publication of world or regional monogrraphs which enable identification of Sri Lanka species The following group and publications belong to this category. Oligochaeta (Brinkhurst and Jamison 1971. Naidu 1965) Tardigrada (Ramozotti 1967, Bartos 1967) Rotifera (Kutikova 1971) Potamonidae (Bott 1970) *Ranatra* (Lansbury 1972) *Anisops* (Brcoks 1951) Coleoptera larvae (Bertrand 1972) Coleoptera (Vazirani 1968, 1970) and Hydracarina (Cook 1971). To this should perhaps be added the Culicidae (Stone, Knight and Starcker 1959). 2. Studies specifically devoted to Sri Lanka material but not exclusively to this material in some cases. Here I am listing only substantial contributions: Tricladida (Ball 1970), Monogenea (Gussev 1963), Parasitic helminths (Fernando and Furtado 1964) Oligochaeta (Costa 1967), Rotifera (Chengalath and Fernando 1973, Chengalath, Fernando and Koste 1973), *Parastenocaris* (Enckell 1972), Parasitic Copepoda, Branchiura and Isopoda (Fernando and Hanek 1973a, 1973b) Atyidae (Arudpragasam and Costa 1962), Potamonidae (Fernando 1956, Bott 1970a), Notonectidae (Leong and Fernando 1962, Fernando and Leong 1963), Micronectinae (Fernando 1964, Wroblewski 1972), Odonata (Lieftinck 1971), Trichoptera (Schmit 1958) and Mollusca (Fernando 1969).

A great deal of material from Sri Lanka freshwaters has been collected by the Swedish Expedition (Lund University) in 1962, the Smithsonian Institute, USA and the present author. Substantial contributions have already been made to the taxonomy of Sri Lanka species based on these collections and more can be expected in the near future.

There has been in general an increase in the sophistication of taxonomic work. This applies in different degrees to different groups of freshwater animals. Early records are sometimes unreliable and the synonomy of species has to be sorted out. Some of this work has been done in the present supplement e.g. in the Cladocera and Copepoda. An attempt has been made to provide illustrations that will enable diagnosis in these two groups to the species level.

From present records it is possible in most cases to deduce with a fair degree of accuracy the numerical species composition of the fauna. I have attempted this exercise to enable me to comment on the faunal composition later on in this paper. The bases for this deduction are as follows: 1. The number of species in some continental tropical islands of similar size, 2. The paucity or abundance of species of each group in the tropics, 3. The number of species recorded so far in relation to the intensity of investigations, 4. The present state of systematic knowledge as applied to species limits in the different groups (e.g. I have reduced the recorded number of Mollusca in my estimated number of species present) and. 5. The Fauna of Adjacent Regions.

The author is well aware that the estimates given are open to criticism as to their bases but he feels that these estimates are the best possible under the present circumstances and will prove useful to workers in these various groups even if it only provides a challenge to prove me wrong.

TABLE I.

Present knowledge of the freshwater invertebrates of Sri Lanka as shown by numbers of species recorded and estimated. The level of knowledge is given by categories : (A) well known (B) fairly well known and (C) poorly known Some species numbers recorded are given for Malaya and Britain for comparison.

Species Numbers

FAUNAL GROUPS	Category	Sri Lanka Recorded	Sri Lanka Estimated	Malaya Recorded	Britain Recorded	INTRODUCTIONS * SUGGESTED INTRODUCTIONS †
PROTOZOA						
Free living	C	40	150	—	—	
Parasitic	C	5	50	—	—	
PORIFERA	B	2	2	—	—	
PLATYHEMINTHES						
Rhapdocoela	C	4	10	0	—	
Tricladida	B	2	5	1	10	
Monogenea	B	21	50	—	—	
Digenea	C	1	20	0	—	
Aspidobothrea	C	0	3	0	—	Cestoda
Cestoda	B	3	5	4	—	**Bothriocephalus gowkonensis*
MINOR PHYLA						
Ectoprocta	B	3	5	—	—	
Gastrotricha	C	2	5	—	—	
Tardigrada	C	3	20	—	—	
Nematomorpha	B	3	5	—	—	
ROTIFERA						
Monogononta	A	115	200	—	—	
Bdelloida	C	3	75	—	—	
NEMATODA						
Parasitic	B	9	30	—	—	
Free living	C	3	300	—	—	
Acanthocephala	B	2	5	4	—	
ANNELIDA						
Oligochaeta	B	31	60	—	84	
Hirudinea	B	9	12	10	—	
Branchiobdellidae	—	0	0	1	—	
MOLLUSCA						
Gastropoda	C	110	40	—	—	
Pelecypoda	C	10	8	—	—	
CRUSTACEA						
Anostraca	B	1	3	0	—	Branchiura
Conchostraca	B	3	5	1	—	**Argulus folliaceus*
Branchiura	A	1	1	2	—	Cladocera †*Daphinia magna*
Cladocera	B	53	65	—	90	**Leptodora kindti*
Ostracoda	C	21	60	—	—	**Bosmina longirostris*
Copepoda	B	27	35	—	—	**Eposmina coregoni*

TABLE I (contd.)

Species Numbers

FAUNAL GROUPS	Category	Sri Lanka Recorded	Sri Lanka Estimated	Malaya	Britain Recorded
Amphipoda	B	2	4	0	15
Isopoda	B	2	4	2	5
Macrura	B	17	20	—	1
Brachyura	A	8	8	12	0
INSECTA (larvae aquatic)					
Odonata	A	112	120	—	40
Ephemeroptera	C	18	170	—	47
Plecoptera	C	4	15	—	30
Neuroptera	C	0	4	—	6
Lepidoptera	C	1	1	—	—
Trichoptera	B	184	250	—	—
Diptera					
Chironomidae	C	22	400	—	380
Ceratopogonidae	C	22	75	—	—
Culicidae	A	122	122	—	—
Dixidae	C	1	2	—	—
Psychodidae	C	6	10	—	—
Simuliidae	C	2	4	—	19
Rhagionidae	C	1	2	—	—
Blepharoceridae	C	1	2	—	—
Sciomyzidae	C	0	2	—	—
ISECTA (all stages, aquatic)					
Hemiptera	B	120	135	110	62
Coleoptera	B	140	185	160	—
Hydracarina	C	25	125	—	—

INTRODUCTIONS *

SUGGESTED INTRODUCTIONS †

Copepoda* *Parastenocaris brevipes*

**Paraergasilus brevidigitus*

Copepoda **Lernaea cyprinacea*

Isopoda

†*Asellus*

Amphipoda

†Gammarids

Macrura

†Mysid

Included in Table I are the recorded numbers of some species from two countreis (Britain and Malaya) as a comparision for species numbers. Both countries are of the same order of size the two differ in being tropical (Malaya) and temperate (Britain). The similarities between freshwater faunas in general and differences due to latitudinal and zoogeographical factors are thus illustrated.

General Remarks on the Fauna

The freshwater fauna of Sri Lanka is quite rich in species. This is to be expected in a tropical country with an abundant rainfall (in some areas at least) and a wide range of habitats. However, Sri Lanka lacks natural lakes and a fauna typical of this habitat has not evolved. The only standing waters of any considerable area are the villus which are marshes connected intermittantly with rivers (Fernando 1971). Most of the country has a monsoonal climate with well-marked dry and wet seasons. During the dry seasons (inter-monsoon) most freshwater habitats dry up. The only habitats (natural) which are perennial are some rivers. The man-made lakes of which there are about 10,000 in Sri Lanka have been colonized via the rivers and have a relatively rich fauna except for typical lake species. If natural lakes were present typical lake forms may have reached these habitats. It is in the reservoirs of the hill country that a real paucity of species is evident. The zooplankton in these man-made lakes is very poor in species and they are also poor in littoral and benthic animals.

The small streams in the wet zone have a high proportion of endemic species at least in some groups. This is evident as shown by Fernando (1971) for fishes and from the extensive studies of Wroblewski (1972) on the Corixidae and Enckell (1972) on the genus *Parastenocaris* (Copepoda, Harpacticioda). It is very likely that intensive studies of stream fauna will show both a richness and a high endemicity of species in this habitat. The small stream in the wet zone has probably been the most long standing and favourable habitat in Ceylon for freshwater species (Fernando 1971).

Table 1. shows the number of species in different invertebrate groups in Sri Lanka. Groups poor in species belong to three categories. (*a*) Those which have few freshwater representatives. e.g. Coelenterata, Porifera (*b*) Groups with few species e.g. Gastrotricha, Conchostraca and (*c*) Groups which have relatively few species in the tropics e.g. Tricladida, Simuliidae, Plecoptera. The fauna lacks some groups e.g. Brachiobdellidae which are predominantly North American. It is rich in Trichoptera, Copepoda (mainly pond species), Hemiptera, Odonata, Macrura and Brachyura. The effects of the lack of natural lakes is seen in the relatively poor Cladocera, and lake Copepoda faunas. The richness of stream fauna has already been mentioned.

With comprehensive studies in the different groups a more accurate analysis will become possible. However the general composition of the fauna will not differ from what has been described above.

An unexpected richness of the fauna has so far been demonstrated in two groups of freshwater organisms namely the genus *Parastenocaris* (Copepoda, Hartacticioda) with eight species of a total described fauna of about 100 species, (Enckell 1971) in the world and the Micronectinae whose richness according to Wroblewski (1972) is "unmatched in any other land". Twenty-one species of this group are known from Sri Lanka. It is possible that some other groups may come within this category of " rich " when intensive studies have been done.

It is unwise in some cases to state categorically whether the paucity of species in a group is due to lack of study or to a natural poverty of the fauna. An example of this situation is the Digenetic Trematoda. Only one doubtful species is on record from freshwater fishes.

Introduction of Fish and Invertebrates

A number of fish and invertebrates have been deliberately or by accident introduced into Sri Lanka freshwaters. The introductions of fish species has bene documented by Fernando (1965, 1971) and Fernando and Indrasena (1969). The impact of fish introductions and the feasibility of new introductions have been discussed by Fernando (1971, 1973). Some introductions suggested by Fernando (1965) have already been carried out and an evaluation of their effects on the freshwater fisheries should be possible now. In the case of invertebrates a number of accidental introductions have occurred. Some of these introductions have been referred to by previous workers. Bar (1924) mentions the possibility that *Bosmina* spp. have been introduced. Fernando and Furtado (1963) mention that the Cestode *Bothriocephalus gowkonensis* Yeh has probably been introduced. The likelihood of this introduction is substantiated by the evidence that it has spread to Eastern Europe from China (Fernando and Indrasena 1969). Fernando and Hanek (1973b) suggest that three of the seven species of parasitic crustaceans recorded so far from freshwater fishes have been introduced. It is likely that introductions may have gone unrrecorded. For example *Parastenocaris brevipes* (Kessel) and *Leptodora kindti* Focke recorded from Sri Lanka are probably recent introductions.

In a previous paper Fernando 1973, raised the question of the prospects of introducing invertebrates into Sri Lanka freshwater to fill gaps in the fauna. The reasons for suggesting these introductions and the existence of the gaps are discussed below. A list of suggested introductions are given in Table 1.

In general there is an aversion to introduction of species into natural habitats. The reasons for this are obvious in that the effects of introductions can rarely if ever be predicted. However, man's domestic and domesticated plants and animals have been introduced into new areas with

beneficial effects by and large. Although, apart from the obvious parasitic and pest species, introductions have had varied effects on native faunas, accidental introduction of freshwater inverteorates have been poorly rocumented. There are a number of references to such introductions in Allee and Schmidt (1951), Elton (1958) and Hynes (1970). In recent years there has been a great deal of planned introductions (acclimatization) of freshwater invertebrates in the USSR and their experience is worth considering in assessing prospective introductions. Dedyu (1963), Ioffe (1963, 1972), Karpevitch (1963) Melnikov and Chaplina (1963) and Karpevitch and Bokova (1970) refer to the introduction of Cladocera, Copepoda and mysids into freshwaters in the USSR with beneficial results to the fisheries. Karpevitch (1963) records that, of 45 species introduced into freshwaters in Central Asia 37 became acclimatized. The success rate was 63% individual transfers. Bogotova (1969) gives *Daphnia magna* as a good species for introduction. Ioffe (1972) records marked improvement of reservoir fish productivity as a result of invertebrate introduction. However, Sidorov (1963), and Zilenko (1963) point out that fish parasites had entered the ecosystem with introduced species of fish and invertebrates. In general only parasites with direct life histories i.e. Protozoa, Monogenea, Copepoda are carried by fish into new habitats.

Below are some reasons for introduction of invertebrates into freshwaters in Sri Lanka based on the composition of the indigenous fauna and ecological considerations, on the basis of the knowledge of the composition of the fauna some prospective introduction are given.

Sri Lanka has no natural lakes, yet over 10,000 " Lakes " have been constructed for irrigation of rice fields, water storage, for drinking and for the generation of hydro-electric power. The fauna of these lakes was not evolved in standing waters of large size i.e. lakes. It is therefore likely that many niches have remained unoccupied or inefficiently utilized. This has been well demonstrated by the success of *Tilapia mossambica* introduced in 1952 (Fernando 1965, 1971). Normally existing lakes and rivers supply faunal recruits to newly formed lakes. Sri Lanka lacks the former but is abundantly supplied with rivers. As shown by Hynes (1970) and Ioffe (1972) rivers can provide the bulk of zooplankters for man-made lakes. However in Sri Lanka the hill country has only torrential streams in which a fauna suitable for lake colonization can hardly be expected to develop. Also Sri Lanka is poor in certain groups of invertebrates which are prominent lake species. These include limnetic Cladocera, gammarids and isopods.

The present author has examined over 300 samples of " zooplankton " collected from lakes, ponds, rice fields and rivers in Sri Lanka during the period 1965-1972. As expected, *all* zooplankters found in lakes occur in natural habitats i.e. ponds and streams. The zooplankton in low country shallow lakes is diverse in spesies composition. The pond and river species have apparently supplied suitable recruits to these man-made habitats. However until standing crops and production of zooplankton are studied the richness or otherwise of the zooplankton cannot be compared with lakes elsewhere. In the up-country reservoirs however the zooplankton species are few and the standing crops appear low. This combined with a very low fish production in these lakes indicates a need for enriching the fauna if these habitats are to yield any quantity of fish.

Discussed briefly are the prospects for acclimatizaion (introduction) of invertebrates species into Sri Lanka freshwater in relation to possible increases in fish production.

On the basis of data available on the freshwater fauna of Sri Lanka it apperas quite feasible that planktonic, benthic and nektonic invertebrates can be introduced into Sri Lanka freshwaters with beneficial effects on the fisheries. At present the poorest faunas found in the lakes are in the hill-country reservoirs e.g. (Castlereagh) and the deeper low-country reservoirs (e.g. Nalanda). For these habitats, species tolerant of lower temperatures (i.e. around 10-20°C) can be considered. The following invertebrates can be considered as good prospects for acclimatization in deeper reservoirs and streams up-country. The Cladocerans *Daphnia magna* Straus *Bosmina* (s.l.) and *Ceriodaphnia* spp. may well prove satisfactory species to raise the production of zooplankton. Besides these, mysids, of which there are at least three indigenous lagoon species namely *Heteromysis zeylanica* Tattersall. *H. proxima* Tattersall and *Mesopodopsis zeylanica* Nouvel (Taffersall 1923, Nouvel 1954) may well prove possible to acclimatize to these habitats.

In Europe there are a number of mysids in frreshwaterr besides *Mysis relicta* Loven which is restricted to the Northern European lakes. Holmquist (1972) lists 18 mysides from Europe. The genus *Daphnia* is poorly represented in the tropics. However this may be a matter of geological history rather than temperature. In any case the temperatures in the up-country resrvoirs are lower than in typical tropical lakes. Holzinger (1955) gives a temperature range of 0.6-24°C for Gregory's Lake, a lake in the hill country of Sri Lanka. mysids have been successfully acclimatized in reservoirs in the U.S.S.R. (Dedyu 1963).

There are two other groups of invertebrates which are poorly represented in Sri Lanka which contribute significantly to production in streams and lakes. There are the gammarids and the isopods. The only gammarids present in Sri Lanka fresh waters are *Paracalliope fernando* Wignarajah, a rare species and *Grandidierella bonneri* Stebbing (=*Grandidierella megnae* Tattersall), a brackish water species. There are in the Indian region however many gammarids including 15 species of *Rivulogammarus* (Staskraba 1967). Some of these species might well prove valuable species to acclimatize to the hill country streams and lakes. There are only two species of isopods recorded from Sri Lanka freshwaters. One of them *Alitropus typus* (Milne Edw.) is an ectoparasite on fish (Fernando and Hanek 1973b). The other is a small interstitial species recorded by Enckell (1970). The prospects of introducing successfully some species of free-living Isopoda and gammarids seem favourable. However it is possible that the *Caridina* species (*Atyidae*) will eliminate any foreign isopods and gammarids. These two groups (*Caridina*—gammarids and isopods) appear to be mutually exclusive and *Caridina* is a tropical genus. However *Caradina* in Sri Lanka is not common in the up-country though one species *Caradina sinhalensis* Ortmann is restricted to this habitat.

It appears that the introduction of freshwater invertebrates into Sri Lanka has reasonable prospects for success and will likely have a positive effect on fish production especially in the up-country reservoirs. However caution should be exercised in selecting species for introduction and the progress of acclimatization should be carefully monitored. The introduction of parasites should be carefully guarded against. Fernando and Hanek (1973 b) suggest some methods for eliminating parasites from fish being used for introduction. Much work remains to be done on the biology of indigenous and introduced species if sestained long-term benefits are to be reaped. However the propects for increased fish production warrant the expenditure of effort in this field in Sri Lanka.

NOTE—

A number of accidental and deliberate introduction of invertebrate species have been documented in recent years Munro Fox, H. (1965) Ostracod Crustacea from Ricefields in Italy, Mem, Ist. ital. Idrobiol 18, 205–214 mentions that 8 species of Ostracoda have been introduced into Italian ricefields. These species originate from all the continents outside Europe and were presumably introduced with samples of rice imported from abroad. Abrahamsson (1972) has a number of papers dealing with the deliberate intoductions of two American crayfish *Orconectes limosus* Rafinisque and *Pacificastasus leniusculus* Dana into Europe. These introductions have enabled the "Crayfish industry" to recover from the disastrous effects of crayfish plague which appeared in Italy in 1890. Although undocumented I have reliable information that American crayfish have been intoduced into East Africa.

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PHYLUM — PLATYHELMINTHES

Class Turbellaria

ORDER TEMNOCEPHALIDA

In the Guide p. 40 three species of Temocephalida are listed from Sri Lanka. The work of Baer (1953) has necessitated a change in the nomenclature of one of these species namely *Caridinicola platei* Fern. which should be *Paracaridinicola platei* (Fern.) Also another species found in Ceylon by Plate (1914) was not listed in the guide. This is *Paracaridinicola indica* Plate. The other two Sri Lanka species are *Monodiscus parvus* Plate and *Monodiscus macbridei* Fern.

A comprehensive revision of this order was made by Baer (1931). Baer (1953) give notes on the geographical distribution and the relations of the ectoparasite with their hosts.

ORDER TRICLADIDA

The first named triclad from Sri Lanka was described by Ball (1970). Besides this species *Dugesia nannophallus* Ball, he found material belonging to Dugesia spp. He is presently studying more material collected in Sri Lanka. It is evident from his work and intensive collecting in Sri Lanka that triclads are not uncommon in Sri Lanka especially at higher elevations. Ball (1970) gave a synopsis of *Dugesia* in the Oriental region. This work should enable more accurate diagnosis in this group, little known at present in the Oriental region. *Dugesia nannophallus* is shown in Fig. 16.

ORDER RHABDOCOELA

While examining "plankton" samples from lakes, ponds, rice fields and streams in Sri Lanka I have come across Rhabdocoeles on many occasions. They have only been diagnosed to the generic level and include *Mesostomum*, *Macrostomum* and *Catenula*. The Rhabdocoela are very poorly known in the Oriental region at present and accurate diagnosis to the species level is not possible except by a specialist. It is also likely that many new species will be found in this group. Study of Rhabdocoela taxonomy has been hindred by the difficulty of preservation and the total lack of specialists working on tropical freshwater forms.

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PHYLUM—TARDIGRADA

Hitherto no member of this phylum has been recorded from Sri Lanka. I found three species in material collected in Sri Lanka for me by Mr. P. B. Karunaratne from two localities and in sorted material sent to me by Professor Per Brinck and collected by the Lund University Expedition to Ceylon in 1962.

The material identified is as follows:

1. *Macrobiotus dispar* Murray.
   Helanda, Ratnapura, Sabaragamuwa Province; stagnant pond; Coll. P.B. Fernando.

2. *Macrobiotus dispar*
   Ratnapura, Sabaragamuwa Province; Gem pit 10.7.72.
   Coll. P. B. Karunaratne.

3. *Macrobiotus dispar*
   Nuwara Eliya, Central Province; pond 27.7.71.
   Coll. P. B. Karunaratne.

4. *Macrobiotus dispar*
   Bopatella Falls. 9 miles NNW./Ratnapura.
   Sabaragamuwa Province; Swedish Lund. Univ. Expd. 19.11.72.

5. *Stygarctus bradypus* Schulz
   Valalai Jaffina, Northern Province, brackish water;
   Swedish Lund. Univ. Expd. 19.11.62.

6. *Echiniscus* (*E.*) *crisbosus* Murray
   Nr. Trincomalee, Eastern Province, dry forest;
   Swedish Lund, Univ. Expd. 10.11.62.

Although widely distributed in acquatic habitats especially in the littoral, tardigrades are often missed in collections because they are seldom recognized and even when noticed they are put aside for lack of interest and the imagined difficulty of identifying them. According to Edmonson (1963) and Pennak (1953) only about 20 species have so far been recorded from the USA and another 20 from Canada. About 400 species are known from the world. These numbers do not represent anywhere near the actual number of species present. In Europe they are far better known and are dealt with extensively in the monographs of Bartos (1967), Ramazotti (1967) and Rudescu (1964). From the former two monographs I have made a list of 17 species so far recorded from the Indian subcontinent and South East Asia. They are as follows:

Macrobiotus annae Richters
Macrobiotus dispar Murray
Macrobiotus hastatus Murray
Macrobiotus macronyx Dujardin
Macrobiotus rubens Murray
Echiniscus (E.) *dubosci* Richters
Echiniscus (E.) *calvus* Marcus
Echiniscus (E.) *bais* Marcus
Echiniscus (E.) *quadrispinosus* Richters
Echiniscus (E.) *reticulatus* Murray
Echiniscus (E.) *spiniger* Richters
Echiniscus (*Bryodelphax*) *tatrensis* Weglarska
Pseudoechiniscus sullus (Ehrenb)
Hypsibius (*Isohypsibius*) *indicus* (Murray)
Hypsibibius (I.) *nodosus* (Murray)
Hypsibius (*Diphascon*) *chiliensis* Plate

It is likely that Sri Lanka fauna of Tardigrada will amount to at least 20 species considering the wide range of aquatic habitats and the cooler temperatures in the hills. Tardigrades are commoner at lower temperatures. Their favourite habitat is moss and they are also often found in the littoral of lakes and among vegetation at the edge of ponds. Few species are marine. Most species have been recorded from wet moss.

Tardigrades are minute in size (about 1mm long) and have a characteristic easily diagnosed external and internal structure. They are usually preserved in 5% formalin and mounted for study in lactophenol or a stain mountant (CMC-S Turtox; gives good results). The body is flattened or slightly arched and carries ventrally four pairs of stubby legs bearing claws. This gives the animal the appearance of a miniature bear (Fig. 18) hence they are referred to as water bears. The body surface is covered with variously ornamented plates which sometimes bear spines or hairs. Anteriorly are a pair of eye spots. Some structural features of tradigrades are shown in Figs. 17-19.

Internally the main organs are a pair of piercing stylets opening into the anterior end of the alimentary canal. The alimentary canal is simple and has in its course a budbous suctorial pharynx, a short oesophagus, stomach and rectum. It opens into the cloacal chamber which communicates with the outside ventrally and anterior to the fourth pair of legs. Opening into the posterior portion of the alimentary canal is the single, dorsally placed ovary (males are rare and unknown in some genera) and two or more laterally placed malpigian tubules and a third more dorsal malpigian tubule. The brain is dorsal and the ventral nerve cord bears ganglia. Detailed descriptions of morphology are given in Pennak (1953) and Edmonson (1963).

Tardigrades are capable of withstanding very adverse conditions by passing into a state of very low metabolic activity. This phenomenon is referred to as anabiosis and is also found in Bdelloid Rotifera.

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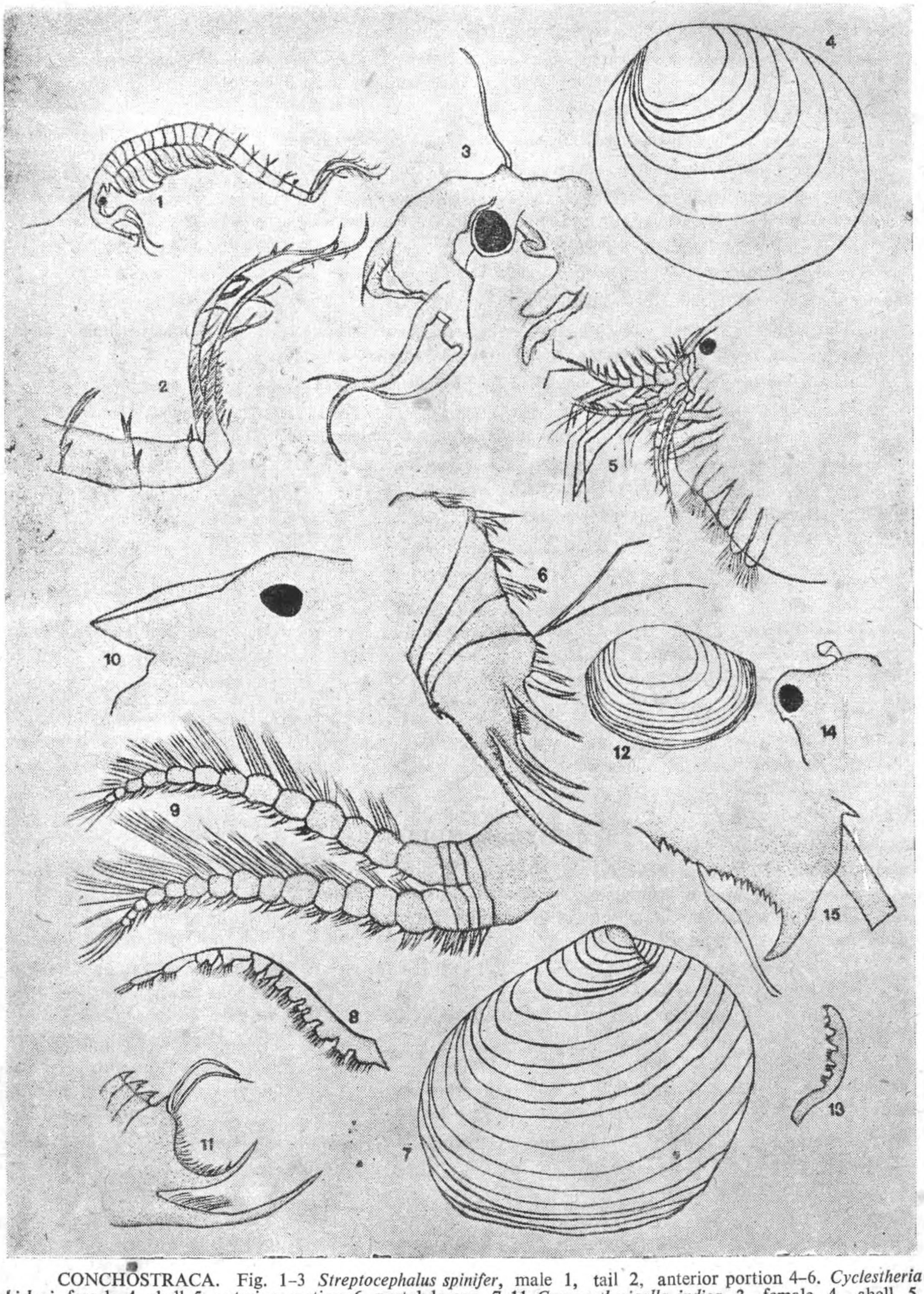
CLASS — OLIGOCHAETA

In all 31 species of aquatic Oligochaeta have been recorded from Sri Lanka so far. They belong to the Aelosomatidae (1 species). Naididae (24 speciés) Tubificidae (4 species). Glassoscolicidae (1 species) and Phreodrilidae (1 species). The total number of species present is perhaps around 60-100. So far relatively little material has been examined from Sri Lanka.

Naidu (1966) records the following numbers of species from the Indian subcontinent: 6 Aelosomatidae, 51 Naididae and 14 Tubificidae. Brinkhurst and Jamieson (1971) have given a comprehensive account of the freshwater Oligochaeta of the world. This book together with the papers of Brinkhurst (1965), Naidu (1962-63, 1965, 1966) and Gates (1945) enable the identification of Sri Lanka aquatic Oligochaeta. Costa (1967) has given a number of new records of species for Sri Lanka.

The following species of freshwater Oligochaeta were identified in samples of zooplankton collected for the study of microcrustaceans. Since records of freshwater Oligochaetes for Sri Lanka are few they have been included here.



CONCHOSTRACA. Fig. 1–3 *Streptocephalus spinifer*, male 1, tail 2, anterior portion 4–6. *Cyclestheria hislopi*, female 4, shell 5, anterior portion 6, postabdomen. 7–11 *Ganenestheriealla indica* 3. female 4, shell 5, Anterior portion 6. Postabdomen 7–11. *Caenestheriella indica* male 7. Shell 8. Antenna I 9. Antenna II 10. Anterior portion II. Postabdomen 12–14. *Eulimnadia michaeli* female 12. Shell 13. Antenna I 14. Anterior portion 15. Postabdoman of male

Allonais galiorensis (Stephenson). Marawila pond 6.12.70.

Allonais inequalis (Stephenson). Gurugoda, Nr. Padukka, pond 23.12.72., Legawatte Est. Badulla, well 8.10.72., Galwela, rice field 6.11.72., Battuluoya, river edge 2.6.72.,

Allonais pectinata (Stephenson). Madurankuliya tank 2.6.72.

Aulophours hymenae Naidu. Pond near Kirillapone 23.12.72., Dothalla, rice field 6.12.72.,

Aulophorus michaelseni (Stephenson). Lahugala tank 28.8.72.

Aulophorus tonkinensis (Vejdovsky). Gurugoda near Padukka, pond 23.12.72., Nagadeepa wewa 1.10.72. Dothalla, rice field 16.12.72., Ratnapura, wayside ditch 18.8.72., Ganegama near Pelmadulla, rice field 18.8.72., Ratnapura, rice field 19.8.72.,

Branchiura sowerdyi Beddard. Nugegoda, rice field 7.8.72.

Chaetogaster distrophus (Gruithuisen). Punchivillu, Puttalum 1.6.72.

Dero digitata Muller. Nagadeepa wewa 10.11.72., Eppawela, small pond 11.8.72., Na-Eliya (near Battuluoya) tank 25.8.72., Polgaswita near Piliyandala, pond 23.12.72.,

Dero zeylanica (Stephenson). Panagoda, pond 23.12.72., Marawila, pond 29.12.72.

Pristina proboscidea Beddard. 19th Ml. Piliyandela–Horana Road, pond 23.12.72. Panagoda, pond 23.12.72. Pelmadulla, small water collection 17.8.72.

Pristina longiseta Ehrenberg. Panagoda, pond 23.12.72., Galwewa tank 6.11.72., 19 Ml. Piliyandala-Horana Road, pond 23.12.72., Ratnapura, wayside ditch 22.8.72.,

Pristina aequiseta Bourne. Divulwewa, rice field 11.8.72.

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PHYLUM MOLLUSCA

About 110 species of freshwater Mollusca have so far been recorded from Sri Lanka. However most of our present knowledge on the species is based on studies made over half a century ago. The only recent paper is that of Fernando (1969) which records thirty-seven species including one new record for Sri Lanka namely *Cerithidea fluviatilis* (Potiez and Michaud).

It is likely that evaluation of the specific status of Sri Lanka freshwater Mollusca in the light of recent work will lead to a reduction in the number of valid species. It is estimated that the reduction will be from the present 110 to about 50 species (Table 1).

The larval stages (Glochidia) of bivalve molluscs are parasitic on the gills and skin of fishes. Glochidia (have also been found) in plankton samples. These are presumably recently shed larvae or those which failed to become ectoparasitic. A glochidum of the common bivalve *Lamellidens marginalis* Lamark is shown in Fig. 20.

Some remarks on Glochidia and methods for preservation and study are given by Fernando et al. (1972).

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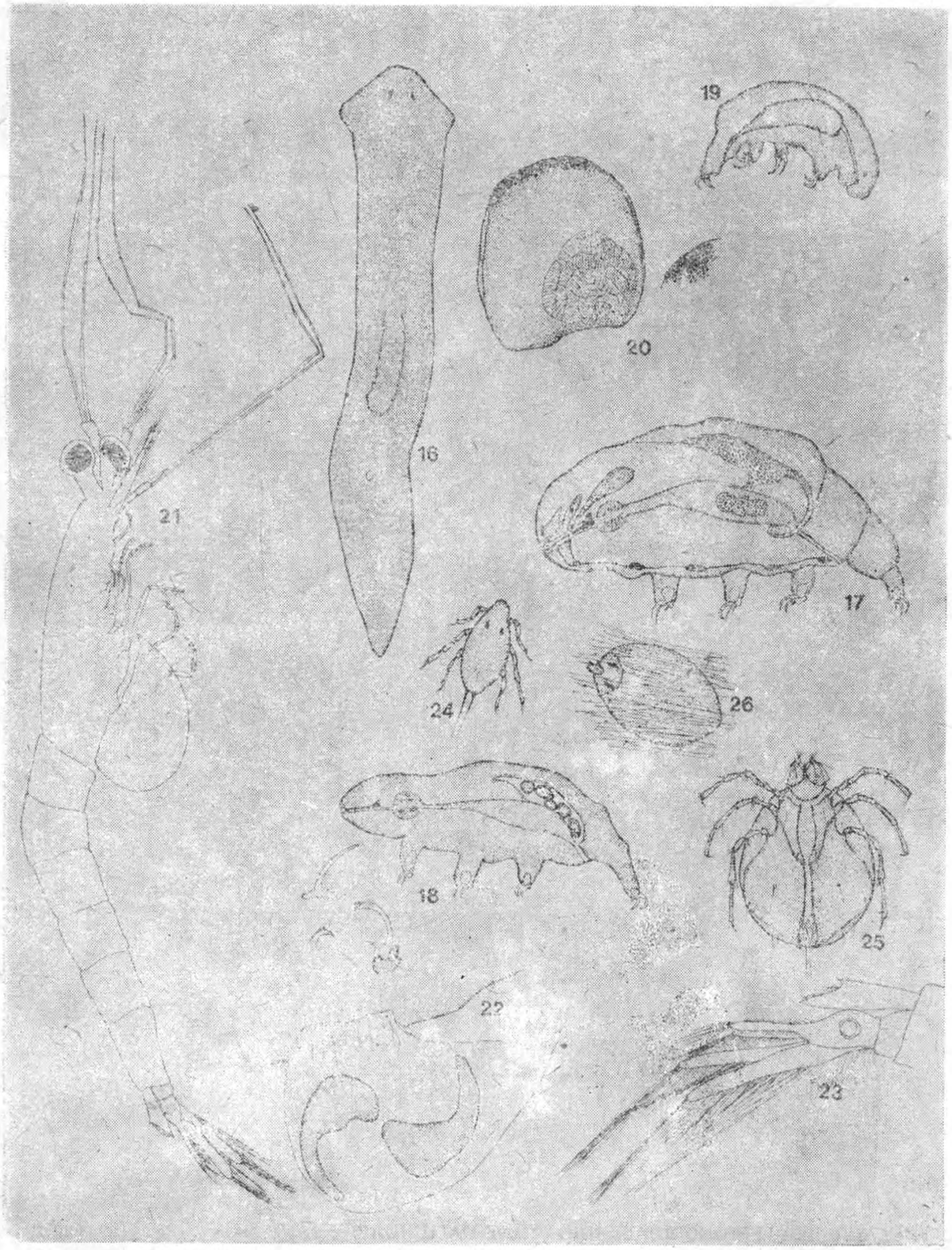
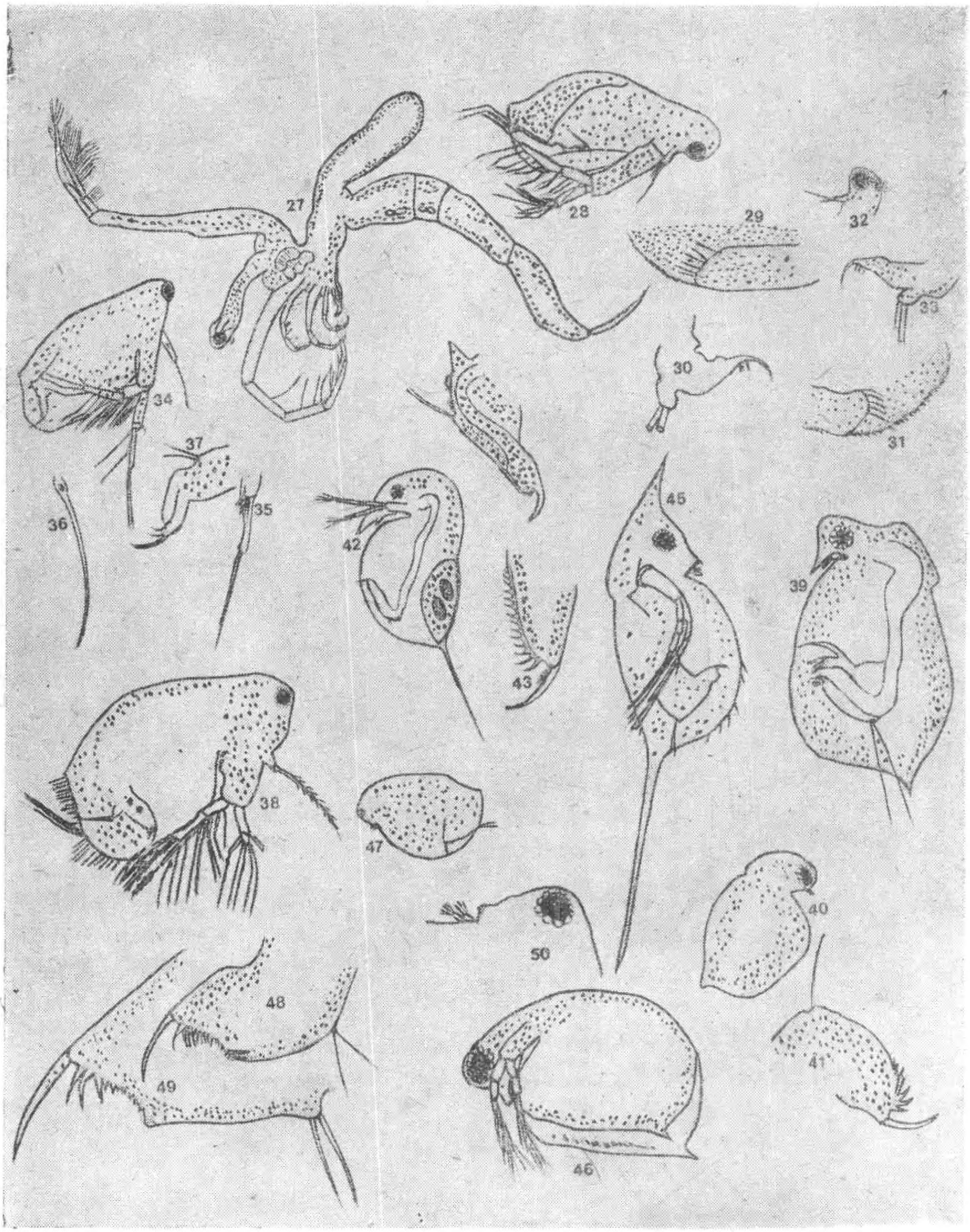
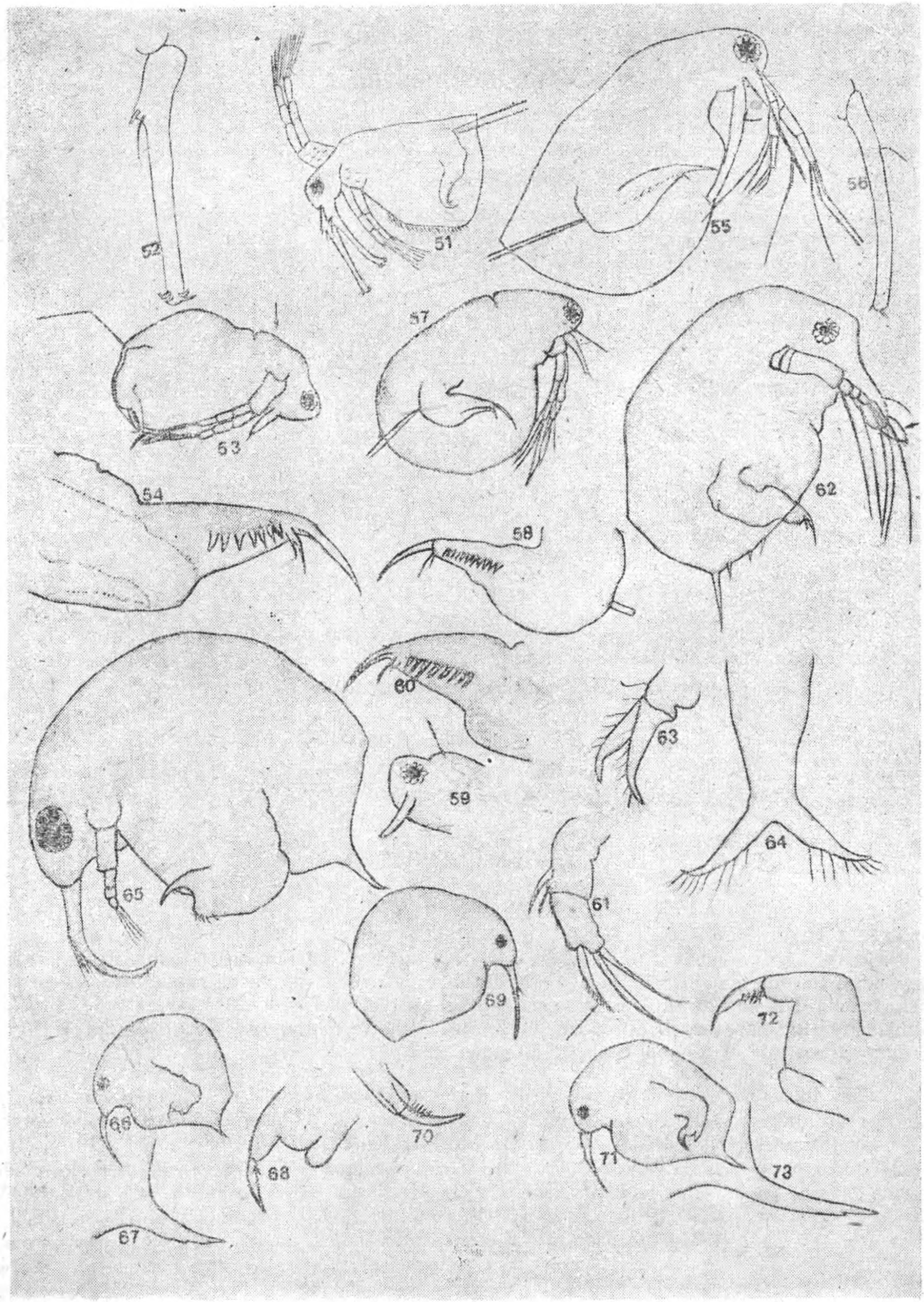


PLATYHELMINTHES, TARDIGRADA, MOLLUSCA, CRUSTACEA (MYSIDACEA), HYDRACARINA..
Fig. 16 *Dugesia NANNOPHALLUS*; 17. *Macrobiotus huflandi*; 18. *Macrobiotus dispar*; 19. *Macrobiotus dispar* 20. Glochidium of *Lamellidens marginalis* 21–23 *Mesopodopsis zeylanica* female, 22. female brood pouch, 23, posterior portion, 24 Hydracarina larva from plankton. 25 *Unionicola* larva. 26 Hydracarina larva from stomach wall of the fish *Etroplus suratensis* (Bloch). fig. 16. redrawn from Ball (1970); 17–19. form Bartos (1967); 25 from Mitchell (1955).



CLADOCERA-LEPTODORIDAE, SIDIDAE AND DAPHNIDAE. Fig. 27. *Leptodora kindti* from Ontario, Canada. 28–30 *Diaphanosoma excisum* female, 29 postero-ventral portion of shell, 30 postabdomen. 31–33 *Diaphanosoma sarsi*, 31 postero-ventral portion of shell, 32 head, 33 postabdomen. 34–37. *Pseudosida bidentata*. 35, antenna of female, 36 antenna of male, 37 postabdomen of female. 38 *Latonopsis australis*. 39 *Ceriodaphnia cornuta* 40 *Ceriodaphnia quadrangula* 41 *C. quadrangula* postabdomen, 42–44 *Daphnia carinata*, 42 ephippial female, 43 postabdomen of same, 44 details of postabdomen of same. 45. *Daphnia lumholtzi*. 46 Scapholeberis kingi. 47–50. *Simocephalus vetulus* 47. *S. vetulus*, Ontario, Canada 48. Same, postabdomen, 49 *S. vetulus* postabdomen of female from Sri Lanka, 50 head of female from Ontario, Canada.



CLADOCERA-MOINIDAE, BOSMINIDAE. Fig. 51–54. *Moina micrura*, 51 male, 52 male antennule, 53 female, 54. female postabdomen, 55–58. *Moinodaphnia mcleayi*, 55 male, 56 male antennule, 57 female, 58 female postabdomen 59–61. *Moina macrocopa* female, 59 head of female, 60 postabdomen, 61. first leg 62–64. *Bosminopsis dietersi*. female 63 rostrum, lateral view, 64 rostrum, spread out : Ventral view. 65 *Bosmina* sp. from Madurai, India. 66–68. *Bosmina longirostris* from Ontario, Canada, 66. female, 67 postero-ventral spine, 68 postabdomen 69–70. *Eubosmina coregoni* from Ontario, Canada, 69 female, 70 terminal portion of postabdomen. 71–73 *Eubosmina longispina* from Ontario, Canada, 71 female, 72 postabdomen, 73 Postero-ventral portion of shell.

SUB-CLASS BRANCHIOPODA

ORDER CONCHOSTRACA

Only a single species *Cyclestheria hislopi* (Baird) has been recorded so far from Sri Lanka. Two new records are now added namely *Eulimnadia michaeli* Nayar and Nair and *Caenestheriella indica* (Gurney). All three species are illustrated in Figs. 4-15.

The collection data on the new records is as follows: *Eulimnadia michaeli* Mandativu, Jaffna ; rainpools 3.12.57. *Caenestheriella indica* Colombo Museum gardens in rainpools 21.10.69. Coll. P. B. Karunaratne. Karainagar, rice fields 15.12 71. Coll. M. J. Fernando.

Both these species have been collected subsequently in other localities in Jaffna and appear to be fairly common *Cyclestheria hislopi* is common in all parts of Sri Lanka.

The relevant papers for Sri Lanka conchostracans are Baird (1859). Gurney (1906a, 1906b) and Nayer and Nair (1968).

ORDER ANOSTRACA

The only member of this order known from Ceylon is *Streptocephalus spinifer* Gurney. In the " Guide " the female of this species is figured. The collection from Karainagar East, Jaffna; rice field 16.12.71 contains both males and females. The male is illustrated (Fig. 1-3).

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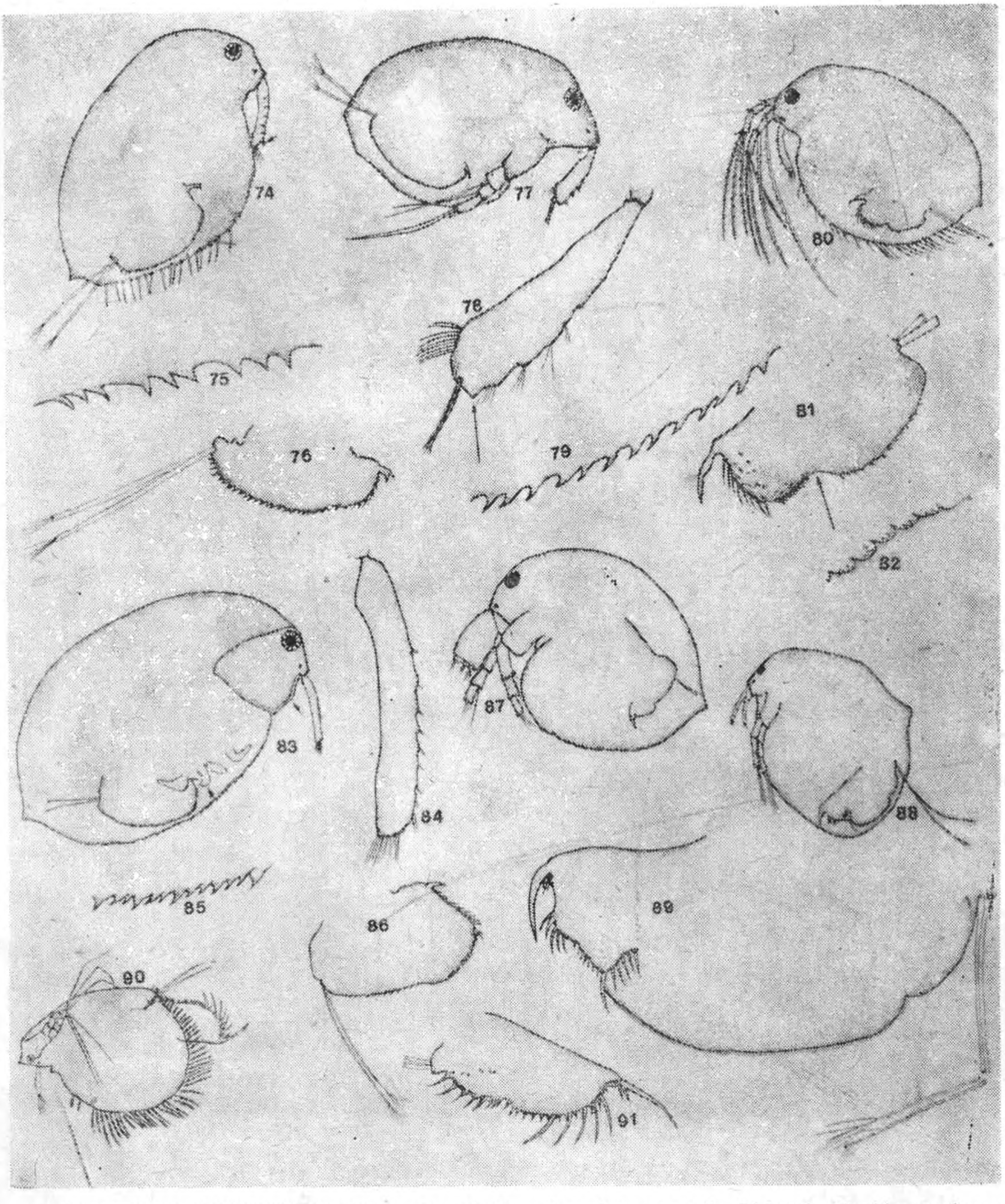
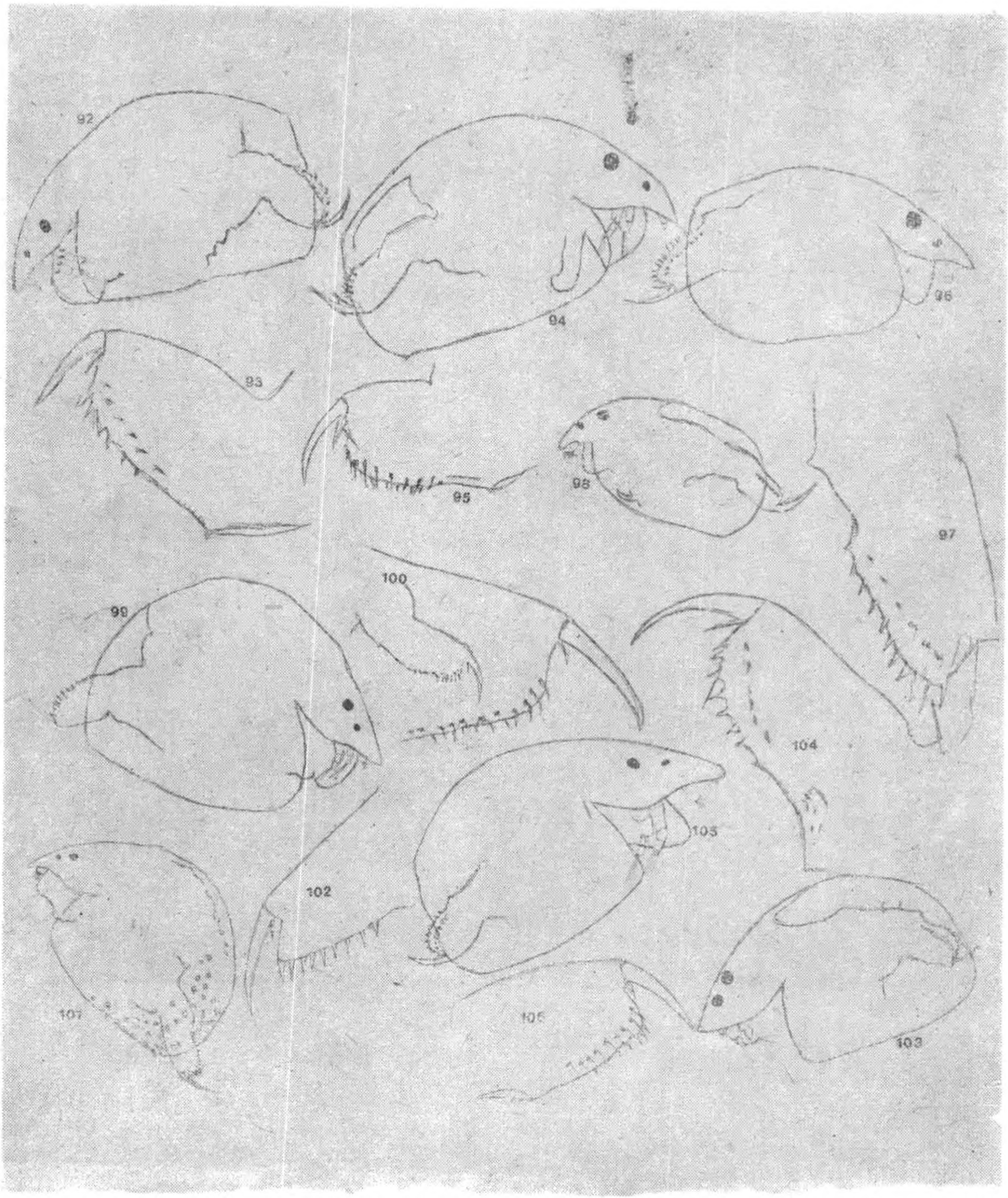
ORDER CLADOCERA

The confusion that exists in the taxonomy of Cladocera is great at the present time in spite of a large number of revisions of genera and many monographic works on a regional or world basis. The present list is based on the study of over 300 samples of zooplankton and the perusal of the relevant literature. However, I have undertaken this work largely because of the help extended to me by three leading authorities on the Cladocera: Dr D. G. Frey, Indiana University, Bloomington, U.S.A.; Dr. V. Korinek, Charles University, Prague and Dr. N. N. Smirnov, Institute of Animal Ecology, Moscow.

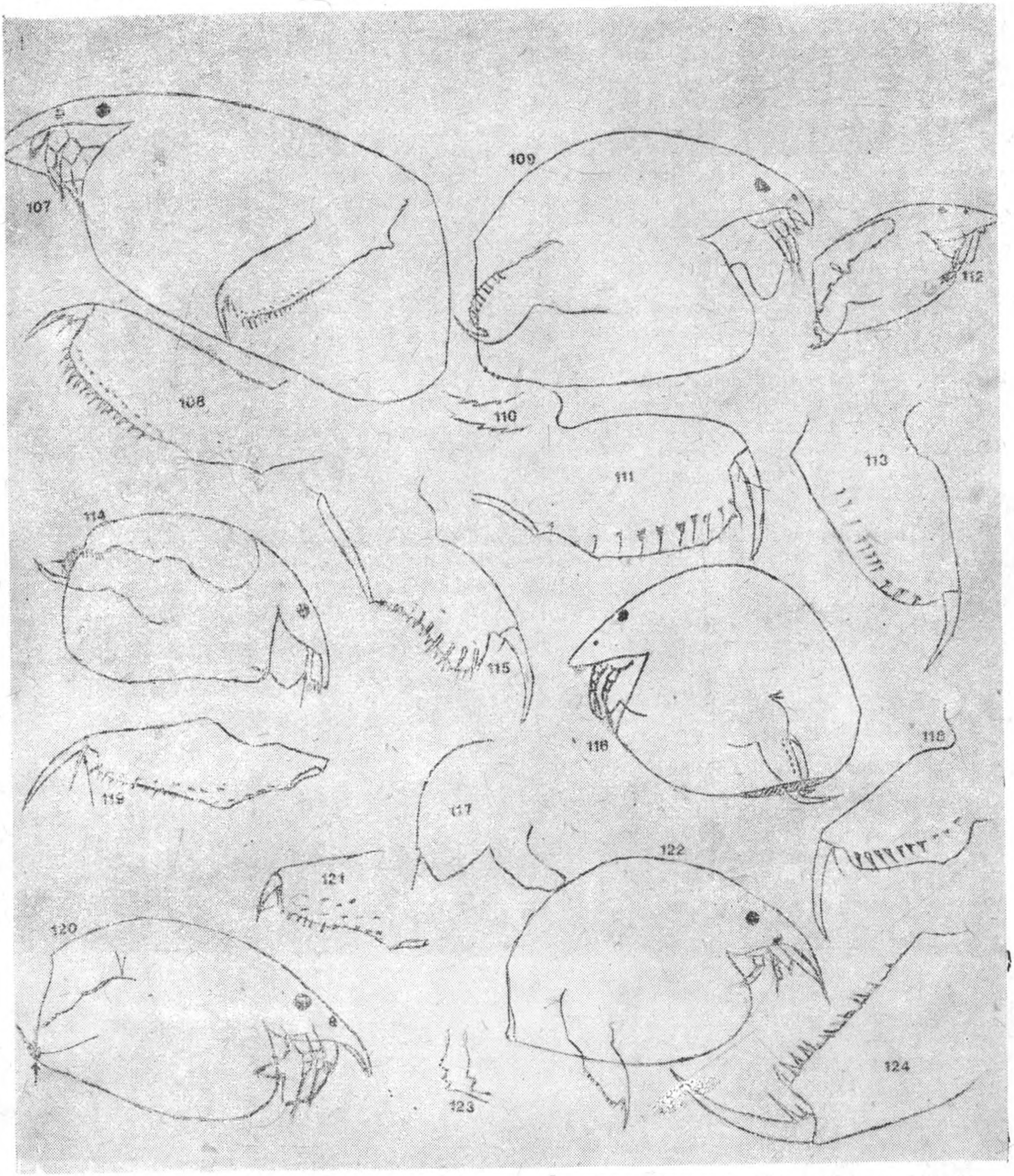
The literature relevant to the study of the Sri Lanka Cladocera can be divided into a number of categories (1) Those where Sri Lanka species have been recorded: Brady (1886), Poppe and Mrazek (1895), Daday (1898a, 1898b), Apstein (1907, 1910), Gurney (1916), Bar (1924) and Fernando and Ellepola (1969). (2) Literature referring to new records of species made in the present paper: Baird (1849), King (1852), Herrick (1882), Richard (1892, 1894, 1895), Vavra (1900), Sars (1901, 1916), Daday (1905), Gauthier (1930), Brehm (1933, 1957), Biraben (1939), and Megard (1967). (3) There are a number of classical papers on the Cladocera which describe presently accepted valid species from different parts of the world. Fortunately, one of these classics is the paper on Sri Lanka Cladocera of Daday (1898). The others of relevence to Sri Lanka species are: Müller (1785), King (1852a, 1852b) Fischer (1854), Leydig (1860), Kurz (1874), Sars (1885, 1888, 1896, 1901, 1916), Richard (1892a, 189b, 1894), (4) Mongraphs on the Cladocera incorporating currently accepted taxonomy are: Behning (1941), Scourfield



CLADOCERA-MACROTHRICIDAE. Fig. 74–76. *Macrothrix triserialis*, 74 female, 75 mid-ventral margin of shell, 76 postabdomen. 77–79. *Macrothrix spinosa*, 79 female 78 antennule, 79 mid-ventral margin of shell. 80–82 *Gurneyella odiosa* 80 female, 81 postabdomen, 82 mid-ventral margin of shell. 83–86 *Ecninisca capensis*, 83 female, 84 antennule. 85 mid-ventral margin of shell, 86 postabdomen. 87 *Gurnella raphaelis*. 88–89 *Grimaldina brazzai*, 88 female, 89 postabdomen. 90–91 *Ilyocryptus spinifer*, 90 female, 91 postabdomen.



CLADOCERA-CHYDORIDAE. Fig. 92–93 *Alona* cf. *harpularia*, 92 female, 93 postabdomen 94–95 *Alona monocantha*, 94 female, 95 postabdomen. 96–98 *Alona pulchella*, 96 female, 97 postabdomen, 98 male. 99–100 *Alona punctata*, 99 female, 100 postabdomen. 101–102. *Alona* sp. Nr. *guttata*, 101 female, 102 postabdomen. 103–104. *Alona setulosa*, 103 female. 104 postabdomen. 105–106 *Biapetura* cf. *intermedia*, 105 female, 106 Postabdomen.



CLADOCERA-CHYDORIDAE Fig. 107–108 *Biapetura affinis*, 107 female, 108 postabdomen. 109–113. *Biapetura karua*, 109 female, 110 spines of postero-ventral edge of shell, III postabdomen, 112 male, 113 postabdomen of male. 114–115. *Biapetura verrucosa*, 114 female, 115 postabdomen, 116–118. *Indialona globulosa*, 116 female, 117 labrum, 118 postabdomen. 119 postabdomen of *Indialona macraonyx*. 120–121 *Alonella excisa*, 120 female, 121 postabdomen. 122–124. *Pleuroxus* cf. *similis*, 122 female, 123 spines of postero-ventral end of shell, 124 postabdomen.

Kurz (1874), Sars (1885, 1888, 1896, 1901, 1916), Richard (1892a, 1892b, 1894). (4) Mongraphs on the Cladocera incorporating currently accepted taxonomy are: Behning (1941), Scourfield and Harding (1958), Brooks (1959), Sramek-Husek et al. (1962), Manuilova (1964), Smirnov (1971) and Flossner (1972). The papers of Frey, (1959, 1962 and 1967) on the head pores of the Chydoridae must be consulted for any detailed study of this group. Recent revisions of genera or families which must be consulted for accepted names and synonomy of Sri Lanka species are: Rzoska (1956), Thomas (1961, 1962), Harding and Petkovski (1963), Goulden (1968), and Deevey and Deevey (1971). (5) There is a considerable but scattered literature on the Cladocera of S.E. Asia most of which are relevant to the study of Sri Lanka species. I have listed only those I have consulted and found useful. They are as follows: Poppe and Richard (1890), Sars (1903), Stingelin (1904), Gurney (1906, 1907), and Brehm (1909, 1950, 1953).

The Cladocera are arranged in their respective families. A few comments are made on the species in each family with special reference to the Sri Lanka species. Illustrations are provided for all the species recorded so far. The auther has been material from Sri Lanka of all the recorded species except for *Leptodora kindtii*, *Moina macrocopa*, *Bosmina longirostris*, *Eubosmina coregoni*, *Chydorus ceylonicus*, *Indialona macronyx* and *Graptoleberis testudinaria*. Through the generosity of Professor D. G. Frey his drawing of *Indialona macronyx* (Daday) made from Daday's material is copied. Daday's (1898) figures of *Chydorus ceylonicus* and Goulden's (1968) figures for *Moina macrocopa* are alos copied. For the other species not seen from Sri Lanka material have been used.

Thirteen new records of Cladocera have been added to the Sri Lanka list. Besides this the synonomy of the recorded species has been sorted out as far as possible. The 50 indigenous species will probably be increased considerably with more detailed studies on the Cladoceran fauna of Sri Lanka.

The author has not used trinominals. They have been used xetensively by Smirnov (1971).

THE LIST OF SRI LANKA SPECIES IS AS FOLLOWS:—

Leptodoridue.

Leptodora kindtii Focke (Introduced)

Sididae

Diaphanosoma excisum Sars
Diaphanosoma sarsi Richard
Pseudosida bidentata Herrick (*szalayi* type)
Latonopsis australis Sars

Daphnidae

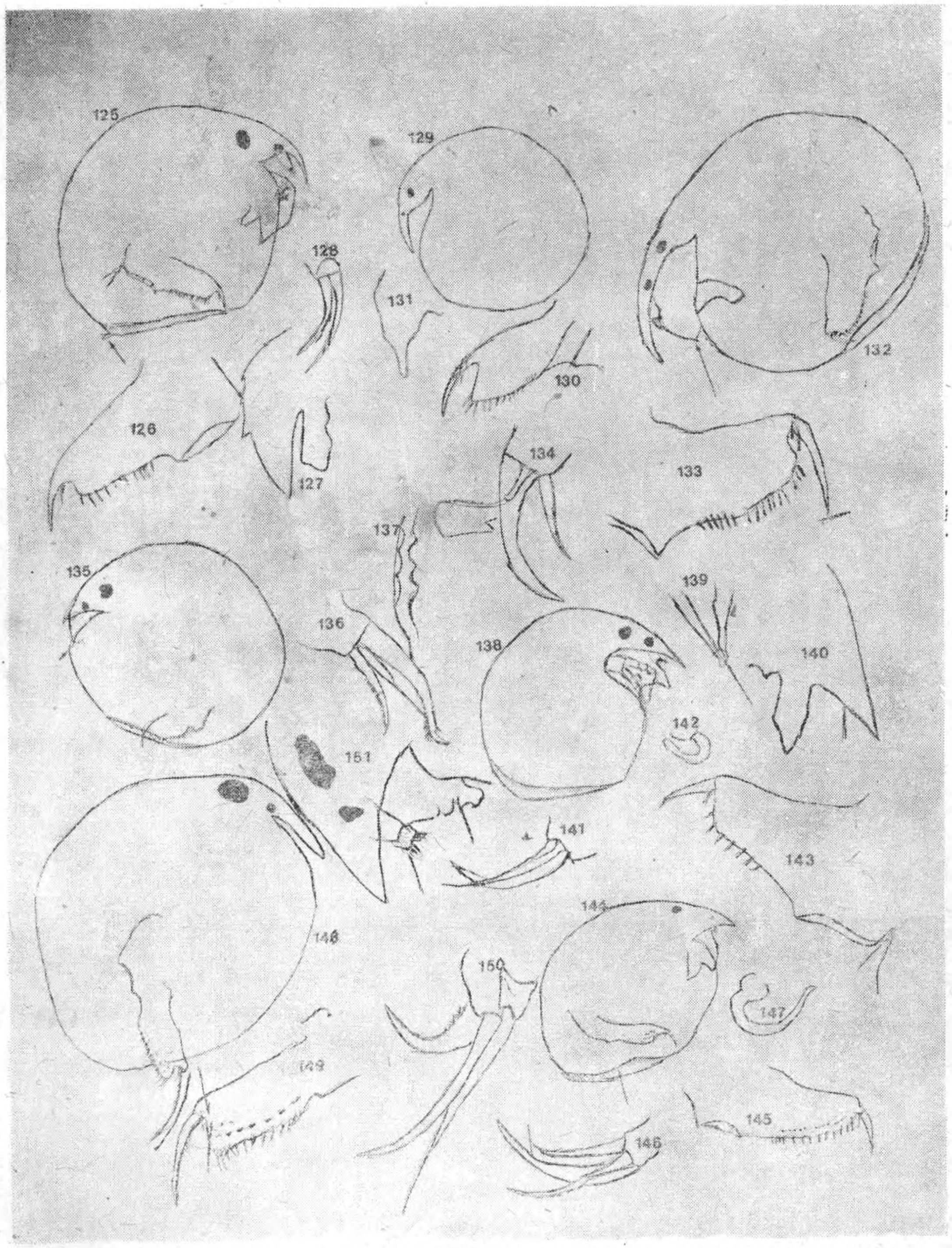
Ceriodaphnia cornuta Sars
Ceriodaphnia quadrangula (O.F. Müller) = probably *C. dubia*
Daphnia carinata King
Daphnia lumholtzi Sars
Scapholeberis kingi Sars
Simocepholus vetulus (O. F. Muller)

Moninidae

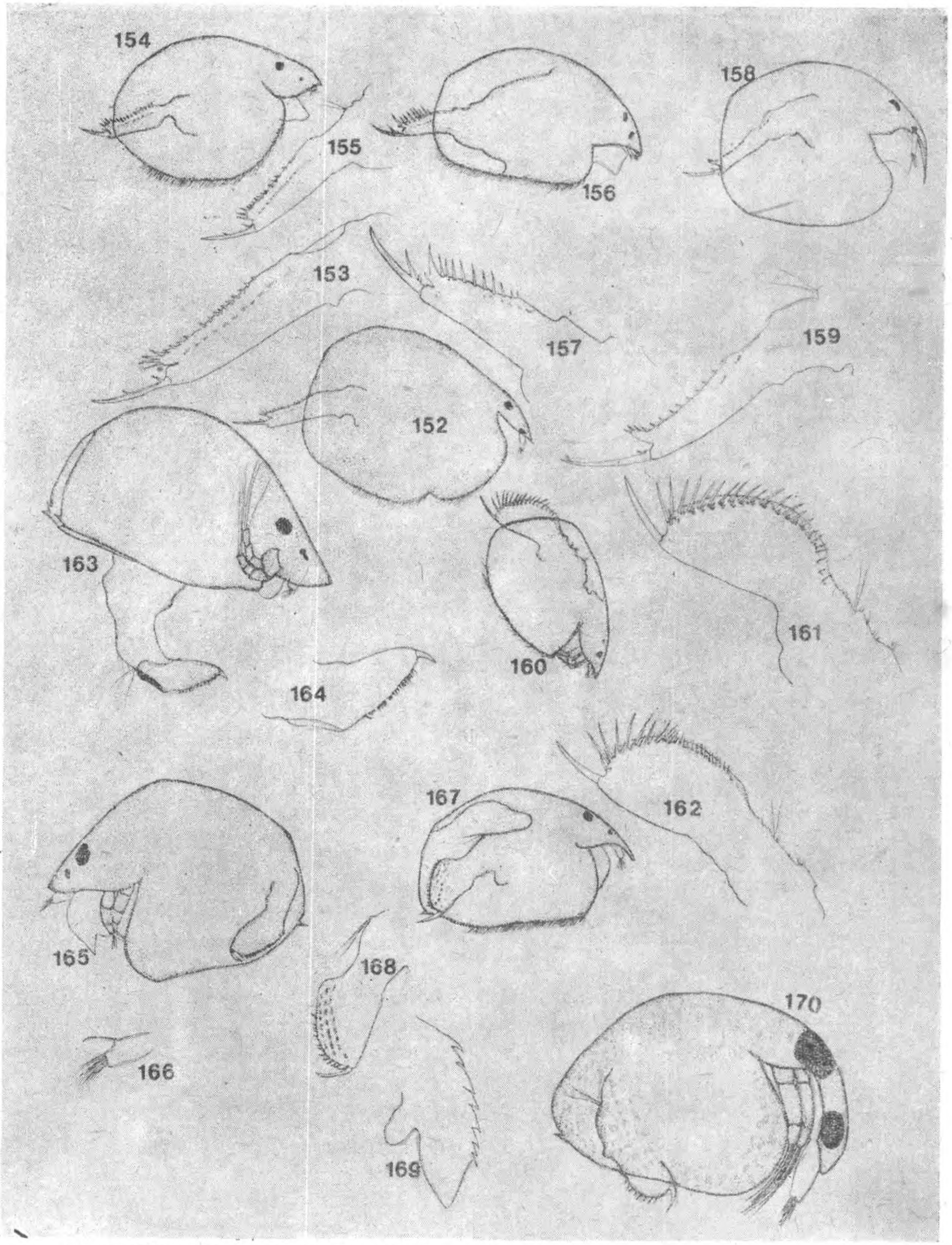
Moina macrocipa (*Straus*)
Moina micrura Kurz
Moinodaphnia mcleayi King

Bosminidae

Bosminopsis dietersi Richard
Bosmina longirostris (O. F. Müller) (Introduced)
Eubosmina coregoni (Baird) (Introduced)
Bosmina sp. (*Sinobosmina*)



CALDOCERA-CHYDORIDAE. Fig. 125–128. *Chydorus barroisi*, 125 female, 126 postabdomen, 127 labrum, 128 leg. i. 129–131. *Chydorus ceylonicus*, 129 female, 130 postabdomen, 131 labrum. 132–134 *Chydorus eurynotus*, 132 female, 133 postabdomen, 134 leg 1. 135–137. *Chydorus, parvus*, 135 female, 136 leg 1, 137 anteroventral edge of shell. 138–143 *Chydorus*, 138 female, 139 tip of rostrum, innerview showing notch, 140 labrum, 141 leg 1, 142 male claw, 143 female postabdomen. 144–147. *Chydorus ventricosus*, 144 female, 145 postabdomen, 146 leg 1, 147 claw of male. 148–151 *Pseudochydorus globosus*, 148 female, 149 postabdomen 150 leg 1, 151 ant. portion of body.



CLADOCERA-CHYDORIDAE. Fig. 152–153 *Euryalona orientalis* (juvenile), 153 postbdomen. 154–155 *Euryalona orientalis*, 154 female, 155 postabdomen. 156–157. *Oxyurella sinhalensis*, 156 female, 157 postabdomen. 158–159 *Kurzia longirostris*, 158 female, 159 postabdomen. 160–161 *Leydigia australis*. 160 female, 161 postabdomen. 162 postabdomen of *Laydigia acanthocercoides*. 163–164 *Graptoleberis testudinaria* from Waterloo, Ontaraio, CANADA, 163 female, 164 postabdomen. 165–166. *Dunhevedia crassa*, 165 female, 166 postabdomen. 167–169 *Dunhevedia serrata*, 167 female, 168 postabdomen, 169 lebrum. 170. *Dadaya macrops* female.

Macrothricidae

**Echinisca capensis* Sars
**Grimaldina brazzai* Richard
Gurnella raphaelis Richard
Gurneyella odiosa (Gurney)
Ilyocryptus spinifer Herrick
Macrothrix spinosa King
Macrothrix triserialis Brady

Chydoridae

**Alona* cf. *harpularia* Sars
**Alona monocantha* Sars
**Alona pulchella* King
Alona punctata (Daday)
**Alona setulosa* Megard
**Alona* sp. (Nr. *A. guttata* Sars)
Alonella excisa (Fischer)
**Biaperura affinis* (Leydig)
Biapetura cf. *intermedia* (Stingelin)
Biapetura karua (King)
Biapetura verrucosa (Sars)
Indialona globulosa (Daday)
Indialona macronyx (Daday)
Pleuroxus. cf. *similis* Vavra
Chydorus barriosi Richard
Chydorus ceylonicus Daday
Chydorus eurynotus Sars
Chydorus parvus
Chydorus sphaericus (O. F. Müller)
Chydorus ventricosus Daday
**Pseudochydorus globosus* (Baird)
Euryalona orientalis (Daday)
Kurzia longirostris (Daday)
Oxyurella sinhalensis Daday
Graptoleberis testudinaria (Fischer)
Leydigia australis Sars
Leydigia acanthocercoides (Fischer)
Dunhevedria crassa (King)
Dunhevedia serrata Daday
Dadaya macrops (Daday)

Locality records of species recorded for the first time in Sri Lanka.

Latonopsis australis	Mandativa, pond 17. 12. 71.
Bosminopsis dietersi	Castlereagh Res. 16. 7. 69.
Bosmina sp.	Giants tank
Grimaldina brazzai	Marawila, ditch 7. 12. 70.
Echinisca capensis	Karainagar, rice field 15. 12. 71.
Alona monocantha	Nugegoda, rice field 22. 12. 70.
Alona cf. *harpularia*	Pond near Nikeweratiya 16. 12. 70.
Alona pulchella	Pond near Nikeweratiya 16. 12. 70.
Alona setulosa	Mankumban, Jaffna, pond 17, 12. 71.
Alona sp. (Nr. *A. guttata*)	Waga, pond 31. 12. 69.
Biapetura affinis	Pond near Horana 23. 12. 72.
Pseudochydorus globosus	Unichchi tank 28. 12. 70.
Pleuroxus cf. *similis*	Habarana tank 4. 1. 65.
Rare species not listed above.	
Indialona macronyx	Well near Kalawewa
Graptoleberis testudinaria	Elephant pond, Mihintale

The illustrations (Figs: 27-171) have been prepared to make the diagnosis of Sri Lanka species as easy as possible. Some of the not too obvious features have been shown by arrows. For the accurate diagnosis of Cladocera careful preparation is necessary. For temporary mounts I have found CMC—S (Turtox) and Polyvinyl Lactophenol coloured with lignin Pink (Gurr. London) very satisfactory. For permanent preparations the method given by Brandlova, Brandl and Fernando (1972) is satisfactory if the technique is mastered. Ringing the coverslip with a sealing compound (e.g. Lactoseal ; Gurr. London) will prolong the life of the specimen in a satisfactory condition. Head shields should be mounted in the same way as whole specimens. Exuviae is very useful when mounted for the study of limb structure.

The Leptodoridae are represented by only one species which is characteristic. Among the Sididae the genera can be separated easily on the basis of the structure of the antennules in the female. Species diagnosis in *Diaphanosoma* can be made on the shape of the ridge on the ventral portion of the shell. The only daphnid which may cause difficulty in diagnosing is *Ceriodaphnia quadrangula* which can be recognised by the lack of a pointed prominence of the

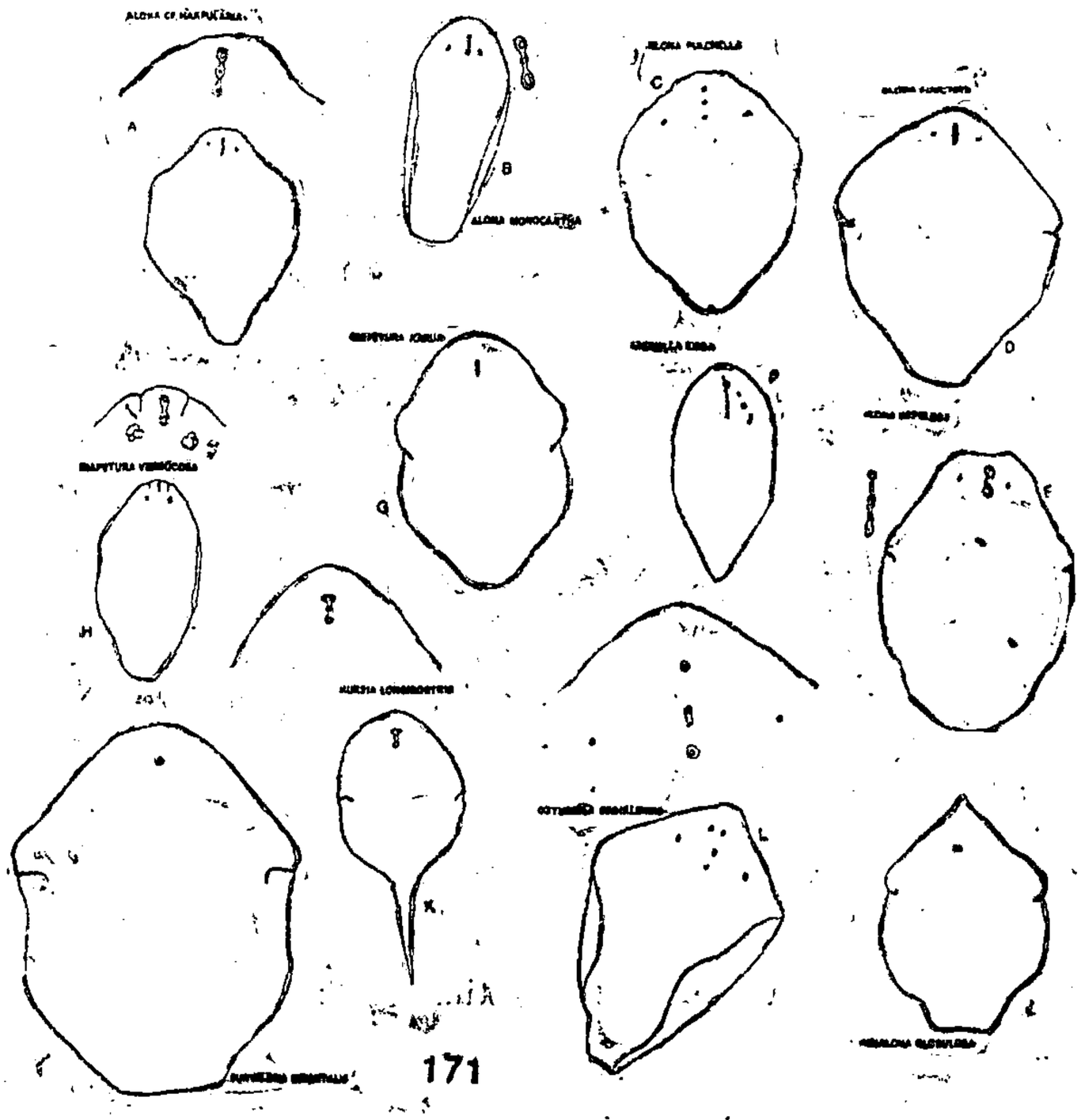


Fig. 171 Head shields and head pores of Chydoridae. All from Sri Lanka material except *Indialona globulosa* from Smirnov (1970)and the entire head shield of *Chydorus* (contd. page 53.)

head. *Moinodaphnia mcleayi* has an ocellus not present in *Moina* spp. *Moina macrocopa* has spines dorsally. The males of *Moina miorura* and *Mounodaphnia mcleayn* are characteristic and shown in Figs. 51 and 55. The diagnostic features of the Bosminidae are not easy to point out. The illustrations of the species recorded with the addition of *Eubosmina longispina* should prove adequate for diagnosis. The Macrothricidae can be diagnosed fairly easily. However, the status of *Macrothrix triserialis* and *M. spinosa* is not very clear. There are probably more than two species of *Macrothix* in Sri Lanka.

It is in the Chydoridae that a great deal of difficulty will be encountered in species diagnosis. The genus *Alona* is probably represented in Ceylon by more than the six species recorded. At the present time the best that can be done in some cases is to approximate specimens to a valid species. *Chydorus* also often confronts the investigator with considerable difficulties. I have illustrated the first leg of the female in all *Chydorus* species reported from Sri Lanka except *C. ceylonensis* of which I have no specimens. The rest of the Chydoridae are relatively easy to diagnose to species. However, the *Pleuroxus* found in Sri Lanka is not *P. laevis* (=*hastatus*) as given by Daday (1898) and Smirnov (1971). It is a species close to *Pleuroxus similis* Vavra. It is also very rare in Sri Lanka.

Based on the examination of over 300 samples of zooplankton collected from all types of freshwater habitats in Sri Lanka and at different times of the year during the period 1962—1972. I have found the following species very rare. The rare indigenous species are: *Daphnia carinata. Ceriodaphnia quedrangula, Moino macrocopa, Sinobosmina* sp., *Echinisca capensis, Grimaldina brazzai, Gurnella raphaelis, Chydorus ceylonicus. Pseudochydorus globosus, Alona setulosa, Biapetura affinis, Indialona macronyx, Pleuroxus* cf. *similis* and *Graptoleberis testudinaria.* The three introduced species have not been recorded during the last 50 years and have probably been eliminated.

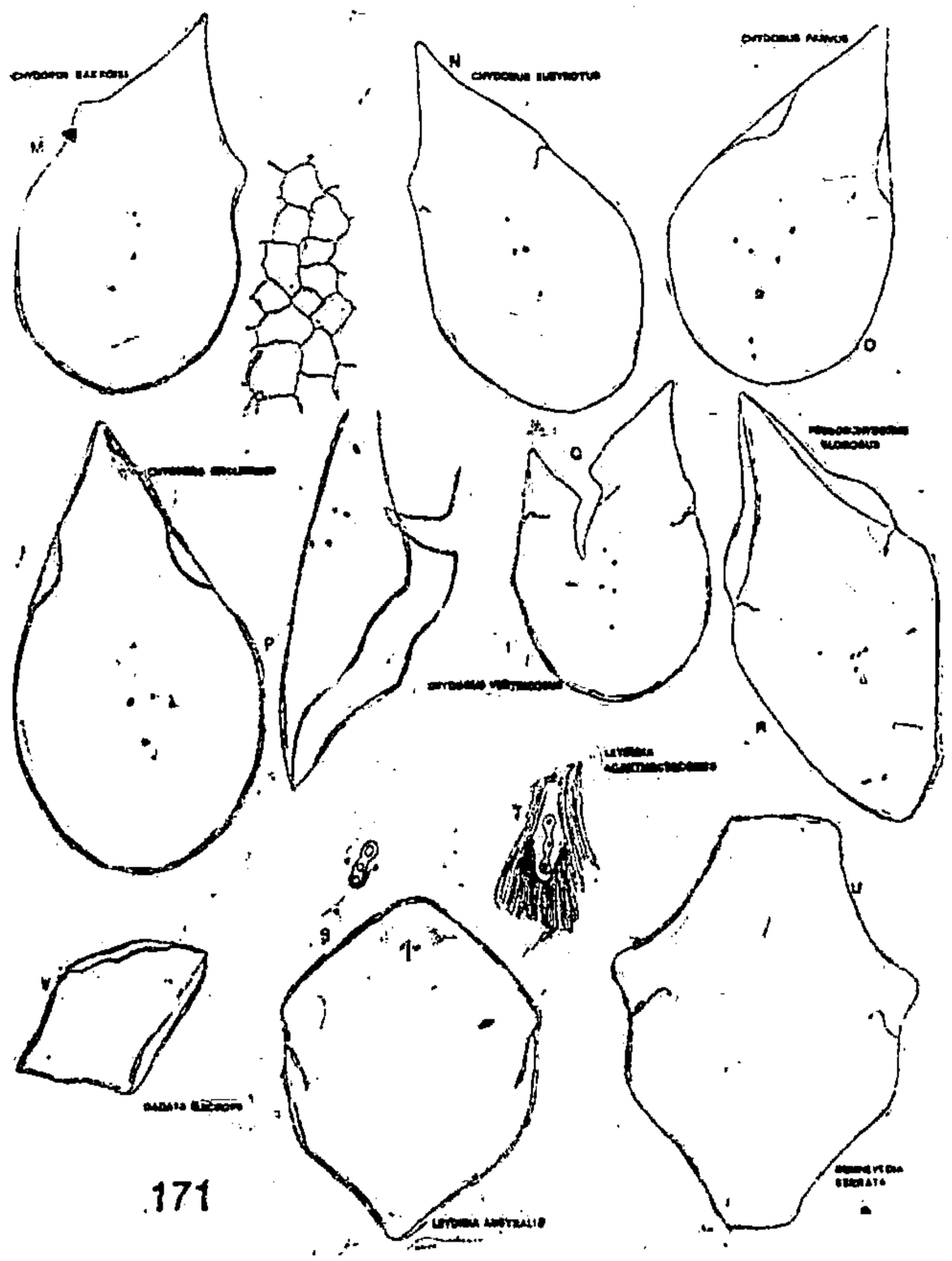


Fig. 171 (contd. from page 52) *Sphaericus* for which an Ontario specimen was used.

I have illustrated some of the head shields of Chydoridae. The study of Cladoceran remains so commonly found in samples enables indentification of species which have been in the habitat besides those active stages when the samples was collected.

Males of Cladocera are rare but they are of considerable value in reaching accurate diagnoses of species. I have illustrated the few males I have found in the samples. A more careful study of all the specimens will certainly give males of most species since the collections were made throughout the year.

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SUB-CLASS: COPEPODA

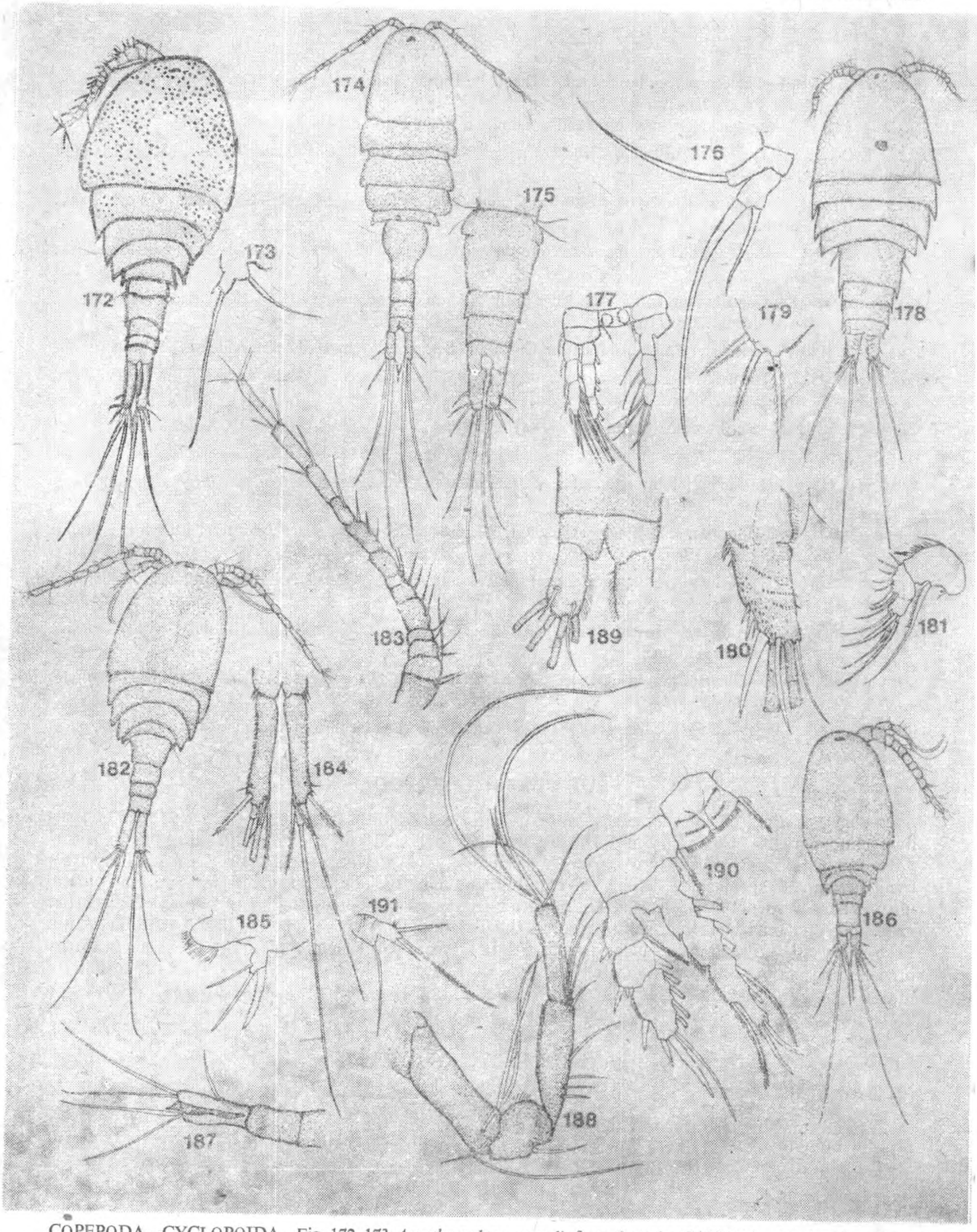
Three orders of this sub-class occur in Sri Lanka freshwater namely the Cyclopoida (free living and parasite, Calanoida and Harpacticoida. Although very common in all types of freshwater habitats, relatively little work has been done on these crustaceans in Sri Lanka. Many free-living cyclopoid species are widely distributed and can be identified using works of a general nature like Rylov (1948). Based on material from over 300 samples of zooplankton earlier examined and on the few previous records the list of Sri Lanka species has been built up. Practically all the records of species from Sri Lanka are not recent and many are inaccurate by present standards. I have attempted to sort out the valid species based on examination of material and the sorting out of past records in the light of recent literature.

ORDER CYCLOPOIDA

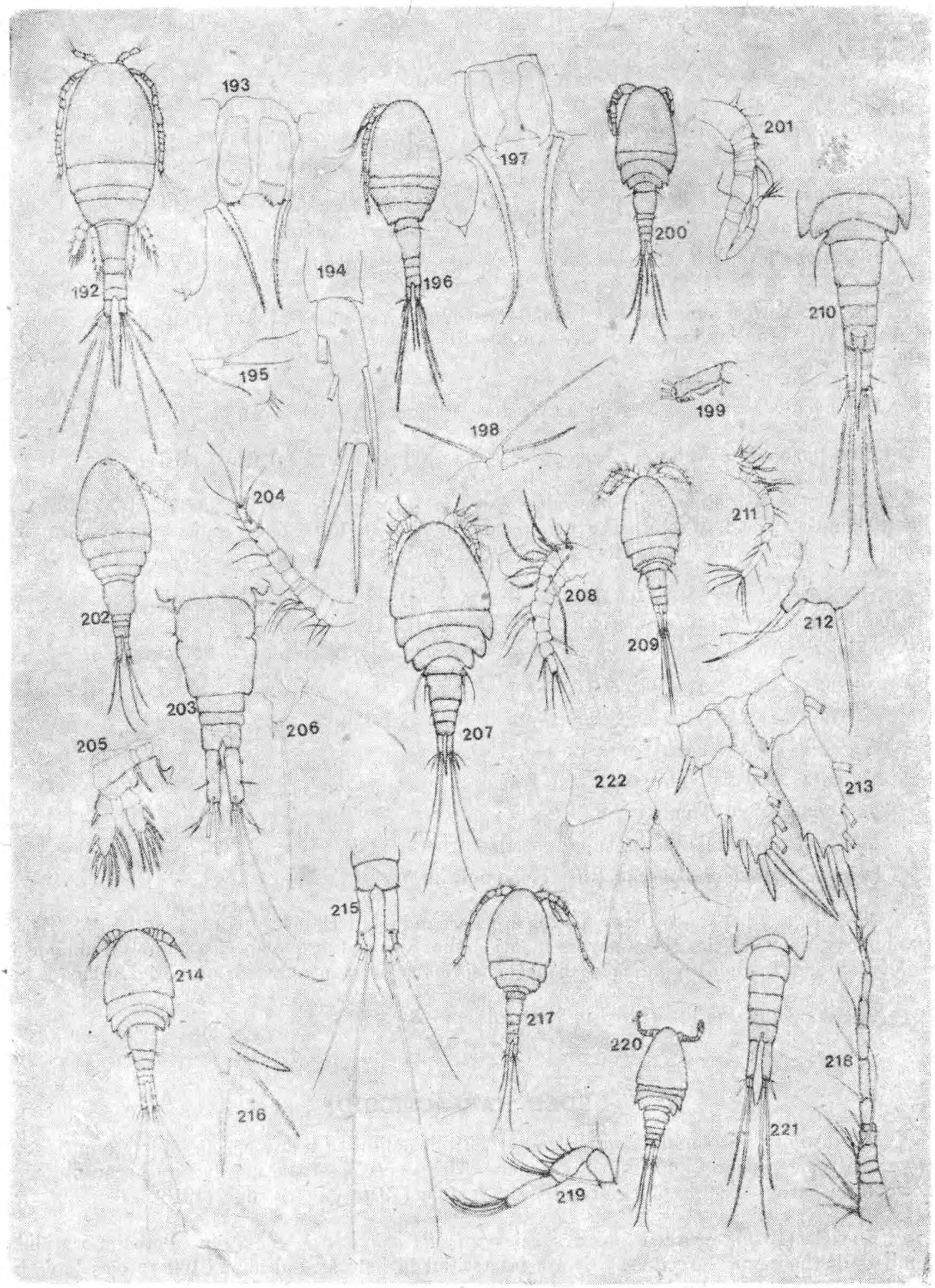
(a) Free Living Forms

The relevant literature to the Sri Lanka species are the papers of Brady (1867), Poppe and Mrazek (1895), Daday (1898), Apstein (1907, 1910), Gurney (1916), Lindberg (1939) and the monographs of Gurney (1931-33), Rylov (1948) and Dussart (1969).

The author has identified ten species in material examined. This includes two new records for Sri Lanka namely *Metacyclops minutus* (Claus) and *Microcyclops moghulensis* Lindberg. I have however not found two species recorded by previous works namely *Acanthocyclops vernalis* (Fischer) and *Diacyclops languidus* (Sars). The commonest species in *Mesocyclops leuckarti* (Claus) while *Macrocyclops distinctus* (Richard) is very rare. All the species recorded from Sri Lanka are illustrated in Figs. 172-222.



COPEPODA—CYCLOPOIDA. Fig. 172–173 *Acanthocyclops vernalis* from Ontario, CANADA, 172 female, 173 leg 5 of female. 174. *Diacyclops nanus*, female diagramatic. 175–177. *Diacyclops* cf. *languidus*. 175 female, posterior portion, 176 leg 5 of female, 177 leg 4 showing membrane. 178–181 *Ectocyclops phaleratus*, 178 female, 179 leg 5 of female, 180 furca of female, 181 antenna of female. 182–185 *Eucyclops serrulatus*, 182 female, 183 female, antennule, 184 furca for female, 185 leg 5 of female. 186–191. *Macrocyclops distinctus*, 186. female, 187 antennule of female, terminal portion, 188 antenna of female, 189 female furca, 190 leg 4 of female showing membrane, 191 leg 5 of female.



COPEPODA—CYCLOPOIDA Fig. 192–195 *Thermocyclops crassus*, 192 female, 193 leg 4 showing membrane in female, 194 female, endopodite of leg 4, 195 legs 5 and 6 of male. 196–201 *Mesocyclops leuckarti*, 196 female, 197 female leg 4 showing membrane, 198 female leg 5, 199 terminal segment of female antennule, 200 male, 201 male antenna. 202–206 *Metacyclops minutus*, 202 female, 203 posterior portion of female, 204 female antennule, 205 female leg 4 showing membrane, 206 leg 5 of female. 207–208. *Microcyclops moghulensis*, 207 female, 208 antennule of female. 209–213 *Microcyclops varicans*, 209 female, 210 posterior portion of female, 211 antennule of female, 212 leg 5 of female, 213 leg 4 of female showing two jointed ends and exopites. 214–216 *Paracyclops fimbriatus*, 216 female, 217 posterior portion of female, 216 leg 5 of female. 217–222 *Tropocyclops prasinus*, 217 female, 218 female antennule, 219 female antenna, 220 male, 221 posterior portion of male, 222 Female leg 5.

The Sri Lanka species are as follows:-

Acanthocyclops vernalis (Fischer)
Diacyclops cf. *languidus* (Sars)
Ectocyclops phaleratus (Koch)
Eucyclops serrulatus (Fischer)
Macrocyclops distinctus (Richard)
Mesocyclops leuckarti (Claus)
Metacyclops minutus (Claus)
Microcyclops moghulensis (Lindberg)
Microcyclops varicans (Sars)
Paracyclops fimbriatus (Fischer)
Thermacyclops crassus (Fischer)
Tropocyclops prasinus (Fischer)

The two new records for Sri Lanka were found in samples taken from a rice field in Nugegoda, Western Province. Included are locality records for the rare species *Macrocyclops distinctus*.

Metacyclops minutus. Nugegoda, Western Province, rice field 24. 2. 71.

Microcyclops moghulensis. Nugegoda, Western Province. rice field 19.3.71.

Macrocyclops distinctus. Nugegoda, Western Province, rice field 25. 7. 71. Gurugoda, Millewa-Padukka Road, Western Province pond, 23. 12. 72. Ratnapura, Sabaragamuwa Province, roadside ditch 22. 8. 72. Marawila, North Western Province, small pond 29. 12. 72.

All three species were recorded from a single habitat namely a rice field in Nugegoda. This habitat has been sampled regularly at fortnightly intervals during 1971 and 1972. It is likely that these three species are widely distributed in Ceylon although not common.

(b) Parasitic forms

Five species have so far been recorded from Sri Lanka namely:

Ergasilus ceylonensis. Fernando and Hanek.
Ergasilus mendisi. Fernando and Hanek.
Paraergasilus bevidigitus Yin.
Lamproglena chinensis sprostoni. Kirthisinghe.
Lernaea cyprinacea chackoensis. Gnanamuthu.

The relevant papers to these species are Fernando and Hanek (1973 *a* and 1973 *b*). Besides describing two new species these papers mention that two of the five species namely *Paraergasilus brevidigitus* and *Learnaea cyprinacea chackoensis* have been introduced into Sri Lanka.

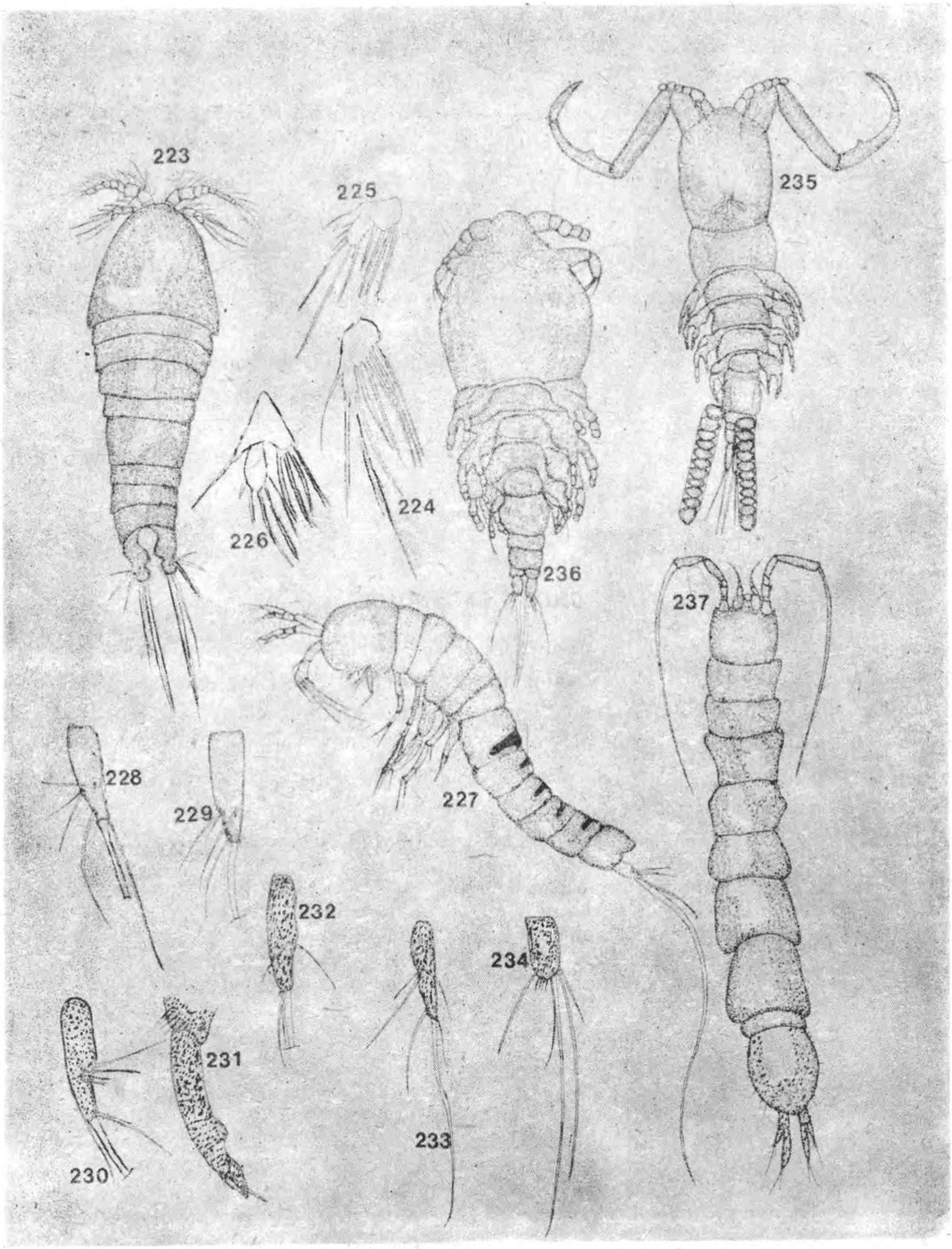
Two ergasilids are illustrated in Figs. 235 and 236.

ORDER HARPACTICOIDA

Because of their small size and the interstital habitat of many species this group has until very recently been poorly known in Sri Lanka. Three species of the family Canthocamptidae are known from earlier records of Brady (1867), Apstein (1910) and Gurney (1916).

Enckell (1970) recorded seven species of *Parastenocaris* (Family Parastanocarididae). Members of the genus *Parastenocaris* are interstitial in habitat and about 100 species have been described so far. Only two species of *Parastenocaris* occur in North America.

The Sri Lanka fauna is therefore quite rich in this group. In a sample from Amparai tank, was found a littoral species which is close to *Parastenocaris brevipes* Kessel. This species is not strictly subterrainean *P. brevipes* is widely distributed and has been recorded from Europe, Asia and North America. Five species have been recorded in Northern Europe Enckell (1969).



COPEPODA-HARPACTICOIDA, PARASITIC CYCLOPOIDA. Fig. 223 *Canthocamptus* sp. female. 224 leg 5 female *Atthyella* sp. 225 leg 5 female *Elaphiodella grandidieri*. 226 leg 5 female *Elaphiodella bidens decorata*. 227 *Parastenocaris* cf. *brevipes*, male. 228–234. *Parastenocaris* spp. males, 228 furca of *P. irenae*, 229 furca of *p. noodti*, 230 furca of *P. sinhalensis*, 231 leg 3 of male *P. sinhalensis*, 232 furca of *P. brincki*, 233 furca of *P. lanceolatus*, 234 furca of *P. curvispinus*. 235 *Ergasilus ceylonensis* female. 236 *Paraergasilus brevidigitus* female. 237 *Protojanira lucei*, dorsal view. 228–237 after Enckell 1970.

The list of Sri Lanka species presently recorded is as follows:—

They are illustrated in Figs. 223-234.
Attheyella cigalensis (Brady)
Elaphiodella bidens decorata (Daday)
Elaphiodella grandidieri (Guerne and Richard)
Parastenocaris cf. brevipes Kessel
Parastenocaris brincki Enckell
Parastenocaris curvispinus Enckell
Parastenocaris irenae Enckell
Parastenocaris lanceolatus Enckell
Parastenocaris noodti Enckell
Parastenocaris singalensis Enckell
Parastenocaris sp.

Identification of Harpacticoida of Sri Lanka can be done using the monographs of Lang (1948) and Borutski (1952) and the papers of Chappuis (1929, 1931, 1934) and Enckell (1970). Professor Per Brinck, Lund University, Sweden informs me that the Swedish Expedition to Sri Lanka in 1962 collected many Canthocumrttdae which are being studied. It is likely that there will be many new species among this material, hence a considerable lengthening of the species list can be predicted.

ORDER CALANOIDA

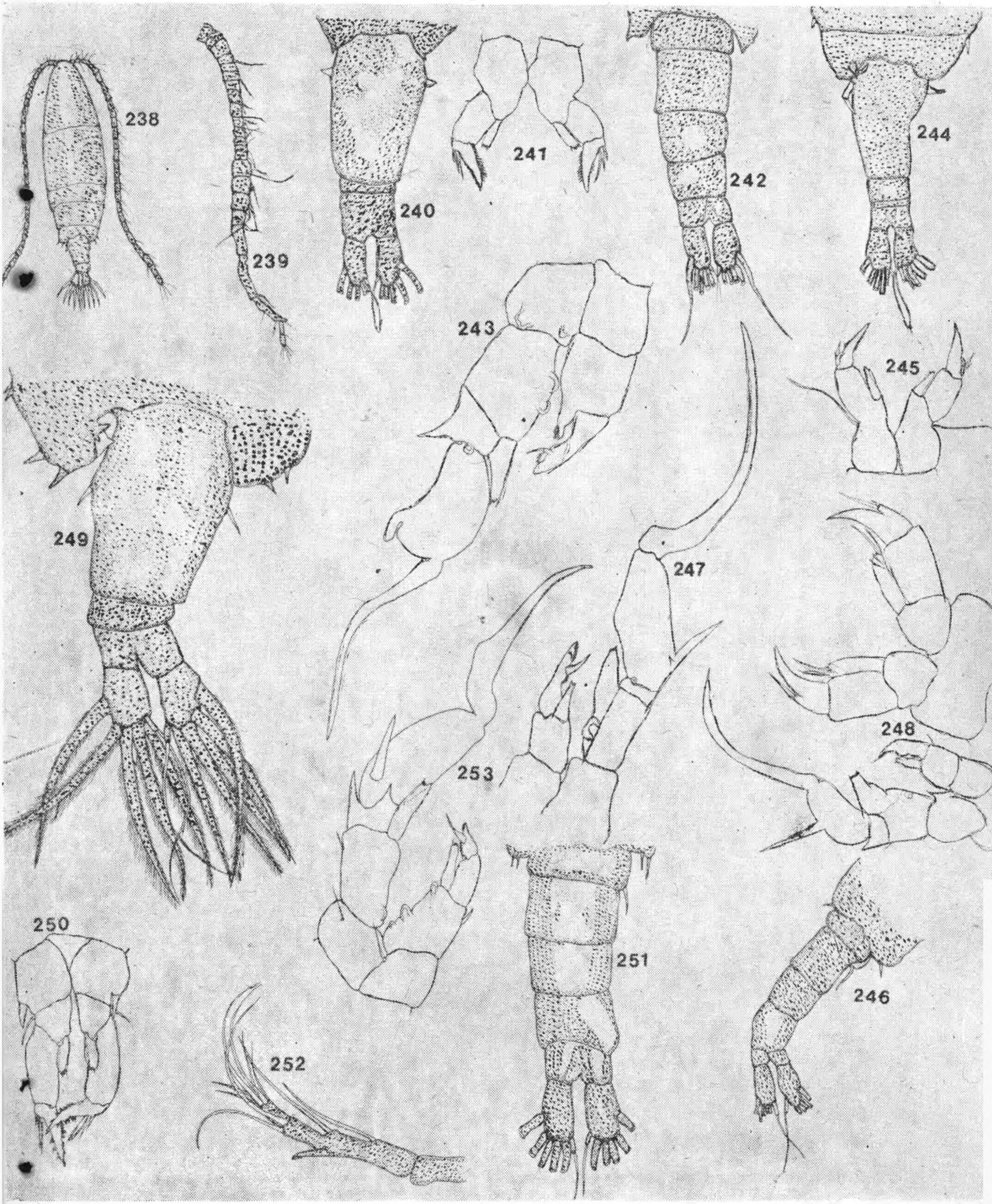
Relatively little material has been examined by previous workers although calanoid copepods are among the commonest freshwater microcrustaceans. The descriptions of many of the Sri Lanka species (Brady 1886), (Daday 1898) are inadequate to establish valid species. The Sri Lanka species are in need of a through study to establish their specific status. It is attempted to sort out the synonomy of Sri Lanka species and list the valid species. This is based on the examination of over 300 " plankton " samples from a wide range of habitats and covering most of the country. It is hoped that a more detailed study of the material will be published later.

The Sri Lanka species are illustrated in Figs. 238-273. The diagnostic features of both male and female for each species is shown.
The Sri Lanka species which I consider valid are the following:—

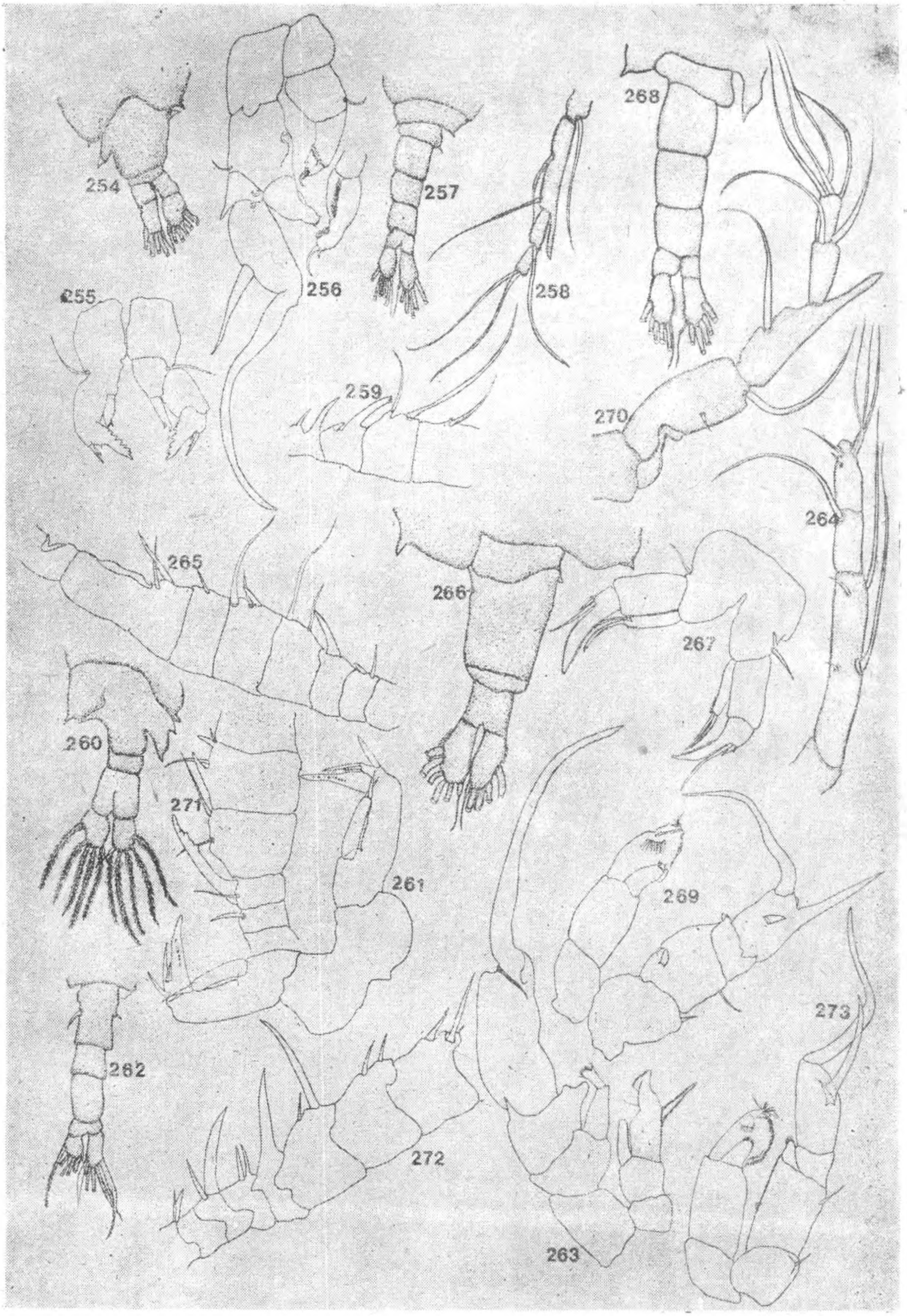
Eudiaptomus cinctus (Gurney)
Eudiaptomus drieschi (Poppe and Mrazek)
Heliodiaptomus viduus (Gurney)
Neodiaptomus schmackeri (Poppe and Richard)
Paradiaptomus greeni (Gurney)
Phyllodiaptomus annae (Apstein)
Tropodiaptomus nielseni (Brehm)
Tropodiaptomus cf. *doriae* (Richard)

Doubtful record:
Eudiaptomus lumholtzi (Sars)
Indeterminate species.
Eudiaptomus sinhalensis (Daday)
= probably *Eudiaptomus drieschi*
Tropodiaptomus orientalis (Brady)

There are at least two species of *Tropodiaptomus* in Sri Lanka. Brady's description could fit either of the two species recorded and also any other closely related species which may occur in Sri Lanka.



COPEPODA-CALANOIDA Fig. 238 *Heliodiaptomus viduus* female. 239–243 *Phyllodiptomus annae*, 239 prehensile antennule of male, 240 posterior portion of female, 241 leg 5 of female, 242 posterior portion of male, 243 leg 5 of male. 244–247. *Eudiaptomus cinctus*, 244 posterior portion of female, 245 leg 5 of female, 246 posterior position of male, 247 leg 5 of male. 248 *Eudiatomus drieschi* leg 5 of male and female. 249–283. *Heliodiaptomus viduus*, 249 female, posterior portion, 250 leg 5 of female, 251 posterior portion of male, 252 terminal portion of prehensile antennule of male, 253 leg 5 of male.



COPEPODA-CALANOIDA Fig. 254–259 *Neodiaptomus schmackeri*, 254 Posterior portion of female, 255 leg 5 of female 256 leg 5 of male, 257 posterior portion of male, 258 terminal portion of male prehensiler antennule, 259 mid portion of same. 260–265 *Paradiaptomus greeni* from Madurai, India, 260 posteriol portion of female, 261 leg 5 of female, 262 posterior position of male, 263 leg 5 of male, 264 terminal portion of prehensile ante
mid portion of same. 266–271. *Tropodiaptomus nielseni*. 266 posterior portion of female, 267 leg 5 of female, 268 posterior portion of male, 269 leg 5 of male, 270 terminal portion of prehensile antennule of male, 271 mid portion of same. 272–273 *Tropodiaptomus* cf. *dorine*, 272 prehensile antennule, 273 leg 5 of male.

Synonymus:

Neodiaptomus strigilipes (Gurney) = *Neodiaptomus schmackeri*

The Sri Lanka species list and the above comments on specific status of some species is based on the following papers and the examination of a large amount of material. The relevent papers are: Brady (1886), Poppe and Richard (1892), Poppe and Mrazek (1895), Daday (1889), Apstein (1907), Gurney (1906, 1916), Tollinger (1911), Kiefer (1930, 1932, 1939), Brehm (1953) and Bayly (1965).

The commonest species in Sri Lanka is *Phyllodiaptomus annae*. *Paradiaptomus greeni* was not found although this species was described from Sri Lanka. This species is illustrated from material kindly sent from Madurai, India by Dr. R. G. Michael.

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ORDER ISOPODA

The only freshwater isopods recorded from Sri Lanka are the parasitic species *Alitropus types* (Milne Edwards) [see Fernando and Hanek 1973] and the stream dwelling species from the rheocene, *Protojanira lucei* Enckell (Fig. 273) described by Enckell (1969). The absence of isopods in tropical streams is probably due to elimination by other crustaceans like *Caridina* spp. though it is possible that their (isopod) niche has not been invaded due to zoogeographic reasons.

Protojanira lucei is shown in Fig.

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ORDER MYSIDACEA

Although no strictly freshwater mysids are found in the tropics a number of species are found in estuarine waters. Included is a list of Sri Lanka species and some papers dealing with mysids because of the possibility that some estuarine mysid can be acclimatized to freshwater and thus be available for introduction into inland lakes.

Mysis relicata Loven found in cold water lakes in Northern Europe and Canada has been introduced into new habitats both in Europe and North America. Many mysids are found occasionally in freshwaters and regularly in brackish waters. Luther and Rzoska (1971) mention a mysid (presumbly a brackish water species) in a small limestone lake in Lankawi Islands, Malaysia. Krishna Pillai (1967) has given an exhaustive review on shallow water mysidacea of the Indian region, Holmquist (1972) lists 18 Europen species. In Sri Lanka three species are known namely *Heteromysis zeylanica*, *H. proxima* and *Mesopodopsis zeylanica* (Tattersall 1922. Nouvel 1954). These species are referred to as Kuni (Sinhalese). *Mesopodopsis zeylanica* is illustrated in Figs. 21-23.

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SUB-CLASS MALACOSTRACA.

SUB-ORDER PARATHELPHUSOIDEA

The freshwater crabs of Asia have been monographed by Bott (1970 b) and the Sri Lanka species have been monographed by Fernando (1960) and Bott (1970 a). According to Bott (1970 b) the Sri Lanka species belong to two families—the Parathelphusidae represented by three genera *Spiralothelphusa*, *Oziothelphusa* and *Ceylonothelphusa* and the family Sundathelphusidae with a single genus *Perbrinckia*.

The list of Sri Lanka species is as follows:—

Ceylonothelphusa rugosa (Kingsley)
Ceylonothelphusa sorror (Zehntner)
Ceylonotheiphusa inflatissima Bott
Oziothelphusa senex senex (F.)
Oziothelphusa senex minneriyaensis Bott
Spiralothelphusa hydrodroma (Herbst)
Spiralothelphusa wuellerstorfi (Heller)
Perbrinckia enodis (Kingsley)

The following are synonyms:

Parethelphusa ceylonensis Fern. = *Oziothelphusa senex sene*
Parathelphusa bouvieri Rathbun (Sensu Fernando 1960) = *O. senex minneriyaensis*
Parathelphusa parvula Fern. = *Spiralothelphusa hydrodroma*
Parathelphusa innominata Fern. = *S. wuellerstorfi*
Parathelphusa hippocastanum Muller = *Oziothelphusa senex senex*

Fernando (1970) however found consistent differences in the colour pattern of *Parathelphusa hippocastanum* = *Oziothelphusa hippocastanum* and the other Sri Lanka species.

In a series of papers published recently it has been shown that freshwater crabs in Sri Lanka are intermediate hosts for human lung flukes of the genus *Paragonimus* besides other trematode parasites of man and vertebrates by Kannangara, (1969, 1971 a, 1971 b) and Kannangara and Karunaratne (1969 a, 1969 b). Previously Dissanaike and Fernando (1960) found a frog metacercaria encysted in freshwater crabs. Freshwater crabs occupy a habitat frequented by a wide range of vertebrate hosts; fish. Amphibia, reptiles, birds and mammals. They also live in close proximity to snail intermediate hosts of trematodes. Freshwater crabs are also eaten by a wide range of vertebrates. It is very likely that further investigations will show freshwater crabs as intermediate hosts for a large number of parasites including Trematodes and Nematodes as shown recently by Poiner and Kannangara (1972)..

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CLASS INSECTA

ORDER EPHEMEROPTERA

This group is still relatively poorly known in Sri Lanka. Extensive collections made by the Swedish Lund University Expedition to Sri Lanka in 1962 are being studied and some new additions and name changes have been made.

Nomenclatural changes:

Kimminsula annulata (Hagen)
Kimminsula fasciata (Hagen)
Kimminsula taprobanes (Walker)

New species:

Megaglena brincki, Peters and Edmunds.
Isca (Tanycola) serendiba. Peters and Edmunds.

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ORDER ODONATA

Lieftinck (1971) has listed 112 species of odonates in his revised list of species for Sri Lanka. This includes six new species described by him in this paper. The adults of the Sri Lanka species are nearly all well known and relatively few species remain to be described as compared to most other groups of invertebrates. However, larvae of many species are still unknown or poorly known.

The Odonata fauna of Sri Lanka has been dealt with extensively by Laidlaw (1924, 1951) and Lieftinck (1940, 1955, 1971). These two authors besides dealing with systematics have discussed the derivation of the Sri Lanka fauna and endemism. Lieftinck (1964) found generic endemism was absent in Sri Lanka while marked in two tropical islands, New Guinea and Madagascar and slight in Borneo. At the specific evel the percentage of endemics in Borneo and Sri Lanka were about the same, i. e. about 40 per cent. In another group of mobile insects the Corixidae Wrobleski (1972) found six endemics in a very rich fauna of twenty-two species, a figure considered high for endemic rates for this group.

New records in Lieftinck 1971:

Anisogomphus solitaris Lieftinck
Disparoneura ramapana Lieftinck
Drepanosticta brincki Lieftinck
Drepanosticta sinhalensis Lieftinck
Elattoneura bigeminata Lieftinck
Gynecantha sp.
Mortonagrion ceylonicum Lieftinck

Name change:

Indothemis carnatica (F.)
for *Libellula caesia* Rambur

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SUB-ORDER HEMIPTERA-HETEROPTERA

In the " Guide " 70 species belonging to this group were recorded of this number five species are not found in Sdi Lanka or have been shown to be synonyms. During the last ten years many new records have been added to the Sri Lanka list and at present about 120 species of aquatic Hemiptera Heteroptera are known. The largest increases of species have been in the Micronectinae studied by Fernando (1964) and Wroblewski (1972) and the Veliidae being studied by Mr. P. B. Karunaratne, National Museum, Colombo. The latter has permitted me to use his records to bring the species list up to date. Many new generic records are included and all except two of these genera have been illustrated in Figs. 274/285. No locality data for the new records are included since these will be given in the publications on these species.

The identification of the new species recorded from Sri Lanka has been aided by the following publication: Cheng and Fernando (1969), China and Usinger (1949), Distant (1904, 1910, 1915), Esaki (1924), Hungerford and Matsuda (1962), Lansbury (1968, 1972) and Lundblad (1933, 1938). Some of the illustrations have been redrawn from Distant (1904, 1910, 1915) and Esaki (1924).

Two families of shore bugs, the Saldidae and Leptopodidae not given in the "Guide" or previous supplements have been added. They are represented by three records so far in Sri Lanka and are refered to in Distant (1915) and Drake and Hoberlandt (1950a, 1950b).

LIST OF AQUATIC HEMIPTERA OF CEYLON

CRYPTOCERATA

Family Nepidae

Cercometus fumosus Dist.
Cercometus strangulatus Mont.
Laccotrephes flavovenosus Dohrn.
Laccotrephes griseus (Guer.)
Laccotrephes grossus (F.)
Laccotrephes maculatus (F.)

Family Belostomatidae

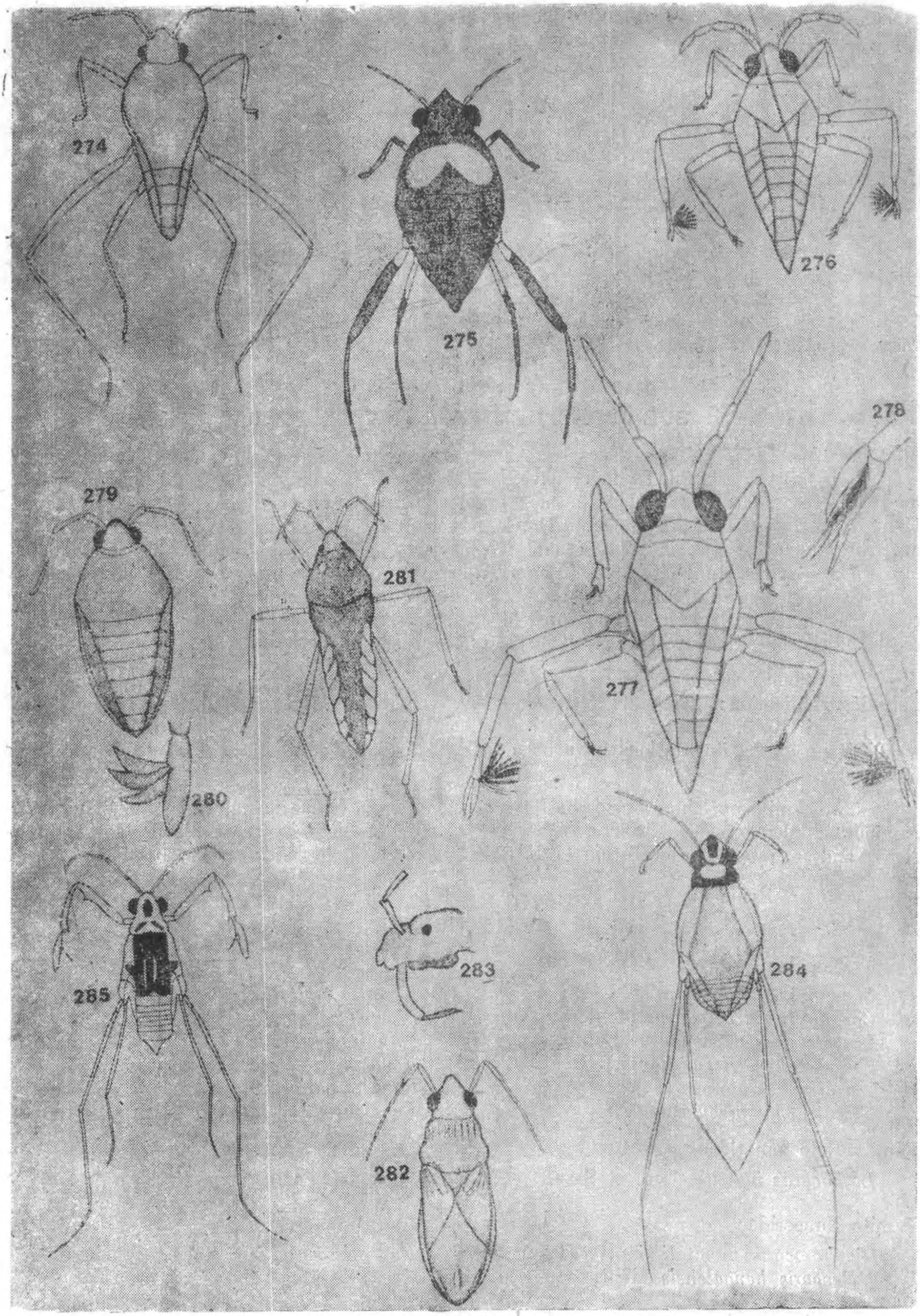
Lethocerus indicus (Lep. et Serv.)

Family Naucoridae

Diaphorocoris punctatissimus (Kirby)
Heleocoris bengalensis Mont.

Family Helotrephidae

Helotrephes kirkaldyi Esaki and China
Limnotrephes campbelli Esaki and China
Ranatra digitata Hafi and Pradhan
Ranatra elongata (F.)
Ranatra filiformis (F.)
Ranatra flagellata Lansbury
Ranatra varipes Stal
Ranatra varipes atropha Mont.
Sphaerodema rusticum (F.)
Naucoris scutellaris Stal
Tiphotrephes indicus Dist



HEMIPTERA-HETEROPTERA. Fig. 274 *Halovelia*. 275 *Strongylovelia*. 276 *Rhagovelia* sp. 277 *Tetraripis*. 278 Terminal portion of hind tarsus of *Tetraripis* showing hair brush. 279 *Xiphovelia* sp. 280 Terminal portion of middle leg of *Xiphovelia*. 281 *Velia currens*. 282 *Hebrus* sp. 283 *Hebrus*, lateral view of head showing buccula (heavily stippled). 284 *Naboandelus*. 285 *Ascelopios annandalei*. (275 after Esaki 1924, 278–289 after Lundblad 1938, 1933 ; 281 and after Distant 1904, 1910 and 1915.)

Family Pleidae

Plea frontalis Fieb.
Plea liturata Kirk.

Family Notonectidae

Anisops ali Brooks
Anisops barbata Brooks
Anisops batillifrons Lundb.
Anisops bouvieri Kirk.
Anisops breddini Kirk.
Anisops extendofrons Brooks
Anisops nivea (F.)
Anisops occipitalis Breddin
Anisops projectus Brooks
Enithares ciliata Fabr.
Enithares simplex Kirby

Family Corrixidae

Agraptocorixa hyalinipennis (F.).
Micronecta albifrons (Mots.)
Micronecta altera Wrobl.
Micronecta anatolica Lindberg
Micronecta ceylonica Wrobl.
Micronecta desertana Wrobl.
Micronecta Fernandoi Wrobl.
Micronecta Fravens Wrobl.
Micronecta grisea (Fieb.)
Micronecta lubibunda Breddin
Micronecta ludibunda langkana Wrobl.
Micronecta prashadana Hutch.
Micronecta punctata (Fieb.)
Micronecta punctinotum Chen
Micronecta quadristrigata Breddin
Micronecta quadristrigata f. ninthe Dist.
Micronecta sancta-catherine Hutch.
Micronecta scutellaris Stal
Micronecta siva (Kirk.)
Micronecta taprobanica Wrobl.
Micronecta tarsalis Chen
Synaptonecta capillata Wrobl.
Synaptonecta pruthiana Hutch.
Tropocorixa pruthiana Hutch.

GYMNOCERATA

Family Hydrometridae

Hydrometra butleri Hung. and Evans.
Hydrometra greeni Kirk.
Hydrometra kahallensis Karunaratne.
Hydrormetra zeylanica Gunawardena and Karunaratne

Family Mesoveliidae

Mesovelia orientalis Kirk.
**Mesovelia* sp.

Family Veliidae

**Halovelia* sp.
Microvelia diluta Dist.
Microvelia douglasi Scott.
Microvelia longicornis Bueno
**Microvelia* 3 spp.
**Neoalardus* sp.
Peritoppus breddini Kirk.
Rhagovelia ceylonica Lundb.
Rhagovelia sp.
**Strongylovelia* 2 spp.
Tetraripis ravana Kirk.
**Tetraripis* sp.
**Velia currens* F.
**Xiphovelia* 2 spp.

Family Hebridae

**Hebrus bengalensis* Dist.
Timasium atratus Dist.
Timasius splendens Dist.

Family Gerridae

Sub-family Rhagodotarsinae

Rhagodotarsus kraeplini Breddin
**Rhagodotarsus* sp.

Sub-family Trepobotinae

Cryptobates raja Dist.
**Metrobatopsis* sp.

Sub-family Halobatinae

**Ascelepios annandalei* Dist.
Halobates germanus White
Halobates micans Esch.
Halobates flaviventris Dist.
Halobates formidabilis Dist.

Sub-family Ptilomerinae

Ptilomera cingalensis Stal
Rheumatogonus custodiendus (Dist.)

Sub-family Gerrinae

Cylindrostethus productus Spin.
Gerris adelaidis Dohrn
Gerris pectoralis Mayer
Limnogonus fossarum F.
Limnogonus nitidus Mayer
Limnogonus parvulus Stal

Family Saldidae

Saldula fletcheri (Dist.)

Family Leptopodidae

Va lerioia assounaensis (Costa)

**Naboandelus* 2 spp.

Matrocoris stali (Dohrn.)
**Metrocoris* sp.
**Ventidius aquarius* Dist.
**Ventidius pubescens* Cheng
Ventidius henryi Esaki

**Rheumatogonus vittatus* Esaki

Onychotrethus sakuntala Kirk
**Onychotrechus* sp.
Tenagogonus anadyomene (Kirk.)
Tenagogonus fluviorum F.
Tenagogonus ceylonensis Hung. and Mats.

Saldula rutherfordi (Dist.)

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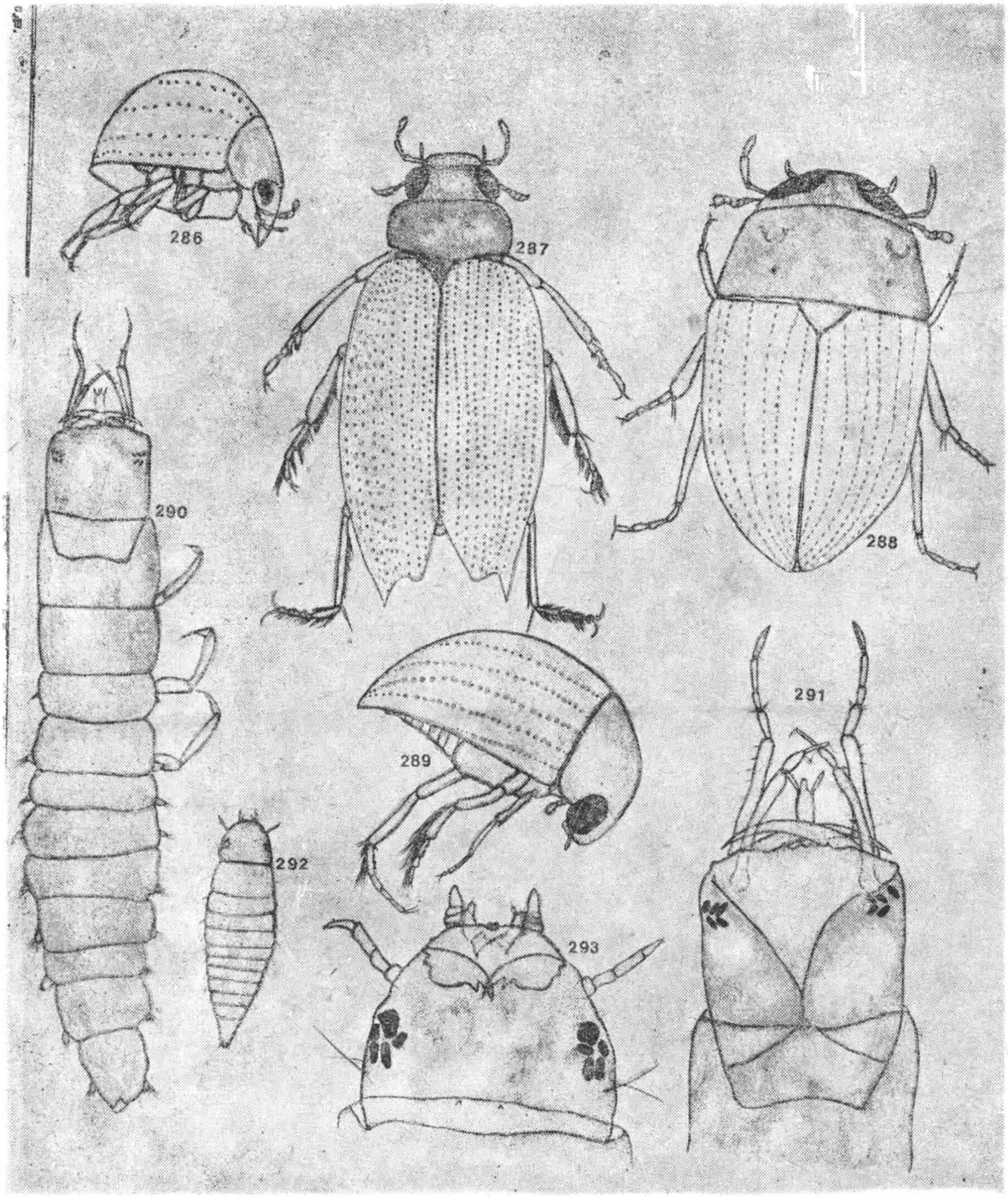
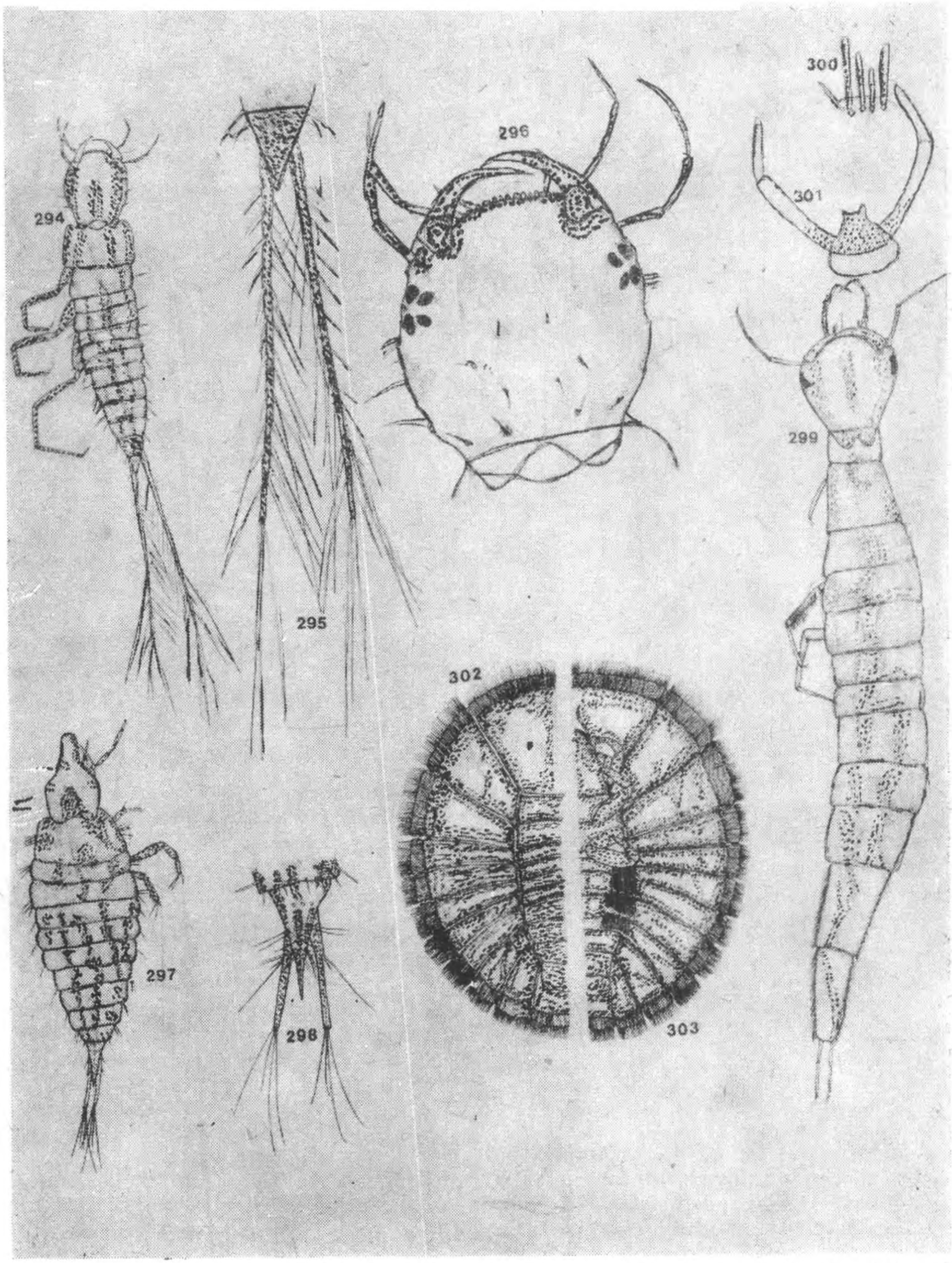


COLEOPTERA-HYDROPHILIDAE, DYTISCIDAE. Fig. 286 *Amphiops gibbos*. 287 *Berosus* sp. 288 *Enochrus* sp. 289 *Regimbartia attenuta*. 290 Larva of *Sternolophus* sp. 291 Head of same. 292 *Canthydrus* sp. Larva. 293 Head of same showing mandibles in transparency.



COLEOPTERA-DYTISCIDAE, PSEPHENIDAE (Larvae). Fig. 294 *Laccophilus* sp. 295 Same, posterior end of body and cerci. 296 Head of same. 297 *Hyphydrus* sp. 298 Same, posterior end of body and cerci. 299 *Hydaticus* sp. 300 Anterior margin of clypeus of same. 301 Labium of same. 302 *Eubrianax*, dorsal view. 303 Same ventral view.

ORDER COLEOPTERA

Beetles of the families Dytiscidae, Haliplidae and Amphizoidae of the Indian Region have been intensively investigated in a series of papers. Guignot (1953, 1954a, 1954b) and Vazirani (1955, 1963, 1964a, 1966a, 1966b, 1968a, 1968b, 1969b, 1969c, 1970a and 1970b). These papers make it possible to diagnose the Dytiscidae and Haliplidae of the Indian Region with accuracy. The Asian Hydrophilidae, Gyrinidae and beetles belonging to various other aquatic and semi-aquatic families e.g. Elminthidae are very poorly known.

The publication of the monograph on aquatic beetle larvae and pupa by Betrand (1972) has made it easier to diagnose aquatic Coleoptera immature stages to the generic level at least. Also Vazirani (1964b) has contributed to the knowledge of *Cybister* larvae. The level of sophistication in taxonomic studies both for adults and larvae has been enhanced in recent years by the publication of numerous papers. Some larvae collected in Sri Lanka and identified to the genus have been illustrated. They belong to *Sternolophus* (*Hydrophilidae*), *Hydaticus*, *Hyphydrus* and *Laccophilus* (*Dytiscidae*), *Canthydrus* ,*Noterinaei* and *Eubrianax* (*Psephenidae*) Fig. (290-303).

The following adult beetles have also been figured from Sri Lanka material. *Amphiops*. *Regimbartia Enochrus* and *Berosus*, Figs. 286-289.

The Sri Lanka list of species given in the guide should be expanded by the inclusion of the following Dytiscidae:—

Copeletus freudei Guignot

Hydaticies ceylonicus Guignot

Hydrovatus ischyrus Guignot

Hydrovatus picipennis Mots

Hydrovatus rufoniger Clark

Hyphydrus intermixtus Walker

Hyphoporus pugnator Sharp

Laccophilus basalis Mots.

Laccophilus parvulus Aube

Laccophilus rufulus Reg.

Microdytes maculatus (Mots.)

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VAZIRANI, T. G. (1964*b*)—On the morphology and ecology of the larvae of *Cybister* spp. (Dytiscidae, Coleoptera). Bull Ent. 5 : 31–48.

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SUB-ORDER HYDRACARINA

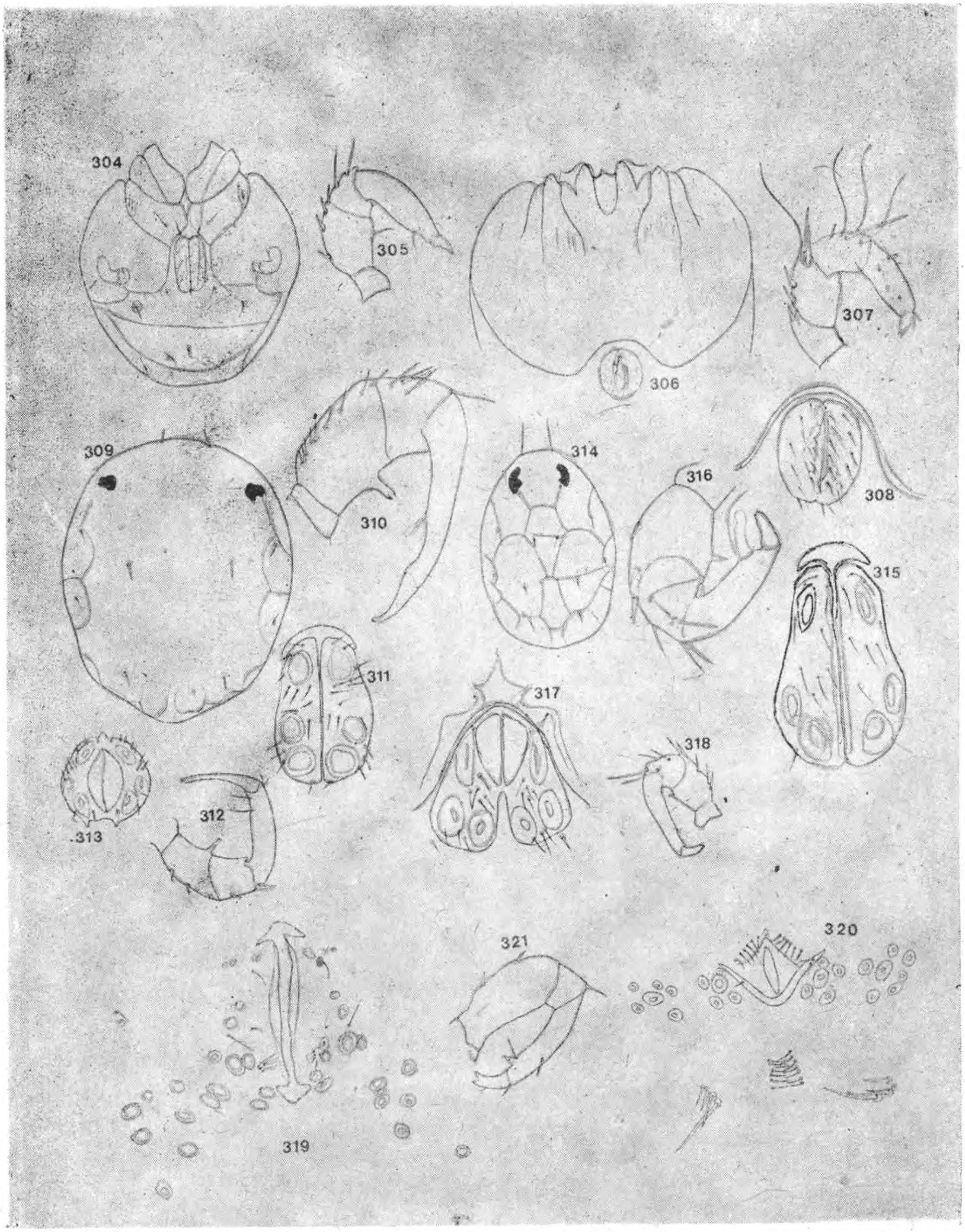
So far only two collections of Hydracarina from Sri Lanka has been studied. Daday (1898) who reported on this collection recorded 14 species of which nearly all were new species. Subsequently priersig (1900) and Walter (1929) reported on the same material and clarified some confusion in the assignment of males and females of different species to one species. This added two new species to Daday's (1898) list. A single species *Piona coccinea var. imminuta* (Piersig) was recorded by Apstein (1910) in his study of zooplankton in Lake Gregory. Cook (1967) doubts the presence of this sub-species in Sri Lanka. The another however found *Piona* sp. (*coccinea* group) in Sri Lanka. Lundblad (1969) recorded some species from a single collection.

The publication of Cook's (1967) monograph on water mites from India has made it possible to diagnose most Sri Lanka species. The another examined material collected with zooplankton from Sri Lanka and found twelve species hitherto unreported. These are listed together with the previous records from Sri Lanka have been illustrated. Species where material was available to the author (Figs. 304-360) have been illustarted.

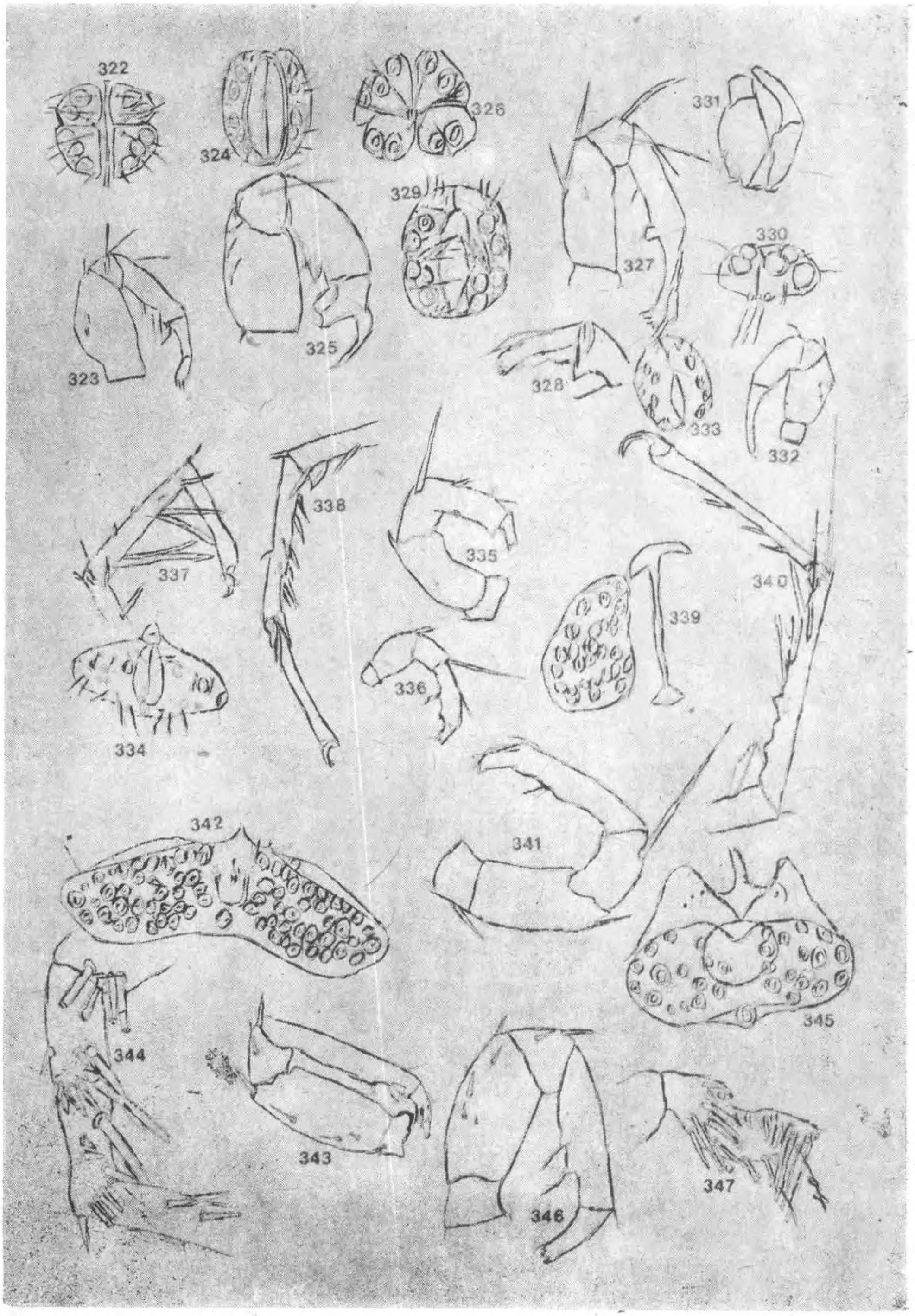
Since records of Sri Lanka Hydracarina are so few the locality data for material examined have been included.

Larval water mites are found infesting the gills and pharynx of fishes: Dubinin (1959). Tedla and Fernando (1970), Fernando et al. (1972). Hydracarina are often parasitic on freshwater mussels in their larval stages. The life history of a typical water mite has been described by Mitchell (1955). Tedla and Fernando (1970) found the non-parasitic larvae *Hydrozetes* causing tissue reaction in fish gills.

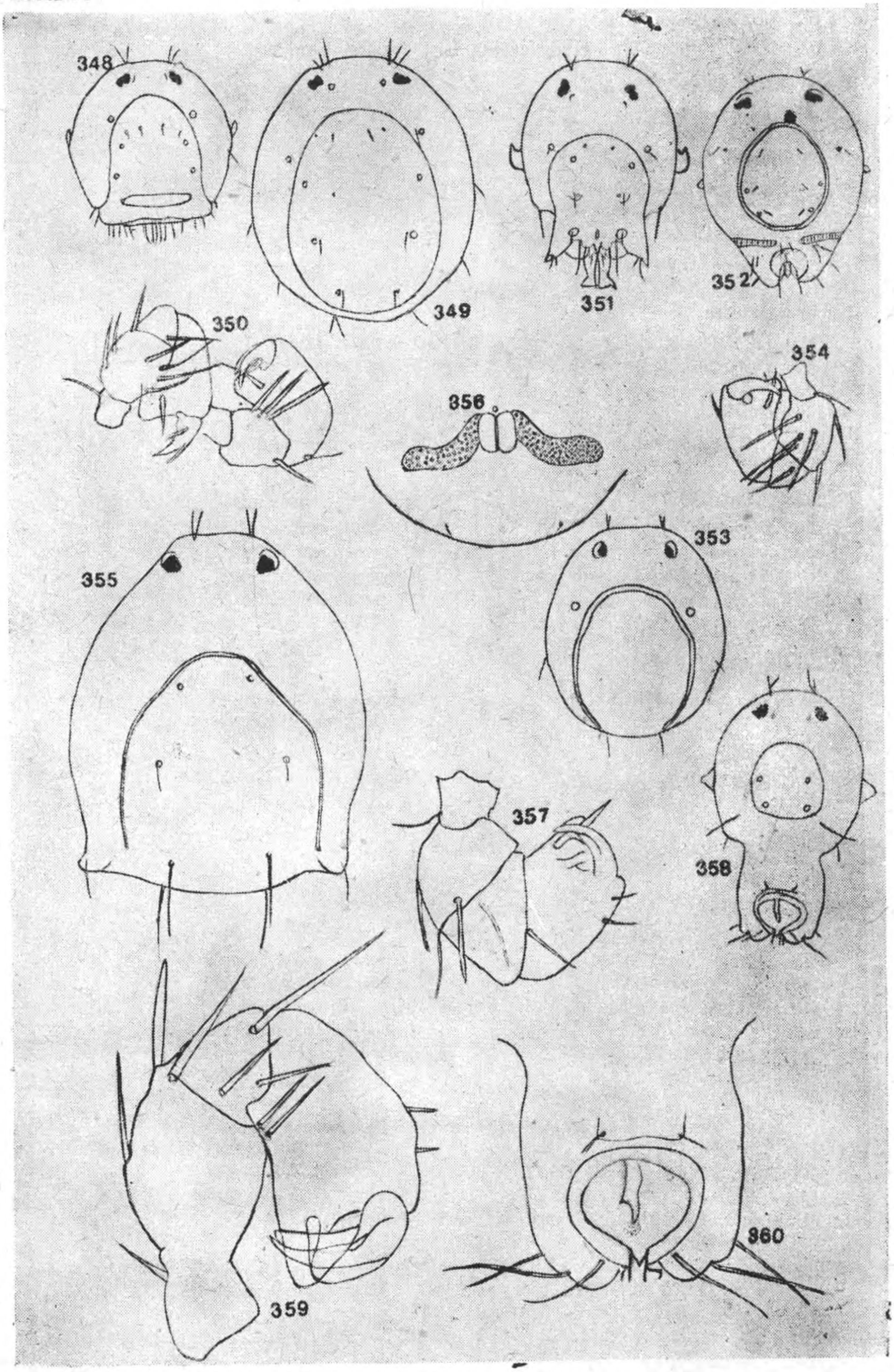
The free-living larval mites (Figs. 24 and 25) and the parasitic stages in the pharyngial wall of a fish (Fig. 26) have been illustrated.



HYDRACARINA. Fig. 304 *Nilotonia indica*, ventral view. 305 Female palp of same. 306–308. *Oxus pictus*, 306 female, ventral view of anterior portion, 307 palp of female, 308 female genital area. 309–313 *Limnesis lembangensis*, 309 female, dorsal view, 310 female palp, 311 female, genital area, 312 male palp, 313 male genital area. 314–318 *Limnesia lucifera*, 314 female, dorsal view, 315 female, genital area, 316 female palp, 317 male, genital area, 318 male palp. 319–321 *Encendridophorus horvathi*, 319 female, genital area, 320 male, genital area, 321 female palp.



HYDRACARINA. Fig. 322 *Unionicola affinis*, female genital area. 323 female palp of same. 324 *Unionicola kantaka*, male genital area. 325 male palp, 326–329 *Unionicola setifera*, 326 female, genital area, 327 female palp, 328 female palp, terminal portion, 329 male, genital area. 330–333 *Unionicola similis* 330 female, genital area, 331 female palp, 332 male palp, 333 male, genital area. 334–338 *Neumania ambigua*, 334 male, genital area, 335 malp palp, 336 female palp, 337 1 leg 4–6, 338 IV leg 4–6 339–341 *Neumania nodosa*, 339 female, genital area, 340 IV leg 4–6 female 341, female palp, 342–344 *Piona dadayi*. 342 male, genital area. 343 male palp. 344 IV leg 4. 345–347 *Piona* (*coccinea* group), 345 male, genital area, 346 male palp, 347 IV leg 4 of male.



HYDRACARINA. Fig. 348 *Arrenurus congener* male. 349 female of same. 350 female palp of same. 351 *Arrenurus liberatus* male 352–354 *Arrenurus maderaszi* 352 male 353 female, 354 female palp. 355–357 *Arrenurus orientalis* 355 female, 356 female, genital area, 357 female palp. 358–360 *Arrenurus caviger*, 358 male, 359 male palp, 360 posterior portion of male.

Hydracarina List for Sri Lanka

Family Hydrachnidae

Hydrachna similis Marsh

Family Hydrodromidae

Diplodontus silvestri (Daday)

Family Anisitsiellidae

**Nilotonia indica* Walter

Family Libertiidae

**Oxus dahli* Piersig
**Oxus longisetus* (Berl)
Oxus pictus (Daday)

Family Limnesiidae

**Limnesia lembangensis* Piersig
**Limnesia lucifera* Lundbald

Family Unionicolidae

Encentridophorus horvarthi (Daday)
Encentridophorus spinifer Koen
Unionicola sinhalensis Daday.
**Unionicola affinis* (Piersig)
**Unionicola chappuisi* Walter
**Unionicola necessaria* (Koen.)
**Unionicola setifera* Cook
**Unionicola similis Viets*
**Unionicola unguiculata* Walter

Family Neumaniidae

Neumania ambigua Piersig
Neumania nodosa Daday

Family Pionidae

**Piona caligifera* Koen
Piona dadayi Peirsig
**Piona flagellifera* Lundb.
Piona (*cocccnea* group)

Family Axonopsidae

**Axonopsis* sp.

Family Arrenuridae

**Arrenurus madaraszi* Daday
Arrenurus ceylonicus Daday
Arrenurus orientalis Daday
Arrenurus liberatus Walter
Arrenurus congener Daday
**Arrenurus caviger* Viets
Arrenurus rostratus Daday
**Arrenurus rouxi* Piersig
Arrenurus sinhalensis Daday

Locality Data of Hydracarina Collected and Studies

Nilotonia indica Nugegoda, rice field 1 ♀ 19.3.72.

Oxus pictus Unichchi tank 1 ♀ 28.12.70. Nugegoda rice field 1 ♀ 27.7.71.

Limnesia lembangensis Madurankuli, pond 1 ♀ 1.6.72 Marawila, pond 3 ♀ ♀ 22.8.72. Ratnapura, wyside pool 1 ♀ 22.8.72 Ratnapura, gem pit 1 ♂ 18.8.72 Udawalawe reservoir 1 ♀ 27.12.70.

Limnesia lucifera Nugegoda, rice field 1 ♀ 22.7.71 Nugegoda, rice field 1 ♀ 22.6.71 Belihuloya, rice field 1 ♂ 16.8.72

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*New record for SRI LANKA.

Encentridophorus horvathi Unichchi tank 1 ♀ 28.12.70 Marawila, pond 1 ♀ 6.12.70 Handapangala tank 1 ♀ 28.12.70 Nugegoda, rice field 1 ♂ 1 ♀ 10.10.71 1 ♀ 22.7.71

Unionicola affinis Tabbowa tank 1 ♀ 6.12.70 Ambiliwewa 1 ♀ 9.8.68 Kebittigollawa Tank 1 ♀ 19.12.70

Unionicola kantaka Kebittigollawa tank 1 ♀ 19.12.70

Unionicola setifera Handapangala tank 1 ♀ 28.12.70 Kebittigollawa tank 1 ♀ 1 ♂ 19.12.70

Unionicola similis Kebittigollawa tank 1 ♂ 1 ♀ 19.12.70

Neumania nodosa Nugegoda rice field 1 ♀ 19.3.72. Ratnapura gem pit 2 ♀ ♀

Neumania ambigua Ratnapura gem pit 1 ♀ 18.8.72 Ratnapura, vegetated pond 1 0 18.8.73

Piona dadayi Nugegoda, rice field 1 ♂ 1 ♀ 10.10.71

Piona sp. (*coccinea* group) Karapala villu 1 ♂ 7.1.72

Axonopsis sp. Kurunegala tank 1 ♂ 3.8.69 Nugegoda, rice field 1 ♂ 24.2.71

Arrenurus congener Nugegoda, rice field 1 ♂ 24.2.71 Nugegoda, rice field 2 ♀ ♀ 22.7.71 1 ♀ 19.10.71 Marawila pond 1 ♀ 22.8.70

Arrenurus liberatus Belihul-oya rice field 1 ♂ 16.8.71 Nugegoda, rice field 1 ♂ 22.7.71

Arrenurus madaraszi Nugegoda, rice field 1 ♂ 10.10.71 Ratnapura, pond 1 ♂ 19.8.72 Nugegoda, rice field 1 ♂ 1 ♀ 22.7.71 1 ♀ 19.10.70,

Arrenurus orientalis Eppawela, pond 1 ♀ 18.8.72

Arrenurus caviger Nugegoda, rice ffeld 1 ♂ 19.3.71

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APPENDIX 1

New Species records for Sri Lanka

The follwoing is a list of species recorded for the first time in Sri Lanka and included in the present paper.

Phylum-Tardigrada

Macrobiotus dispar Murray
Stygarctus bradypus Schulz
Echiniscus (*E*) *cribosus* Murray

Phylum Arthropoda

Class Crustacea

Order Conchostraca

Caenestheriella indica (Gurney)
Eulimnadia michaeli Nayar and Nair

Order Cladocera

Latonopsis australis Sars
Bosminopsis dietersi Richard
Bosmina sp.
Grimaldina brazzai Richard
Echinisca capensis Sars
Pseudochydorus globosus (Baird)
Alona monocantha Sars
Alona ef. *harpularia* Sars
Alona pulchella King
Alona setulosa Megard
Alona cf. *guttata* Sars
Biapetura affinis (Leydig)
Pluroxus cf. *similis* Vavra

Order Cyclopoida

Diacyclops cf. *languidus* (Sars)
Metacyclops minutus (Claus)
Microcyclops moghulensis Lindberg

Order Calanoida

Eudiaptomus cinctus (Gurney)
Tropodiaptomus neilseni Brehm
Tropodiaptomus cf. *doriae* (Richard)

Order Harpacticoida

Parastenocaris cf. *brevipes* Kessel

Class Insecta

Order Hemiptera

Mesovelia sp.
Halovelia sp.
Microvelia 3 spp.
Neoalardus sp.
Strongylovelia 2 spp.
Tetraripis sp.
Velia currens F.
Xiphovelia sp.
Hebrus bengalensis Dist.
Rhagodotarsrus sp.
Metrobatopsis sp.
Naboandelus sp.
Ascelepoos annandelei Dist.
Metrocoris sp.
Ventidius aquarius (Dist.)
Ventidius pubescens Cheng
Rheumatogonus vittatus Esaki
Onychotrechus sp.

Class Arachnida

Sub-order Hydracarina

Nilotonia indica Walter
Limnesia lembangensis Piersig
Limnesia lucifera Lundhlad
Unionicola affinis (Piersig)
Unionicola kantaka (Cook)
Unionicola similis Viets
Neumania ambigua Piersig
Piona sp. (*coccinea* group)
Axonopsis sp.
Arrenurus caviger Viets